



U.S. National Library of Medicine

2017

Programs and
Services



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A Message from the Director

My first full year as Director of the National Library of Medicine has been one of transition. Most notably the Library and its staff dove into the strategic planning process and faced the departure of two respected leaders.

We spent a good part of the year gathering information in support of a strategic plan that will guide us for the next decade. We reached out to global stakeholders to gain their input on NLM's priorities and future directions. We empaneled experts to consider four key aspects of NLM's work—building collections, supporting public health, advancing biomedical discovery, and furthering data

science, open science, and informatics. And we evaluated our products and internal processes, looking for areas we can build upon or streamline.

We came away from the experience knowing we must evolve while simultaneously holding firm to our core mission: helping to translate biomedical research into practice. We also certified what we have always suspected—that our most precious commodity is the public's trust. That is a treasure we cannot squander.

Many of the accomplishments in these pages speak to that trust, from the milestones reached by dbGaP, MEDLINE, and MedlinePlus to our work with ClinicalTrials.gov, hurricane survivors, and the opioid crisis to the training and resources professionals and consumers come back to again and again.

NLM's people also embody that trust, none more than the woman we said farewell to in June. After more than 44 years of service to NLM, to the medical library community, and to the public, Betsy Humphreys retired, leaving behind a legacy of collaboration and achievement. Betsy worked tirelessly, combining skill and dedication with generosity and goodwill to forge partnerships that enhanced health care through the improved exchange of health data and expanded access to research publications. Her impact and influence touched much of what's in these pages. We miss her.

Another powerhouse, David Lipman, also took his leave this year. NCBI would not be where it is today without David's talents, vision, and leadership. In fact, it's hard to think of anyone at NIH who has had a greater impact on the way research is conducted around the world. Over three decades, he shaped NCBI into an essential resource for biomedical information and biological sequence data, building the infrastructure and tools that have enabled countless discoveries. We're all richer for his contributions.

In this report we look back on these and other accomplishments, but we also can't help but look forward to the remarkable things this Library is poised to tackle. The successes in these pages are just prelude to greater exploits. Thank you for joining us on the journey.

Patricia Flatley Brennan, RN, PhD
Director

A Leader Who Set the Standard: NLM Deputy Director Betsy Humphreys Retires



Asked why she stayed at NLM, Humphreys said the answer was simple. “A combination of the mission and the great people I get to work with.”

June 30, 2017 marked Betsy Humphreys’ last day as Deputy Director of the National Library of Medicine. Retiring after more than 44 years of public service, she is remembered for many contributions to the medical library community, including serving as Acting Director of NLM—the first woman and first librarian to do so—improving health data standards, and helping to develop NIH and HHS policies on health information technology, public access to research results, and clinical trial registration and results reporting.

In mid-June, hundreds of people from the Library, NIH, and across the country gathered at NIH’s Natcher Center to salute her.

Formal remarks by former NLM Director Dr. Donald Lindberg and NIH Director Dr. Francis Collins highlighted notable achievements from Humphreys’ career, along with the patience, persistence, skill, and grace with which she reached them.

NLM Director Dr. Patricia Flatley Brennan, a friend and colleague of more than two decades, praised Humphreys’ talents, noting in a tribute that “one of your best has been your relationship with NLM staff members, in all divisions and at all levels. You have led, inspired, mentored, and modeled behavior for so many and held high such virtues as diversity, inclusion, and cooperation.”

In a play on the old television series “This Is Your Life,” colleagues, associates, and family members took turns toasting—and occasionally roasting—Humphreys, remembering with warmth, affection,

and good humor both her professional contributions and her personal drive.

Humphreys began her career at NLM in January 1973 as a librarian in the Technical Services Division. She went on to a series of increasingly responsible positions, eventually serving as Chief of the Technical Services Division, Deputy Associate Director, and then Associate Director for Library Operations, before taking on the NLM Deputy Director position in 2005.

Asked why she stayed at NLM, Humphreys said the answer was simple.

“A combination of the mission and the great people I get to work with.” Plus, she added, “I’ve never been bored,” pointing out that the Library’s work encompasses everything from an 11th century manuscript to the next generation of data science. “It’s been fun!” she proclaimed.

