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Publication Date (Web): November 15, 2012 | doi: 10.1021/bk-2012-1110.ch005

Chapter 5

Activities of Regional Consortia in Planning e-Science Continuing Education Programs for Librarians in New England

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In 2009, the libraries of the five University of Massachusetts campuses initiated a series of professional development programs to help New England science, health sciences, and engineering subject librarians build the knowledge and skills that are needed to support e-Science pursuits at their institutions. These programs have expanded to include the following annual events: an e-Science symposium, a Professional Development Day, and a Science Boot Camp. Alongside these conferences, the Lamar Soutter Library at the University of Massachusetts Medical School initiated a collaborative e-Science Portal for New England Librarians, partnered on a grant to develop frameworks for a data management curriculum, and established the Journal of eScience Librarianship. This chapter describes e-Science, its impact on libraries, and examines the e-science continuing education programs and research sponsored by a consortium of New England science, health sciences, and engineering librarians.

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In Special Issues in Data Management; Xiao, N., et al.;
ACS Symposium Series; American Chemical Society: Washington, DC, 2012.

Background of e-Science

Dramatic advances in digital technologies in the late 20th and early 21st centuries have created a ripple effect in the ways that scientists conduct research, collect and analyze data, and communicate their findings to colleagues and scholarly communities. Increasingly scientists utilize automated instrumentation like remote sensors, gene sequencers, simulation programs, micro-arrays, and computerized modeling in their research work. Large scale research investigations such as genomic sequencing and astronomical sky surveys have generated data sets of a magnitude and granularity exceeding any that could have been spawned by paper and analog photography (*1*). While the specific instrumentation may differ from one discipline to another, a key feature of all of these technologies is that they rapidly produce massive amounts of raw digital data. This accelerated generation of data in conjunction with the availability of the internet has enabled scientists to globally collaborate and quickly collect, analyze, and disseminate their findings—fast forwarding a scholarly process that used to take months or years. More than ever teams of scientists are working on a single project. Add to this scenario desktop access to journals and databases, and the result is today's research era of data-intensive scientific discovery known as the "Fourth Paradigm"— where "all of the science literature is online, all of the science data is online, and they interoperate with each other (*2*)." The research methodology intrinsic to the Fourth Paradigm is referred to as e-Science.

This new methodology of e-Science is data centric, data driven and collaborative. The term e-Science was first used in 1999 by John Taylor, Director General of Research Councils in the UK, to describe the "global collaboration in key areas of science and the next generation of infrastructure that will enable it." (*3*). Key features of e-Science include the adaptation of technologies for computation, modeling, sensing, data analysis, visualization, and collaboration in scientific research work. The availability of the internet and communication technologies has lowered geographical barriers and fostered virtual collaboration and team science. Through the internet, researchers can rapidly disseminate digital data sets. This in turn has fostered data sharing and an unprecedented level of access, promoted interdisciplinary teamwork on complex problems, and enabled other researchers to use data for different purposes than what the creator of the data had envisioned. Researchers and students reuse raw data to explore new or related hypotheses, often integrating the data with other datasets for analysis. The greater scientific community and the general public benefit from the sharing of data: it encourages multiple perspectives, enables scrutiny of findings, discourages fraud, aids in the training of new researchers, and increases the efficiency of funding by avoiding duplication of effort and resources. (*4*).

While the term e-Science often implies the computational work of large research teams, it is just as relevant for "small science", hypothesis driven research led by a single investigator or small research group that generates and analyzes its own data. (*5*).

Interestingly, the term "e-Science" has been more widely adapted by library and information science professionals than by the research community. Science researchers do not commonly describe the nature of their research endeavors as

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"e-Science". They may not use any terminology at all to describe the e-Science phenomenon. The use of computational tools and methodologies has become so ingrained in science that many researchers simply acknowledge it as the way that they "do science".

In the context of this chapter, the term e-Science includes all natural and physical sciences, health and other applied sciences, and technological disciplines.

Libraries and e-Science

As science becomes increasingly cognizant of data's potential for advancing research, all players in the traditional infrastructure of scientific research and communication have been strategizing potential roles in the science data landscape. National libraries, research funding agencies, universities and research libraries, software and publishing industries have all been exploring ways to address the data deluge (*6*). As historic leaders in the advancement of knowledge, universities have borne significant responsibility for the long-term preservation of knowledge through their libraries. Among the many participants in scholarly communication, librarians have been recognized for their expertise in organizing, enhancing and disseminating information, and have been identified as logical partners in the stewardship of digital data. A few university libraries have initiated shared data archives. According to Clifford Lynch, director of the Coalition of Networked Information (CNI), "these projects unite groups of people who usually don't work together: scientists and scholars on one side and library and IT folks on the other, are all feeling their way for the right roles for everybody." (*7*). The Association of Research Libraries (ARL) notes a need for new partnerships and collaborations among domain scientists, librarians, and data scientists in order to better manage digital data collections, and advocates expanded library roles in preservation and curation services of digital data sets.

Developing library infrastructures that support data curation and preservation activities requires a retooling of library services. Traditionally research libraries serve as custodians of "downstream knowledge"-- organizing and maintaining collections of post-research publications such as conference proceedings, journal articles, and books. Data science and management diverges from the text-oriented systems that still dominate library roles in science communication and publishing. With e-Science comes a new impetus to develop library infrastructures that support the "upstream knowledge" component of the research lifecycle early on in the scientific process. Reconfiguring library workflows so that librarians are involved in documentation during the earliest stages of research would help to ensure long-term preservation of data (*8*).

In Figure 1, Data and Publication Life Cycles, the steps of the pre-publication phase (i.e. upstream) and the publication phase (i.e. downstream) of the data and publications life cycle are illustrated. (*6*). While most librarians are well acquainted with the post-publication phase, for many the pre-publication phase of research during which data is created, collected, managed, and analyzed is unchartered territory.

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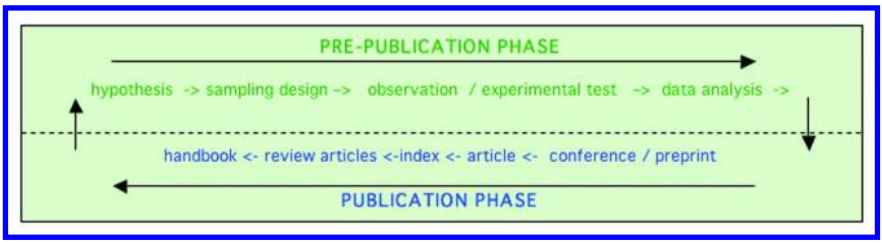

Figure 1. Data and Publication Life Cycles. (Reproduced with permission from Anna Gold, ©2007, CNRI)(6).

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In 2006, recognizing that libraries would need to adapt to changing conditions brought about by networked science, the Association of Research Libraries (ARL) appointed a task force to raise awareness and position research libraries to participate in e-Science. One of the task force's key findings is that librarians need to be actively engaged with their user communities more than ever before, and to do this, librarians need "to not only understand the concepts of a domain, they also need to understand the methodologies of scholarly exchange" (*9*).

It is important to note that many research libraries have already demonstrated an understanding of new methodologies of scholarly exchange by initiating outreach services through various ventures such as managing institutional repositories, publishing scientific journals, and collaborating with campus research and computing groups to develop and maximize the reach of research information networks. As digital collections and desktop accessibility become more prevalent, these ventures illustrate how librarians have successfully filled niches that address the information needs of their research communities. Although the format of information has changed, the call for librarians to collect, gather, organize, and make information accessible to those who need it still remains (*10*). Furthermore, just as academic librarians conduct information literacy classes to students, they can also address the gap in science data literacy through teaching data management best practices and by providing consultation services to their research community.

While there have been multiple reports that advocate library involvement in e-Science, many science, health sciences, and engineering librarians find themselves at a loss as to exactly how they might participate in e-Science and what skills they can offer. How can a subject librarian help a scientist with a data management plan? What advice does a librarian give to a research group on the management of multiple versions of intricate data sets? How does a librarian become knowledgeable about metadata standards for different science domains? Where does a librarian find models for implementing working relationships with researchers? There is a need for professional development and working models that address the everyday tasks of e-Science librarianship. Purdue librarians Garritano and Carlson (*11*) identified skill sets that librarians new to e-Science should expect to adapt or develop:

- Library and Information Science expertise
- Subject expertise
- Partnerships and outreach (both internal and external)
- Participating in sponsored research
- Balancing workload

In ARL's 2007 report "Agenda for Developing e-Science in Research Libraries", the ARL's Joint Task Force on Library Support for E-Science identified desired outcomes for positioning the research library community as partners in the development of e-Science. One addresses criteria for a future research library workforce: "Knowledgeable and skilled research library professionals with capacity to contribute to e-science and to shape new roles and models of service". The task force suggested the following strategy: "build a library workforce with relevant new skills and knowledge about emergent forms of documentation and research dissemination." One proposed action for implementing this strategy is to "pursue science librarian skills to meet the needs of e-science." (*12*).

In October 2008, the ARL and the Coalition for Networked Information (CNI) hosted the "Reinventing Science Librarianship" forum. During this forum, several speakers shared their ideas on what the science librarian in the near future would look like in terms of skills, capacities, and institutional positioning. One speaker, Rick Luce, Vice Provost and Director of University Libraries, Emory University described his vision of a future science library in which multi-skilled information management teams could be created "on the fly", and embedded librarians would collaborate with research teams or departments to provide timely and holistic advice on documentation throughout the research process. Luce commented that emerging forms of scientific practice will require different kinds of library support at different times. One point of consensus among all the forum presenters was that "the fundamental role of the science librarian needs to expand to incorporate skills related to organizing and manipulating data and data sets." (*13*).

With an interest in exploring new library roles in e-Science and heeding the recommendations from the recent ARL report and forum, in 2008 a small group of library administrators and science librarians from the five University of Massachusetts libraries met. At this meeting the group discussed ways that the UMASS libraries could develop e-Science library services and engage in the state's Life Science Initiative (*14*). During the group's early discussions, the need for affordable continuing education opportunities for science, health sciences, and engineering librarians was raised. Acting on this need, the group laid the groundwork for a series of events that has significantly raised New England librarians' level of understanding of science subjects and e-science; and promoted intercampus working relationships. The history of this early group, its strategy for promoting e-Science librarianship in the New England region, and its findings are featured in the next section. The remainder of the chapter will include details on the components of the University of Massachusetts and New England Area continuing education and research program in e-Science.

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While New England research libraries were contemplating ARL's agenda for initiating library engagement in e-Science, in June 2008 Massachusetts Governor Deval Patrick enacted the Life Sciences Initiative, a one billion dollar investment package to enrich and strengthen the state's globally recognized leadership in the life sciences. The strategy of the Life Sciences Initiative was "to bring together industry, academic research hospitals and public and private colleges and universities to coordinate this effort, spur new research, strengthen investments, create new jobs and produce new therapies for a better quality of life." (*15*).

Highlighted as a partner for driving further innovation in life science research, the University of Massachusetts (UMASS) established a Life Sciences Task Force (LSTF), which was charged with "crafting a university-wide aspirant vision in the life sciences and promoting inter-campus collaboration." (*16*).

The greater academic community, the academic health sciences libraries and the community of ARL science libraries within the Boston Library Consortium responded positively to this call for inter-campus collaboration. In the fall of 2008, library directors and nine science librarians from the five UMASS campuses met to explore how the individual campuses could collaborate to be included in the Massachusetts LSTF's future funding allocations. This group, which has since come to be known as the "UMASS 5", brainstormed ways that they could expand their library services to support the networked research efforts of the Life Sciences Initiative. Each member of the UMASS 5 shared a common concern as to how her library would meet ARL's outcome of building a library workforce with an e-Science capacity. Many ideas and concerns were raised, including the need to educate librarians in research areas relevant to the Life Sciences Initiatives.

Following the initial meeting of the UMASS 5, in October 2008, the National Networks of Libraries of Medicine for the New England Region (NN/LM NER) held a meeting with sixteen New England Resource Library Directors. When asked about their interest in learning more about e-Science and exploring opportunities for inter-campus collaboration, all directors expressed a need to learn more about how their libraries could be positioned to participate in the scientific research arena. They agreed to attend and invite their library staff to attend a regional symposium on e-Science and instructed the Lamar Soutter Library at the University of Massachusetts Medical School (UMMS), to take the lead in planning this e-science symposium. This consensus by the New England Resource Library Directors cemented the UMASS 5's and the NN/LM NER's primary strategy to foster librarian education and collaboration in e-Science in the New England region. Funding was obtained from the NN/LM NER and the Boston Library Consortium for this daylong symposium, which would serve as a resource workshop and think-tank for regional academic health sciences and science librarians (*17*). The Lamar Soutter Library then proceeded to plan the first annual e-Science symposium, which was eventually held in April 2009.

While the planning activities of the UMASS 5 group initially focused on the data aspects of e-Science, several librarians in the group noted that they had no formal training in the sciences. The group conceded that this lack

of a science background was a common one hindering many librarians from approaching researchers and engaging in the scientific arena. This led to an overall acknowledgment that having disciplinary knowledge is a fundamental first step for e-Science related library services. Not being versed in the terminology of a science or understanding its key concepts are obstacles for librarians attempting to assist researchers in using databases or subject-specific tools. Noting the financial and time constraints that preclude working librarians pursuing a second degree in a science, the UMASS 5 group discussed the need for affordable continuing education in the sciences for librarians and came up with the idea of hosting a Science Boot Camp for librarians. (*18*).