A resolution approved by NLM’s Board of Regents and presented to Humphreys by its chair, Dr. Robert Greenes, acclaimed her as a public servant who has had a profound and lasting impact on NLM, the United States, and the global community. In tribute to her significant accomplishments, US Senator Chris Van Hollen honored Humphreys by reading the Board’s resolution into the *Congressional Record*.

The resolution, in its entirety, follows:

Board of Regents of the National Library of Medicine Resolution—May 9, 2017

Ms. Betsy L. Humphreys has served NLM, the United States, and the global community with distinction since 1973, culminating in her appointment as the NLM Deputy Director in 2005, a post she continues to occupy today, and serving as NLM Acting Director from April 1, 2015 to August 14, 2016—the first woman and first librarian to lead the Library.

In a career that could be called one long highlight reel, she directed the groundbreaking Unified Medical Language System project, which produces knowledge sources to support advanced processing, retrieval, and integration of information from disparate electronic information sources, and which is used around the world. In the process, she developed unique knowledge and experience with the content and format of many biomedical terminologies, health vocabularies, and clinical classifications that would serve her well in all endeavors to follow.

She was a key contributor to interagency efforts to advance standardization of electronic health data, which resulted in the development, promotion, and implementation of mechanisms for designating US standards for health data exchange. She was also a major contributor to the Federal regulation setting the standards for use in electronic interchange of administrative health data.

Taking a broader view, she led US government efforts to remove major barriers to the use of standard clinical terminologies in electronic health records (EHRs). Before there was an Office of the National Coordinator (ONC) for Health Information Technology within HHS, she negotiated the world's first nationwide license for a clinical terminology, SNOMED CT, with usage terms favorable to the US. This became a model for other countries and was adopted by the International Health Terminology Standards Development Organisation (IHTSDO) when it was formed to put ownership of SNOMED CT in an international entity. She was IHTSDO's founding Chair and has served with distinction as its US member.

With the establishment of the ONC, she led NLM's substantial and ongoing collaboration with that body to develop, support, and disseminate for free US use the key clinical terminologies required for certification of EHR products and use of EHRs by Medicare and Medicaid providers and hospitals. She also directed the development and dissemination of many tools, including mappings, subsets, browsers, etc., and innovative systems, including the NLM Value Set Authority Center and NIH Common Data Element Repository, to support the use of standards in health care, quality measurement, and in research.

She directed the legislatively mandated expansion of ClinicalTrials.gov to encompass registration of additional trials and submission of summary results information. This multi-year, multi-faceted process involved numerous partners and stakeholders, showcasing her ability to grasp and solve complex problems and her considerable skill at consensus building. ClinicalTrials.gov is the largest and most heavily used international clinical trials registry.

She worked tirelessly and creatively to expand and enhance access to research publications, data, and high-quality health information for scientists, health professionals, system and product developers, information professionals, and the general public. This often involved building and maintaining strong partnerships across the Federal government to adapt and rebrand strategies to changes in Administrations and priorities and to capitalize on emerging opportunities.

She oversaw the expansion of PubMed Central to include direct deposits of articles from many publishers, manuscript submissions from investigators of publications resulting from NIH-funded research and research funded by other Federal agencies and private funders, including the Gates Foundation, and digitized articles from back issues of biomedical journals, through a partnership with the Wellcome Trust.

She led a collaboration with the Food and Drug Administration (FDA) to make drug information and device registrations submitted to the FDA by product manufacturers available to the public via NLM's heavily used DailyMed system. In addition, she guided the creation of the AccessGUDID database, which provides public access to registration data for medical devices.

Under her enthusiastic direction, NLM became an early implementer of application programming interfaces and download sites for its many heavily used data and information resources, flinging open the gates and allowing their use by other computer systems and by innovative product developers.

As NLM Acting Director, even in the face of hiring restrictions, she enhanced the quality and efficiency of NLM's high-volume operations, ensured reliable 24/7 availability of electronic information services that are essential to research, health care, and public health worldwide, and advanced major initiatives, including the re-competition of NLM's Informatics Research Training Grants and the re-competition and migration from contracts to cooperative agreement grants of the Regional Medical Libraries in the National Network of Libraries of Medicine.