With a directive and financial support from their library administrators and the NN/LM NER, and the Boston Library Consortium, the UMASS 5 group has since organized four Science Boot Camps and assisted with programs organized by UMMS and the NN/LM NER. These programs offer affordable professional development opportunities designed to educate librarians in the sciences, promote readiness for e-Science engagement, and provide opportunities for librarians to engage and collaborate with each other and scientists. In all, the 2009 inaugural events that paved the way for an ongoing series of New England e-Science learning opportunities include:

- e-Science symposium on April 6
- Stem Cell Workshop Professional Development Day on May 13
- Science Boot Camp on June 24-26, 2009

These first three educational events have promoted working relationships among campus libraries in the New England region and spurred the development of a regional e-Science Librarian Community of Interest (COI). Collaboration within this e-Science COI has paved the way for an e-Science portal for New England Librarians, a broader engagement of New England librarians beyond the original UMASS 5 in planning yearly Science Boot Camps, a partnership between the University of Massachusetts Medical School and Worcester Polytechnic Institute on an IMLS National Leadership Planning Grant to develop frameworks for a data management curriculum and identify user needs for a shared data repository, and the *Journal of e-Science Librarianship*. Each of these initiatives will be discussed in this chapter.

Strategy for New England e-Science Library Programs

The preceding section presents the chronology of the planning events that sparked ideas for the e-Science symposium, Professional Development Day, and Science Boot Camp. The primary strategy for supporting these programs was to promote librarian education and collaboration in the area of e-Science. Over the past four years as the New England region became more active and aware of e-Science issues, this primary strategy diverged into six components: Common

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identity, Roadmap, Tools, Continuing Education, Dissemination of findings, and Scholarship & Research. Table 1 illustrates these strategy components and their activities.

Table 1. e-Science Strategies and Activities of the New England Consortia

e-Science Strategy	*Activities*
Community Engagement (common identity)	Community of Interest (COI)
Roadmap for Libraries (how to engage in e-Science)	e-Science Symposium
Tools	e-Science Portal for New England Librarians, Frameworks for a Data Management Curriculum
Continuing Education	Professional Development Days, Science Boot Camps
Dissemination of Findings and Intellectual Examples	Journal of eScience Librarianship
Scholarship & Research	Assessment of competencies, survey of educational programs in data curation and management

Each of these six components addresses specific facets for promoting and supporting e-Science librarianship in the New England region. Building an e-Science Community of Interest (COI) is an ongoing activity that began with the first meeting of the UMASS 5 and has grown to include all the attendees of the e-Science symposia, Science Boot Camps, and Professional Development Days. A goal for developing this COI is to build a community of librarians with a common understanding of e-Science library roles in the region. Currently the e-Science Community of Interest includes 155 New England science, health sciences, and technology librarians.

The Roadmap for Libraries strategy aims to increase awareness amongst New England librarians of the importance of e-Science and how libraries can support scientific research. At each of the e-Science symposia, presenters have discussed examples of library engagement in supporting science—in various ways from NSF "big science" grants to an example of a library research data working group that is scanning the needs of science researchers across campus in order to plan relevant library research support services. The poster presentations at the e-Science symposia have allowed individual librarians to disseminate news of their e-Science related library projects in a setting conducive to one-on-one discussions—fulfilling the roadmap strategy and helping to build relationships among the e-Science COI.

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Tools provide resources specifically targeted for librarians that support their engagement in e-Science services. One such tool is the e-Science Portal for New England Librarians. The portal is a centralized online website that provides links to information on e-Science, sciences, data curation, data management planning, courses, workshops and opportunities. The Frameworks for a Data Management Curriculum, with its lesson plans and research cases, serve as a tool for librarians and science, health science and technology faculty for implementing formalized data management instruction to their students.

Continuing education supports working librarians by bringing them up to speed on emerging fields and new research methodologies. Planning for these continuing education activities are heavily based on attendee evaluations at previous events—resulting in a series of professional development days and Science Boot Camps that feature topics regional librarians want to explore and understand better.

The Journal of eScience Librarianship provides a forum for dissemination of scholarly findings and intellectual examples. The journal's mission is to advance the theory and practice of librarianship with a special focus on services related to data-driven research in the physical, biological, and medical sciences. It welcomes original articles related to outreach, collaborative, and educational aspects of e-Science librarianship from librarians around the globe.

The sixth and final strategic component is Scholarship and Research. Work in this area is underway. The UMMS e-Science team has been assessing the region's e-Science COI in order to identify requisite data management competencies that area librarians need to engage in e-Science. The team has also conducted a survey of library school programs that provide data curation and management training.

The following sections of the chapter will further describe the events and tools created by the New England consortia.

e-Science Symposium for New England Librarians

Since 2009, the Lamar Soutter Library at UMMS, the NN/LM NER and the Boston Library Consortium have co-sponsored four annual e-Science symposia for New England Librarians. Each symposium is a daylong conference featuring presentations by nationally recognized experts and local librarians. The ultimate goal for the e-Science symposium initiative has been to develop a strategy for a regional collaboration for delivery of e-Science resources and services.

The inaugural e-Science symposium held in 2009 was intended to increase awareness among New England area librarians of the importance of e-Science and the role of the library in supporting scientific research. Eighty science, health sciences, and technology librarians from thirty-eight regional libraries attended. The morning's introductory panel featured two health sciences librarians and one researcher. Their presentations included defining e-Science, its major issues, and the roles librarians can play to support e-Science at their institutions. This panel was followed by presentations from a bioinformatics librarian at a major biomedical research institution and a researcher from the University

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of Massachusetts Medical School International Stem Cell Registry, which demonstrated two specific applications of e-Science to symposium attendees. A subsequent presentation about the University of Massachusetts Center for Clinical and Translational Sciences explained Clinical and Translational Science and its goal to strengthen collaboration among all sciences programs and encourage interdisciplinary collaborations that will enable and accelerate translation of research discoveries in labs into clinical practice. The ability of high-computing technologies and interdisciplinary networking between labs and departments to extend research work beyond the confines of a single institution was emphasized, along with the impetus for librarians to keep abreast of research projects within their institutions so that they can identify potential areas for library involvement.

During this first e-Science symposium, there was a pivotal afternoon breakout discussion session that prompted attendees to begin thinking about e-Science issues and how their libraries could build working relationships with their research communities. One key area of discussion during this breakout session addressed the credentials, knowledge and competencies that librarians need to engage in e-Science. Attendees noted that these would include specific technical skills for data stewardship, disciplinary content knowledge, and collaboration skills. This topic evolved into further conversation on what types of continuing education events and resources would help practicing librarians acquire necessary competencies and knowledge. Feedback from the discussion groups showed a strong preference for a combination of in person classes and online resources. The idea for a centralized online e-Science web portal that would provide links to resources, tutorials, and tools and include a discussion forum for librarians working in diverse science research institutions in New England was widely embraced by the group. Taking these responses into consideration, in May 2009 the Lamar Soutter Library began planning the development of the e-Science portal for New England Librarians, which will be described further on in the chapter.

Since this first e-Science symposium in 2009, the programs for successive symposia have featured both nationally recognized and local speakers—librarians, computer scientists, life and physical scientists presenting on topics ranging from large-scale National Science Foundation data projects, library involvement in planning campus data services, institutional approaches to data curation, linking data to publications, data repositories, science data literacy, and current research projects that illustrate data creation and management in lab settings. Beginning in 2010, the symposia have also featured poster presentations by mainly regional librarians (over the years this has broadened with more librarians outside the NE region participating) discussing their respective e-Science projects. To view the programs and presentations for the 2011 and 2012 e-Science symposia, go to the University of Massachusetts and New England Area Librarian e-Science symposium website at http://escholarship.umassmed.edu/escience_symposium/. Programs and slides presentations from the 2010 and 2009 symposia can be accessed through the University of Massachusetts and New England Area Librarian e-Science Initiatives webpage at http://library.umassmed.edu/escience_initiatives.

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Next Steps

Topics for future e-Science symposia will include library roles in high-performance computing initiatives, qualities of effective library collaborations, and characteristics of library leadership in successful collaborations.

Professional Development Days

Professional development days provide area librarians with an affordable continuing education opportunity to learn about a specific area of scientific study or aspect of science librarianship. The following topics have been covered in these professional development day workshops for New England Science Librarians:

- Exploring Stem Cell Research: What does it mean for Librarians?
- Nanotechnology in the Health and Applied Sciences: Implications for Librarians and Researchers
- Scientific Data Management
- Metadata Day

The Exploring Stem Cell Research professional development day was held in May 2009 and was hosted by the Lamar Soutter Library and the Center for Stem Cell Biology and Regenerative Medicine at UMMS. The program consisted of an introduction to stem cell biology, an overview of the International Stem Cell Registry http://www.umassmed.edu/iscr/index.aspx that resides at UMMS, a discussion on the intellectual property and patent issues related to stem cell research, bioethical considerations; a tour of the Stem Cell Center, and an afternoon table discussion of opportunities for librarians in the sciences.

The following year in May 2010, the University of Massachusetts Amherst Libraries sponsored the Nanotechnology in the Health and Applied Sciences professional development day. The focus of this program was nanotechnology in health and other applied sciences. Librarians learned about nanotechnology terminology, tools, and information resources used by nanotechnology researchers, such as *InterNano* (http://www. internano.org/) an information portal managed by one of the science librarians in the UMASS 5 group.

Scientific Data Management was the topic for the 2011 Professional Development Day. Jian Qin, director of the e-Science program at the Syracuse iSchool delivered a comprehensive presentation that included background history of scientific approaches that has lead up to the current data-centric e-Science methodology, descriptions of datasets, a survey of science metadata standards, conducting data interviews, and recommendations on how librarians can build working skills in e-Science. Her presentation can be viewed on the Scientific Data Management subject guide at http://libraryguides.umassmed.edu/content.php?pid=176769&sid=1496225.

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The fourth in this series of professional development days, Metadata Day, has yet to be held as of the writing of this chapter. The idea for devoting a program to metadata came from attendees at the 2011 Scientific Data Management workshop, who wanted to explore the role of metadata in more depth. The program for this day will feature an overview of metadata and its role in enabling discoverability, access, and interoperability of information, and afternoon breakout sessions at which local librarians from diverse science research libraries will present their metadata-related work projects.

The subject guide for Metadata Day can be viewed at http://libraryguides.umassmed.edu/content.php?pid=319888.

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Next Steps

The proposed topic for the next professional development day is an exploration of tools that support research collaboration, such as research information networks.

Science Boot Camp for Librarians

Initiated in 2009, the goal of Science Boot Camp for Librarians has been to provide more in-depth, affordable science education and networking opportunities for librarians over a two and a half day period. Each boot camp features three sessions in which local science faculty share their expertise by providing an overview of a science followed by presentations of relevant research projects within the field. Faculty presenters gear their lectures toward non-specialists. This has provided boot campers with an understanding of the concepts and terminologies of science disciplines, which will ultimately enable them to better engage with their research faculty.

Science Boot Camp's casual atmosphere fosters dialogue between faculty and librarians. This has been an all-around positive experience for both faculty and librarians--enabling librarians to directly ask faculty questions about their area of expertise and get a better understanding of their research processes--and informs faculty about the role of libraries in supporting scientific research. Each boot camp has been held at a different university and has featured three science sessions. At the request of attendees at the first boot camp, a capstone lecture was added for the last day of boot camp. The capstone sessions highlight innovative projects of librarians relevant to e-Science. Links to the Science Boot Camp library guides and recorded presentations from the Science Boot Camps (except for the 2009 Science Boot Camp recording) are posted on the Science Boot Camp page of the e-Science Portal for New England Librarians http://escience library.umassmed.edu/science_bootcamp.

Table 2 provides a summary of the host campuses, featured science topics, and Capstone topics for the boot camps as of June 2012.

Table 2. Summary of Science Boot Camp Topics 2009-2012

Year	*Host*	*Science Topics*	*Capstone Presentation*
2009	University of Massachusetts Dartmouth	• Bioinformatics • Geographic Information Systems • Nanotechnology	(Had not been initiated yet)
2010	University of Massachusetts Lowell	• Genetics • Remote Sensing • Climate Change	• DataStaR: Cornell's data repository • e-Science portal
2011	Worcester Polytechnic Institute	• Robotics • Astronomy • Epidemiology	• Science informatics at the Marine Biological Lab at Woods Hole Oceanographic Institute Library
2012	Tufts University	• Neuroscience • Organic chemistry • Data visualization	• ARL e-science Institute • Library school programs

Planning Process

Having conceived the idea for Science Boot Camp, the UMASS 5 science librarians planned the first two boot camps in 2009 and 2010. As noted in Table 2, these boot camps were hosted at the UMASS campuses in Dartmouth and Lowell. The planning process for each boot camp gets underway about ten months prior to the actual boot camp and involves three face to face meetings at UMASS Medical School in late summer, fall and winter, followed by phone conferences in the spring months leading up to boot camp. Except for the inaugural 2009 boot camp, planning starts with a review of attendees' evaluations from the most recent boot camp. In these evaluations, attendees provide feedback on the venue, activities, science and capstone sessions, along with recommendations for changes and topics for future boot camps. The group makes note of the attendee feedback when selecting the science topics and planning arrangements for the next boot camp.

A concerted effort is made to host Science Boot Camp at a different campus each year; enabling each librarian in the group an opportunity to host a boot camp on her campus. Selection of the venue for boot camp is done as early as possible in order to secure conference facilities at the host campus and set the date. Traditionally Science Boot Camp is held in early June when students have left campus for summer break so that overnight boot campers can stay in student dormitories. Efforts are also made to plan boot camp dates that do not conflict with national library association conferences. The librarian serving as Boot Camp host coordinates the accommodations, food, meeting rooms, A/V recordings of presentations, and check in process at her campus.