Throughout her career, in an exemplary fashion, she demonstrated creativity, adaptability, and resilience in partnering with stakeholders inside and outside of NLM. She leads by fostering employee development, diversity, teamwork, and making optimal use of human, financial, and information resources.

Throughout NLM, she is respected and indeed beloved for her kindness, her resourcefulness, and her can-do spirit. Truly a treasure as a human being and as a public servant, she demonstrated a career-long commitment to interagency collaboration and harnessing government resources for the public good.



Jerry Sheehan Appointed NLM Deputy Director

Jerry Sheehan was named NLM Deputy Director effective July 31, 2017, replacing Betsy Humphreys, who had retired one month earlier. In announcing the appointment, Library Director Dr. Patricia Flatley Brennan praised Sheehan's "creativity, wise counsel, and clear thinking."

Sheehan stepped into his new role following more than 10 years as the Assistant Director for Policy Development at NLM, where he contributed to the development and implementation of NIH, HHS, and US government-wide policies regarding open science, public access to government-funded

information, clinical trials registration, and electronic health records. He also served a 16-month detail with the White House Office of Science and Technology Policy, where he worked to develop public access policies across all Federal science agencies.

Sheehan's new responsibilities will involve working with Dr. Brennan to develop and evaluate NLM's overall programs, formulate policy, and direct and coordinate all Library activities, in addition to managing the Library's day-to-day operations.

Library Director Dr. Patricia Flatley Brennan praised Sheehan's "creativity, wise counsel, and clear thinking."



NCBI Director David Lipman Leaves a Legacy of Achievements, Hands Reins to James Ostell



“How lucky I am to have something that makes saying goodbye so hard.”

On May 3, 2017, Dr. David Lipman announced he would be moving on after serving as Director of the National Center for Biotechnology Information (NCBI) for nearly 30 years. “How lucky I am to have something that makes saying goodbye so hard,” Lipman said, using a quote often attributed to Winnie the Pooh. It was apt, as Lipman regarded his NCBI colleagues as friends devoted to a common pursuit—to provide essential information to biomedical researchers, medical practitioners, patients, and the biotechnology community worldwide.

NCBI began its journey to becoming a national resource for molecular biology information in 1988, with a modest budget of about \$4 million and a dozen staff members. As NCBI’s first director, Lipman came to NLM having been a key developer of the FASTA algorithm, which evolved into BLAST, now the virtual standard for comparing DNA sequences to those in a database. Under his leadership and that of his three branch chiefs—Dr. James Ostell (Information Engineering Branch), Dr. Dennis Benson (Information Resources Branch), and Dr. David Landsman (Computational Biology Branch)—NCBI rapidly grew into a major information hub, both nationally and internationally.

Lipman realized early on that massive amounts of biomedical data left unorganized and not curated would be of little value to science. He recognized the need to pull together the fragmented and uncoordinated efforts taking place in biotechnology and to create integrated information resources.

Anticipating an avalanche of information from genetics and molecular biology laboratories around the world, Lipman and the NCBI team built an infrastructure to support storage and access to that information, along with links to the related medical literature and to tools, such as sophisticated algorithms, that enable computational analysis.

Over three decades, NCBI’s original handful of staff has grown into a dedicated group of over 700, and the information infrastructure they created has expanded into more than 40 integrated databases used by more than 4 million people each day. These interlinked databases—which connect a variety of genomic information with the biomedical literature, along with chemical and other scientific data—provide a rich information space for users to explore and make the kinds of discoveries that lead to new medical treatments and diagnostics.

But Lipman’s impact reaches further still.

A long-standing advocate for open access to the world’s medical literature, Lipman directed the creation of PubMed, which enabled anyone with computer access to search for free NLM’s MEDLINE database of journal citations and abstracts. Vice President Gore, who joined Lipman and US Senators Arlen Specter (PA) and Tom Harkin (IA) at the 1997 launch of this service, predicted that this advance “may do more to reform and improve the quality of health care in the United States than anything else we have done in a long time.”