Once the group selects three science topics for the boot camp science sessions, planning group members suggest faculty subject experts from their respective campuses to present. Following this meeting, they contact these faculty members to inform them about Science Boot Camp and gauge their interest and availability. At the next meeting, the group discusses faculty responses and

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collectively decides which specific faculty members to invite to present. The agenda for the capstone and ideas for librarian presenters are also planned. Over the course of late fall and winter, invitations are issued and the agenda is planned in more detail. Tasks and roles are assumed by specific librarians in the planning group. These include publicizing boot camp, setting up a boot camp subject guide, setting up and processing registrations, planning social events for boot camp, and developing evaluation forms and science session merit badges. During Science Boot camp, planners help the host with last minute details such as setting up folders and displays, meeting, greeting, assisting attendees and presenters, maintaining attendee lists, facilitating social events, and collecting evaluation forms.

After the 2010 Science Boot Camp, the UMASS 5 noted that expanding its boot camp planning group to include librarians outside of UMASS would provide new opportunities for collaboration, fresh ideas, and open up boot camp presentations to faculty from other universities. The group invited attendees working in other New England institutions to participate in planning future Science Boot Camps via a Science Boot Camp follow-up online survey sent to attendees. Included in the survey was a section where interested librarians could fill out their names, institutions, and contact information. Eight librarians indicated interest in participating in boot camp planning in their survey responses. Reviewing these responses, the UMASS 5 group realized that it needed to set criteria for librarian involvement in Science Boot Camp in order to ensure that librarian participants would have institutional support and commitment. The following criteria were established:

For a librarian to participate in the Science Boot Camp planning group, the following criteria need to be met:

- The librarian must be currently employed at a library.
- This library or its parent institution must provide co-sponsorship funding for Science Boot Camp (*19*).

Having secured financial sponsorship from their parent institutions, librarians from Worcester Polytechnic Institute, Tufts University, University of Connecticut, and College of the Holy Cross have joined the planning group. With this expansion, the UMASS 5 Science Boot Camp planning group has evolved into the "Science Boot Camp Planning Group."

Funding for Science Boot Camp is made possible through co-sponsoring libraries, the NN/LM NER and the Boston Library Consortium. The combined efforts of the librarians who have collaborated to plan Science Boot Camp have been crucial to its success. Sharing a passion for science, they are committed to providing affordable quality continuing education to the greater library community. The process of sponsoring boot camp demands a cohesive team effort to plan a budget, venue, science sessions, capstone, and social events; invite speakers, publicize, process registrations, and serve as hosts during the actual event. Each year an average of sixty librarians attend Science Boot Camp.

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The librarians in the boot camp planning group have made a concerted effort to disseminate news of Science Boot camp through publications in library journals and presentations at various library conferences, both nationally and internationally (*22*).As word of boot camp has spread, it has sparked a keen interest among librarians both inside and outside the New England region to use the boot camp model for continuing education events in their communities of interest. One example of this is a Social Science boot camp that librarians at Tufts University initiated in 2011 (*20*).

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Next Steps

Planning for the 2013 Science boot camp will commence in fall 2012. Decisions for future science topics for each science session will be based on campers' suggestions from the 2012 Science Boot Camp evaluations. With continued funding from the NN/LM NER, the Boston Library Consortium, and institutional sponsors, the Science Boot Camp Planning Group's long range plan is to continue the ongoing series of annual Science Boot Camps while maintaining affordable registration fees, and to offer sponsoring libraries opportunities to serve as Science Boot Camp hosts on their campuses.

e-Science Portal for New England Librarians

The e-Science portal for New England Librarians http://esciencelibrary.umassmed.edu/ is an openly accessible web resource with links to reports, white papers, articles, tutorials, conference presentations, and science primers that are relevant to e-Science librarianship. A component of the portal is the e-Science Community blog, where opinion pieces, reviews, and thoughts by contributing science librarians, and news, events and opportunities are posted. Any postings on the blog automatically feed to the portal's Twitter account @NERescience.

The content of the portal is divided among these main focus areas:

- **About e-Science**: e-Science Overviews, Researchers and Data, Cyberinfrastructure, Policy
- **E-Science and Libraries**: ARL reports, Library roles, Librarian Education, Assorted library blogs
- **Data Support Services**: Data management Planning, Data Repositories, Data Curation, Science Data Literacy, Research Information Networks
- **e-Science Community**: e-Science Community blog, New England Projects, National Projects, Organizations
- **Science Primers**: Links to overview tutorials in life and physical sciences; Science Boot Camp, Research Tools and Methodologies
- **About the Portal**: Scope statement, content selection criteria, information about the portal staff, advisory and editorial board members

As mentioned earlier in the chapter, attendees at the first e-Science symposium in April 2009 noted the need for a web portal to provide e-Science continuing education. In May 2009, the Lamar Soutter Library at UMMS obtained funding from the NN/LM NER to develop the e-Science portal. After a portal web team was established, one of the first steps in planning the portal was to assess what New England science, health sciences, and engineering librarians' e-Science learning needs were. This information was critical to guide the construction and scope of the portal. There were three key objectives for this needs assessment:

- To establish the need for an e-Science portal
- Examine what e-Science and data services librarians and libraries were currently providing
- Identify the educational background of the region's science, health sciences and technology librarians along with their educational needs and social media preferences in order to develop the portal scope and transmission mechanism

The assessment was developed as an online survey that was sent out to 168 unique libraries and individual medical, health sciences, and science and technology librarians who served or whose institutions served medical or interdisciplinary biomedical researcher patrons. Seventy-eight librarians responded to the survey. Overall, the responses to the survey revealed that a small number of New England libraries were currently engaged in e-Science activities at their institution or with other institutions, with a larger number of librarians seeing potential for future e-Science projects. These results indicated that the New England library community needed an e-Science web portal. Results also showed a regional demand for e-Science and data services tools and scientific content tutorials. Respondents indicated that they were comfortable with using a variety of educational web 2.0 tools for self-guided learning and online discussions (*21*).

Another early step in planning was to populate an advisory board of New England librarians that would define the scope of the portal, its major subject areas, aid in the selection of content editors, and guide the portal's overall development. A science librarian with a strong interest in e-Science and who managed a nanotechnology portal accepted an invitation to serve as chairperson for the advisory board. Invitations were then issued to library directors and librarians who advocated the development of e-Science library services in the region. Eight individuals from the following research institutions joined the advisory board: MIT, Worcester Polytechnic Institute, Massachusetts General Hospital, UMASS Medical School, Genzyme, and Yale University. Ex-officio members of the advisory board included the PI for the portal, portal coordinator, and the associate director of the NN/LM NER. The first meeting of the advisory board was held in October 2009. During this meeting the results of the portal needs assessment were presented, and the board discussed what the scope, audience, and topic areas would be for the portal. The advisory board created this scope statement:

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The portal is designed for librarians working in research organizations that generate, share, store and/or use data for basic scientific research in the health, biological, and physical sciences. Bringing together resources on education, outreach and collaboration, current practices and e-science news—the portal provides librarians with the tools, knowledge and skills to effectively participate in networked science (*22*).

Two months after this initial meeting, the advisory board reconvened to plan charges for a portal editorial board and recommend experienced science subject librarians who could oversee the selection of content for the portal focus areas and participate in joint meetings with the advisory board to guide the portal web team in developing the portal. Upon the advisory board's recommendations, the portal coordinator sent invitations to the suggested subject librarian candidates and within a few months the editorial board was established. Members of the editorial board include science, health sciences and engineering subject librarians from Tufts, MIT, Northeastern, and UMASS Amherst, NN/LM NER, and a high school science teacher with an MSLIS who is currently pursuing a PhD in education. In April 2010, the editorial board and the advisory board met for their first joint meeting. During this meeting, the portal web team and the boards planned the delegation of portal content areas to specific editorial board members and established the process by which content would be selected, annotated, evaluated and posted on the portal. The portal web manager joined this meeting and presented his ideas on how he would initiate planning the structure of the portal with Drupal, an open source content management system.

The delegation of portal focus areas to the content editors is based on their area of expertise and interest. Two editorial board members submit content relevant to news, events and current projects. Two board members assumed responsibility for the development of the portal blog. The established workflow between editors and the portal coordinator includes the following steps:

1. Content editor reviews, selects and annotates resources (articles, papers, video tutorials, news items).
2. She then submits the content to the portal coordinator. This has been done mainly by e-mail. For the news/events content editor, it became much easier for her to post content on a social bookmarking site that the portal coordinator could regularly access.
3. The portal coordinator reviews the content to ensure it meets the content selection guidelines and falls within the scope of the portal. If she has questions about this, she discusses it with the content editors or an advisory board member. Once the coordinator approves the content, she forwards it to the portal site manager to post it.

After almost two years of planning, the portal was officially launched at the e-Science symposium in April 2011. During the afternoon session of the symposium, the project coordinator presented the portal and explained its key focus areas to symposium attendees. Since the launch, the portal staff reviews monthly usage statistics for both the portal and the e-Science community blog. Usage of the portal

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has increased steadily and globally since the portal was first launched. Usability studies have been conducted annually. Subjects of these usability studies include Simmons College GSLIS students enrolled in a science and technology resources course, and librarians working in New England research libraries. The results of these usability tests have informed the staff of ways they can revise the portal to enable users to find content and navigate the portal more efficiently.

The portal serves as a great working model of regional librarian collaboration. The synergistic expertise of administrative and subject librarians has facilitated the identification of critical learning needs and selection of quality content that will help librarians develop necessary knowledge, skills and competencies to engage in e-Science.

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Next Steps

The idea of expanding the portal advisory and editorial boards to include librarians outside of New England was discussed at a recent board meeting. It was decided that for the near future, oversight of the portal will continue by a collaboration of New England librarians. Limiting the board members to New England librarians facilitates the hosting of affordable in-person biannual joint board meetings.

Currently the e-Science portal for Librarians is targeted specifically for librarians. This may continue, or a decision may be made to broaden the portal content to target scientific researchers as well as librarians. This idea will be open for discussion at a future joint meeting of the portal staff, advisory and editorial boards.

IMLS National Leadership Planning Grant: Planning Frameworks for a Data Management Curriculum and User Needs for a Student Data Repository

In August 2010, the Lamar Soutter Library at UMMS and the George C. Gordon Library at Worcester Polytechnic Institute were awarded a collaborative one year Institute of Museum and Library Services (IMLS) National Leadership Planning Grant and funding from the NN/LM NER to develop frameworks for a data management curriculum for undergraduate and graduate students in the sciences, health sciences, and technology disciplines; and to identify user needs for a collaborative data repository for data generated from student research projects. Reports about this grant, along with presentations and the project outputs are accessible via the project's website at http://library.umassmed.edu/imls_grant (*23*).

The impetus for this grant arose from discussions between the two schools' library directors who had compared notes on the lack of consistent data management standards in the research arena in general, and a local need for formalized data management instruction for students in the sciences. Both were

well aware of frustrations voiced by faculty at their schools over data management issues in the lab and clinical settings. They also recognized the potential value data from student projects has for re-use in future projects. In addition to planning a data management curriculum, the two schools also wanted to explore available open source repository software systems to assess their usability for possible development of a shared repository for data generated by student projects.

Grant personnel included a Steering Committee made up of the two library directors who served as co-PIs, the project coordinator, an associate library director from UMMS, and the director of research computing at WPI; and an Education Committee of faculty and librarians from the two schools, and outside consultants (curriculum consultant, evaluation consultant, and an instructional design consultant).

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Planning Frameworks for a Data Management Curriculum

The first phase in planning the curriculum was an extensive literature search of existing online data management curricula. Findings from this revealed very few curricula that were consistently accessible and targeted for students in the sciences (outside of library and information sciences).

In the second phase, project consultants conducted 50 interviews with students (30 freshman at WPI, 10 UMMS students, and 10 WPI graduate students) about data sharing and their current data management practices. The idea of sharing data was alien to many students, particularly freshmen undergrads. Two medical students at UMMS who had previously worked in labs for drug development companies stated that the concept of sharing data with other researchers outside of their organization was akin to disclosing trade secrets. One graduate nursing student described how she kept all data from subject interviews for a public health research project in files on her laptop, which she kept at her side at all times. Once the project was done, she destroyed these files. She was not aware of the option of stripping the data of personal identifiers so that it could be shared with other researchers without jeopardizing subject confidentiality. It was found that students maintain data in a variety of formats such as Excel, Sims 3, Word, Power Point, Adobe Illustrator, SPSS, and SAS. They often store data in their e-mails, in the cloud (e.g. Google Docs), on local drives, laptops, network drives, or external drives. There was a lack of standard naming conventions for directories and files, unless specific instructions were given by the PI or research supervisor. A common scenario in several research labs is the use of a paper lab notebook for specific types of data, as well as digital files. This juxtaposition of analog and digital data stored in separate locations can present challenges and potential gaps in integrating project data. The interviews with students from the two schools revealed many areas for potential data mismanagement, reflecting many findings from the literature search.

After the literature search and responses to student interviews were analyzed and the National Science Foundation's general requirement for data management plans was reviewed, the following learning objectives for the data management curriculum were identified:

By participating fully in this curriculum, the student should be able to:

1. Explain the need for managing/sharing research data, relevant public policies, and the lifecycle continuum for managing and preserving research data
2. Identify potential re-users, the value of your research data for re-use, and a dissemination strategy
3. Use an abbreviated data management plan or data curation profile to manage your research project data and define roles/responsibilities of research staff
4. Explain the range of research data types, stages, formats, and relevant software that may need to be managed and pre- served in your future research efforts
5. Identify what descriptive data needs to be documented in a standard way via metadata to allow your research data sets to be managed and preserved
6. Plan how to handle issues involved in securely storing research data in central databases, archives and/or repositories, backing it up, and managing access to your data
7. Explain legal (ownership) and ethical considerations related to data-sharing
8. Plan for issues related to long-term preservation, discovery, and re-use

These learning objectives were then translated into a plan for seven discrete course modules as noted in Figure 2.