Lipman followed up that accomplishment in 2000 with PubMed Central, which provides free permanent access to the full text of certain biomedical and life sciences journal articles. PubMed Central now includes more than 4 million articles from both participating journals and federally funded research. Millions of researchers, students, health professionals, patients, and others use PubMed and PubMed Central each day.

NCBI's more recent projects have focused on genetics and genomics. Many have come to support NIH's precision medicine initiative, including the Database of Genotypes and Phenotypes (dbGaP), which includes the results of studies that examine the interaction between genetic makeup and observable traits; ClinVar, which presents the clinical significance of genetic variations; and the Genetic Testing Registry, which provides information on the availability and scientific basis of genetic tests. NCBI's genomic resources



James Ostell, PhD

PubMed Central now includes more than 4 million articles from both participating journals and federally funded research.

are also part of the collaborative effort to identify and track foodborne illnesses in the United States.

The valuable information NCBI has made available worldwide has played an instrumental role in advancing biomedical research and public health. As a result, Lipman has garnered several awards, including being named a White House Champion of Change “for the vision he has demonstrated and for his commitment to open science.”

While Dr. Lipman will be missed, he has left behind a talented and dedicated staff, now working under the leadership of James Ostell, PhD, who was appointed NCBI Director in September. An NIH Distinguished Investigator and NCBI's chief database architect, Ostell has played a major role in making NCBI the world's foremost source for genetic and biomolecular databases.

In announcing Ostell's appointment, NLM Director Dr. Brennan highlighted his strong qualifications to lead the organization. “He brings a wealth of insight and experience, as well as vision, creativity, and a deep commitment to public service,” she said. “His appointment will ensure the continued preeminence of NCBI and maintain its outstanding record of achievement.” ■

The valuable information NCBI has made available worldwide has played an instrumental role in advancing biomedical research and public health.



dbGaP Celebrates 10-Year Anniversary: Groundbreaking Database Collected, Shared Study Data

Since its launch, dbGaP has grown from two studies to more than 900, with data on more than 1.5 million participants.

When dbGaP, the database of Genotypes and Phenotypes, launched in November 2006, it marked an unprecedented opportunity to share data from genome-wide association studies (GWAS). Such studies explore the association between specific genes (genotype information) and observable traits, such as blood pressure or the presence or absence of a disease (phenotype information).

Genome-wide association studies were of particular interest to NIH because they identify genetic factors that influence health and disease. In fact, whole genome information, when combined with clinical and other phenotype data, offers the potential for increased understanding of the basic biological processes affecting human health. That is, GWAS help identify the genetic variations associated with certain diseases, especially such common, complex ailments as asthma, diabetes, and heart disease. Armed with that knowledge, researchers and clinicians can better detect, treat, and prevent these and other diseases.

Clearly, genome-wide association studies are a powerful tool with great potential.

But like so much of what can happen in the realm of Big Data, one must first be able to locate and download these studies to tap into that potential.

Enter dbGaP.

Thanks to this database, a product of NLM's National Center for Biotechnology Information, NIH could—for the first time—store and share study information available at the level of the individual participant while protecting the privacy of those participants and complying with their participation agreements.

These elements made data sharing possible and secure, and that sharing yielded numerous benefits: allowing researchers to re-use datasets to address additional research questions, to combine data to increase the statistical power and scientific value of their findings, and to better assess the reproducibility of research results.

dbGaP also provided for the first time a central location for study documentation, such as study protocols and questionnaires, helping researchers, students, and others learn about and evaluate study design. In addition, dbGaP links study data to related publications and relevant NLM genomic resources, thereby simplifying the discovery process.

Now, 10 years since its launch, dbGaP has grown from two studies to more than 900, with data on more than 1.5 million participants. It also includes other types of studies (beyond GWAS) that investigate the interaction of genotype and phenotype, such as medical sequencing studies and molecular diagnostic assays.

The impact has been significant.

Researchers have made extensive use of the data in dbGaP to conduct their own studies. More than one thousand research papers have been published based on dbGaP data, with incalculable benefits to translational science and public health.