The modular format of the curriculum is designed to be flexible in use for students at various educational levels (undergraduate, Master's/PhD). For example, an undergraduate working on his first research project may be required to review all seven course modules while a graduate student working in a new lab may be required to review modules 1-3. The curriculum is designed to be delivered in a variety of methods: video, online self-paced, and classroom instruction. These options allow faculty to customize course content so that it can be integrated into a range of learning environments.

Two UMMS faculty members on the project Education Committee suggested the addition of research case studies that depicted real life scenarios in lab, field and clinical research settings to the curriculum. Noting that work practices, terminologies, and data vary considerably from one discipline to another, they recommended to the Steering Committee that actual cases from a range of science, health sciences and engineering research areas be included in the curriculum. This would tie abstract data management concepts to real life situations that students could envision. The project Evaluation Consultant and a librarian from the Education Committee met with faculty members at both schools to elicit details of data management issues from their research experiences. From these interviews, the two wrote cases that illustrated data management issues in the following research settings: clinical behavioral health, biomedical lab research, orthopedic medicine, and an aerospace engineering lab.

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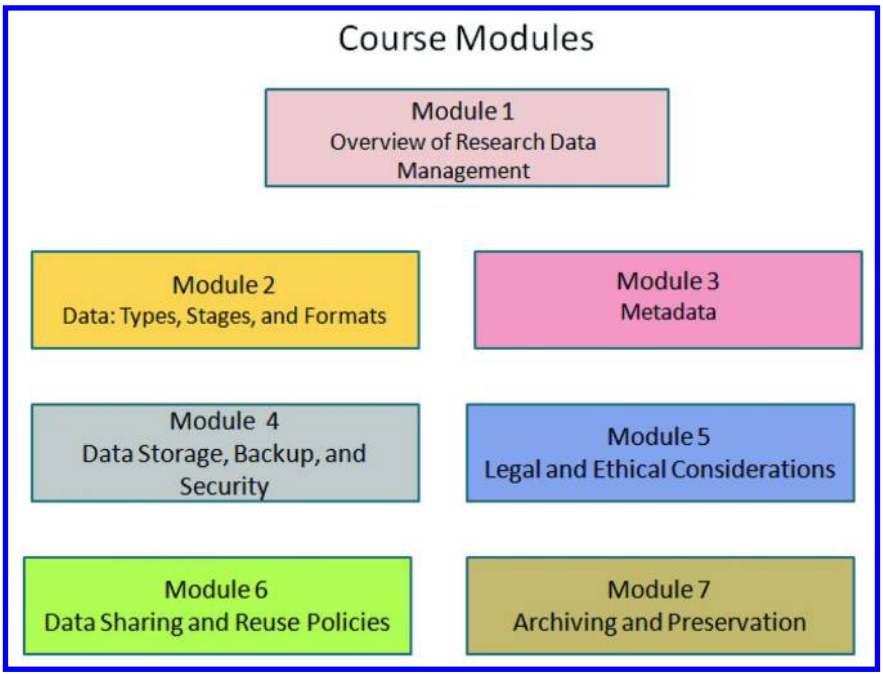

Figure 2. Course Modules for Data Management Curriculum.

Lesson plans for the course modules were developed by librarians on the Education Committee and the Evaluation Consultant. Each lesson plan included specific learning objectives, lecture content, readings, activities, and an assessment. Content for Course Module 5 "Legal and Ethical Considerations for Research Data" was completely developed and integrated into a prototype online module featuring video and text instruction. This was done as a proof of concept for presentation to faculty at the two schools.

Identifying User Requirements for a Collaborative Data Repository

The Steering Committee investigated open source repository software systems that could be used to develop a data repository through a search of open access data repositories. They accessed data repositories to examine their user interface, analyze search functions, navigability, ease of access to data sets, and details about their software components. Findings were that many repositories were built on highly customized software, some with proprietary software, and of the open source software systems, DSpace, Fedora, and Islandora were the most prevalent.

WPI's Research Computing Services department conducted studies on DSpace, Fedora, and Islandora data repository software by loading data sets onto these three systems and evaluating the systems' user interface, analyzing search functions, tools, administrative requirements, available technical support and cost. Details of this testing can be viewed in the document "Evaluating User Requirements for Data Repository Software" at

http://library.umassmed.edu/eval_user_reqs_data_software.pdf. The criteria and findings from the testing are outlined in "Matrix of User Requirements for Repository Software at http://library.umassmed.edu/user_reqs_matrix.pdf.

Next Steps

As of the writing of this chapter, the Lamar Soutter Library at UMMS has requested further funding for full implementation of the course content and pilot instruction of the modules at partnering institutions. These partnering institutions include UMASS Amherst, Tufts University, Northeastern University, and the Marine Biological Laboratory at Woods Hole Oceanographic Institute.

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Journal of eScience Librarianship

In February 2012, the Lamar Soutter Library at UMMS launched the *Journal of eScience Librarianship, (JESLIB),* an open access, peer-reviewed online journal whose goal is to advance the theory and practice of librarianship with a special focus on services related to data-driven research in the physical, biological, and medical sciences. JESLIB aims to promote the development of e-Science librarianship as a discipline and provide a forum for librarian discussion on issues related to managing, curating, preserving and retrieving clinical and science data. Original research papers, case studies, editorials, and conference proceedings from the annual University of Massachusetts and New England Area Librarian e-Science Symposium are featured in the journal.

The journal is an outgrowth of the series of e-Science conferences and outreach projects that have taken place in New England and outlined in this chapter. Like the other initiatives, *JESLIB* is a collaborative effort. The editorial board of the journal is made up of a team of librarians from the Lamar Soutter Library and an editorial consultant at the University of California Davis. Librarians engaging in e-Science services or projects in New England and other US regions serve as peer reviewers. (*24*).

The Journal of eScience Librarianship can be accessed at http://escholarship.umassmed.edu/jeslib. Since the launch of the first issue of JESLIB that featured the proceedings of the 2011 librarian e-Science symposium, JESLIB has received several manuscript submissions for its upcoming issue. These submissions have included original research papers, case studies, and reviews of e-Science workshops by librarian authors working in diverse research institutions across the US.

Next Steps

JESLIB was launched a few months prior to the writing of this chapter. Since then, its editorial board of UMMS librarians has been evaluating the processes that it implemented for publishing the first issue. The board has clarified editorial roles and responsibilities, fine-tuned the peer review process, and established editing and dissemination policies and procedures in order to build an efficient

and successful working model for publishing future issues. Submissions for the next issue of *JESLIB*, which will be published in late summer of 2012 are currently being peer reviewed.

Scholarship and Research

The Lamar Soutter Library is just embarking on this strategic component of the e-Science program. In 2011, the library's e-Science team surveyed the NE region's e-Science librarian COI to assess the competencies needed by health sciences, science and technology librarians to engage in data curation and management and support e-Science research endeavors. Findings from the assessment revealed twenty requisite competency areas. Of these competency areas, the one with the greatest need for librarian training was the digital description and curation of large data sets (*25*). In the six months between Fall 2011 and Spring 2012, the library's e-Science team conducted a survey of current data curation and management courses available in American Library Association-accredited Library and Information Science Programs in North America. Results of this survey have revealed a significant gap in educational programs in data management and curation. (*26*).

Discussion

The e-Science symposia, professional development days, Science Boot Camp, e-Science Portal for New England Librarians, Frameworks for a Data Management Curriculum and User Requirements for a Collaborative Repository project, the Journal of eScience Librarianship, and e-Science scholarship and research are components of a long range strategic plan for e-Science learning and practice in New England. This strategy began with the first e-Science Symposium and has gradually developed over the last four years. The New England e-Science regional program now serves as a model of collaboration for other library consortia. Libraries interested in initiating similar ventures would benefit from understanding the key components that have contributed to the success of the New England regional e-Science program:

- **Clear purpose**: to promote and support e-Science librarianship through educational programs, development of an e-Science community of interest, and promotion of regional library partnerships in e-Science projects.
- **A lead institution with dedicated staff**: the Lamar Soutter Library at the University of Massachusetts Medical School.
- **Funding mechanism**: funding has been provided by the National Network of Libraries of Medicine for the New England Region, whose mission is to bring librarians together to support their continuing education needs. The Boston Library Consortium and The Institute

In Special Issues in Data Management; Xiao, N., et al.;
ACS Symposium Series; American Chemical Society: Washington, DC, 2012.
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of Museum and Library Services have also funded e-Science program components.

- **Identified need and commitment from regional library directors**: contribution of resources (staff, funding, materials).
- **Regional interest**: Science, health sciences, and technology librarians in New England have identified e-Science librarianship as a common area of interest and are demonstrating a commitment to the e-Science program through ongoing attendance and participation.

A crucial first step in laying the groundwork for the e-Science program was securing a commitment to e-Science programming from the resource library directors of the Boston Library Consortium. Over time, this commitment has included financial sponsorship and donation of staff time and resources to the program. To ensure broad attendance at the first e-Science symposium, the Lamar Soutter Library sought and obtained commitment from New England Resource Library directors that each director would delegate two of their staff subject librarians to attend the event.

The e-Science program team reviewed the attendee evaluations for each of the inaugural events in 2009 (e-Science symposium, stem cell professional development day, Science Boot Camp). These reviews revealed a keen interest among regional librarians for further e-Science related educational programs and resources. Moreover they enabled the program team to identify regional librarians who were interested in helping plan and organize further events. The team followed up on these evaluations and issued invitations to these librarians to participate in the e-Science portal project as advisory and editorial board members. Since accepting these roles, the portal board members have shared their time and expertise by guiding the development of the portal, contributing content, promoting the portal, conducting usability studies of the portal, and advising the portal staff on next steps. Through their contributions to the portal project, the portal boards have demonstrated an extraordinary level of commitment to promoting e-Science librarianship in the New England region.

The original UMASS 5 Group and the Science Boot Camp Planning Group that evolved from it have also demonstrated this extraordinary level of commitment. To date the group has organized four very successful Science Boot Camps and will soon begin planning the fifth. The success of Boot Camp is reflected by the positive feedback from enthusiastic Science Boot Campers, the high percentage of campers who return each year, a surge in first time Science Boot Campers from diverse regions of the US and Canada, and use of the Science Boot Camp as a model for developing the Social Sciences Librarian Boot Camp at Tufts University.

The e-Science program has promoted awareness of e-Science, potential roles for librarians in providing e-Science related services at their institutions, and the competencies needed to engage in these roles, to librarians in the New England region. E-Science services can include data management instruction to students and faculty, consultation on data management plans for funding agencies, managing data collections in institutional repositories, participation in the development of research information networks, and data curation and

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preservation. Through its research and scholarship initiatives, the e-Science program has identified e-Science services currently underway and plans for future e-Science services at New England research libraries. Findings of the data management competencies assessment serve to inform future directions for the program's continuing education initiatives. Librarians who use the e-Science portal, the Journal of eScience Librarianship, and attend the e-Science symposia, professional development days, and Science Boot Camp can acquire knowledge and competencies that will enable them to effectively engage with researchers at their institutions and provide data support services. In addition to providing learning opportunities, the e-Science program has promoted collaboration among science, health sciences, and engineering librarians in the region. Successful collaborations in which library partners are able to leverage their resources and expertise will spur innovations in e-Science library services across and beyond the New England region.

Since the data management plan mandate for National Science Foundation grants was implemented in 2011, New England librarians have been asked to assist researchers in writing data management plans and providing data management instruction. In response to this increasing demand for library based data support services, there have been changes in librarian job descriptions and new positions such as data librarians have been created. Several New England libraries have partnered with their research and IT departments to plan campus-wide research data management services. Librarians involved in these endeavors and librarians who are preparing for future e-Science roles have come to rely on the resources provided by New England's e-Science program.

Conclusion

Technologies and the resulting outgrowth of digital data continue to evolve and expand in scale. Librarians serving the scientific community face both opportunities and challenges as they look for ways to tackle the data deluge and forge ahead in the nascent discipline of e-Science librarianship. Participating in research data management services requires a retooling of established library roles, workflows and competencies-- and a collaborative spirit. This collaborative spirit is alive and well in New England, where the combined efforts of a regional consortia of science, health sciences, and technology librarians have resulted in a repertoire of initiatives that will support e-Science professional development in New England and around the world.

Acknowledgments

Many thanks to the members of the initial UMass Five Campus Science Librarians group, the library directors of the UMASS 5 campuses, the Science Boot Camp planning group, and the librarians involved in the e-Science portal for New England Librarians project. Thanks especially to Elaine Martin, Sally Gore, Raquel Abad, Rebecca Reznik-Zellen, and Maxine Schmidt for their input. Components of the New England e-Science programs for librarians are possible

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due to the sponsorship from the National Network of Libraries of Medicine New England Region, the Boston Library Consortium, the Institute of Museum and Library Services, and the following New England institutions: the five University of Massachusetts campuses, Worcester Polytechnic Institute, University of Connecticut, Tufts University, and College of the Holy Cross.

The e-Science program for librarians in the New England region is funded by the National Library of Medicine, National Institutes of Health, Department of Health and Human Services, under Contract No. N01-LM-6-3508 with the University of Massachusetts Medical School. The Frameworks for a Data Management Curriculum and Requirements for a Collaborative Repository project is made possible by a grant from the Institute of Museum and Library Services and with funds from the National Library of Medicine under Contract No. N01- LM-6-3508. The Boston Library Consortium has cosponsored the e-Science symposia, professional development day workshops, and Science Boot Camps.

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