With such an auspicious beginning, there's no telling what dbGaP's second decade will bring. ■

MedlinePlus Magazine 10th Anniversary

With its Fall 2016 issue, NIH MedlinePlus magazine marked its 10th year of bringing trusted quality health information to the public. Introduced in 2006 at an event on Capitol Hill, the inaugural issue featured Mary Tyler Moore as a spokesperson for diabetes research. The 39 issues since then have addressed health topics ranging from addiction to Zika, delivering the latest breakthroughs from NIH-supported research and sharing stories of how people from all walks of life have handled their health challenges.

A variety of celebrities have graced the cover of the magazine, including such notables as Presidents George W. Bush and William Clinton, sports legends Martina Navratilova and Michael Phelps, and award-winning actors Kathy Bates and Michael J. Fox. Available in print and online, the magazine is published quarterly.

MEDLINE Celebrates 45 Years

MEDLINE, NLM's index to the literature in medicine and the life sciences, celebrated its 45th anniversary in October 2016. Over the four and a half decades since its launch, the database has exploded in content and popularity, going from 236 journals indexed in 1971 to 5,618, and seeing usage reach the stratospheric mark of 2.8 billion searches and 601 million unique visitors during FY2015. MEDLINE launched with only 22 users and registered 70,000 searches its first year, and the 490,000 citations it held in 1972 pale in comparison to the nearly 23 million included at the end of 2015. What heights will these numbers reach by MEDLINE's 50th anniversary? Check back in 2021.

MedlinePlus Reaches 1,000th Health Topic

With the addition of "eye health" and "tonsillitis," MedlinePlus.gov, NLM's website for patients, families, and consumers, reached 1,000 health topics. The site provides reliable, up-to-date health information on conditions, symptoms, diseases, and medications. Each health topic page provides a description of a condition or issue and directs users to vetted information from NIH and other trusted sources. All content is regularly reviewed and meets strict quality guidelines.

Those high standards have paid off. Every 24 hours, 1 million people turn to MedlinePlus.gov or its sister site, MedlinePlus.gov *en español*. The site launched with just 22 health topics in 1998.



NCBI's MutaGene Helps Reveal Cancer's Mutational Profiles

NCBI researchers have developed a freely available resource, called MutaGene, that helps scientists understand what brings about certain genetic mutations. And since cancer commonly arises from such mutations, the ability to understand the underlying process of mutation has potentially far-reaching consequences in our fight against this common and often deadly disease.

The word “cancer,” however, suggests a single disease we are battling, when, in fact, it is a multitude. Not only do cancers differ by where they originate (lung cancer vs. ovarian cancer, for example), but researchers now know that within a broad cancer type, there can be many variations or subtypes, depending on the specific genetic mutation(s) underlying each. Scientists have also discovered that certain mutations can appear across cancer types, which only adds to cancer’s complexity.

Collectively, the unique genetic characteristics of each cancer create its mutational profile. Mutational profiles are almost like fingerprints, reflecting distinctive patterns of normal and mutated DNA that can identify what type of cancer it is, the primary tumor site, and what likely caused the mutation. There is a particular mutational profile consistent with tobacco exposure, for example.

Knowing what factors contributed to a cancer patient’s somatic mutations—those mutations that accumulate in the body’s cells, as opposed to

Now a proven tool, MutaGene opens a new dimension for researchers as they try to understand cancer as a genetic disease.

those one is born with—can be crucial for identifying the correct cancer treatment and determining the patient’s prognosis.

It’s here that MutaGene flexes its muscle.

Once scientists identify a patient’s specific mutations—a step accomplished by comparing the DNA sequences of a patient’s tumor cells with the sequences of their normal cells—they can use MutaGene to calculate the tumor’s mutational profile. Then, still within MutaGene, they can analyze that profile, breaking it down into known “signatures” (unique combinations of mutation types) that, in turn, can identify the most likely mutational process behind it.

Drawn from more than 9,000 genomes and exomes, MutaGene currently includes the mutational profiles for 37 cancer types and their underlying signatures, but the resource is expected to grow.

The mutational profiles MutaGene elucidates are coming to light thanks to the wealth of cancer genomics data collected by The Cancer Genome Atlas project and the International Cancer Genome Consortium. By using computational methods within these large genomic datasets, researchers have been able to identify mutational processes that operate in a given tumor or patient and find potential driving events in cancer.

While MutaGene was released this year, the project itself began in 2015 as a prospective study

designed to evaluate the diagnostic and clinical potential of context-dependent mutational profiles derived from cancer samples. As part of that evaluation, researchers at NIH's National Cancer Institute and at Florida State University successfully applied MutaGene to studies of skin cancer (basal cell carcinoma), brain cancer (medulloblastoma), and lung cancer (pulmonary adenocarcinoma).

Now a proven tool, MutaGene opens a new dimension for researchers as they try to understand cancer as a genetic disease and look to translate that understanding into effective diagnostic tools and treatments. ■




Laying the Groundwork for Data-Powered Health

The ability to manage and make sense of one's personal health information is a vital part of being and staying healthy. Today, thanks to advancing technology, smartphones, apps, wearable devices, and computer networks can work together to identify developing health issues and put people on a healthier path before early symptoms develop into something more. Mobile health devices are also changing the way doctors and patients connect, how biometric and other data get captured and transmitted, and how patients, caregivers, and medical providers make health care decisions.

Against this technological and cultural backdrop—and with an eye toward a future of

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data-powered health—NLM's Extramural Programs Division launched a new data science research grant program this year. Titled "Personal Health Libraries for Consumers and Patients," this funding initiative was designed to stimulate research and development into open source tools that patients, caregivers, and others can use to gather, manage, share, and use personal health information.

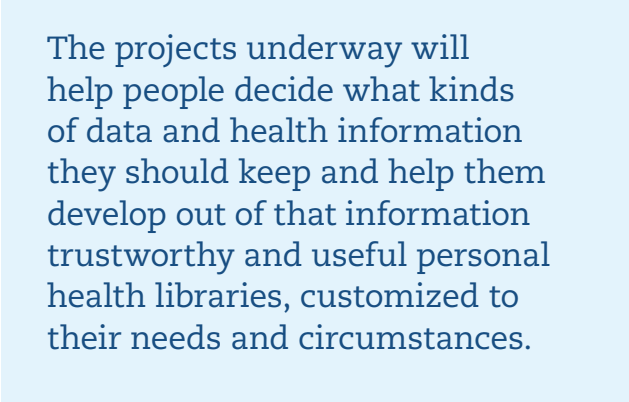


Such tools could also enhance dialogue between patients and clinicians, particularly patients with chronic conditions such as diabetes and arthritis.


Under this broad data science research initiative, NLM funded three projects for a total of \$1.1 million. These projects target diverse user groups—from older adults and their caregivers to people managing multiple chronic conditions to youth emancipated from foster care—and seek to bring the benefits of data research to consumers and patients. The projects underway will help people decide what kinds of data and health information they should keep and help them develop out of that information trustworthy and useful personal health libraries, customized to their needs and circumstances.

Elsewhere in the biomedical research arena, NLM continued backing projects to strengthen data management processes and to fund training to help build a workforce capable of handling the expected data-driven future. These foundational investments include the following:

- five new data science awards, including three focused on the digital curation of biomedical research data (\$4.9 million from NIH Common Fund)
- nine administrative supplements for the broad-based involvement of the National Network of Libraries of Medicine in the NIH *All of Us* Research Program (\$4.4 million)
- curriculum and faculty development projects in data science at 14 of NLM's training program locations (\$1.3 million)
- 16 five-year grants for university-based training in biomedical informatics and data science




The projects underway will help people decide what kinds of data and health information they should keep and help them develop out of that information trustworthy and useful personal health libraries, customized to their needs and circumstances.



In the latter case, more than 170 pre- and post-doctoral positions are supported through these training centers, with emphasis in one or more of the following areas: health care or clinical informatics, translational bioinformatics, clinical research informatics, and/or public health informatics (which includes environmental exposure informatics).

Together, these consumer-level and research-oriented investments are expected to help researchers, clinicians, and patients themselves make sense of the vast stores of biometric, genetic, behavioral, and environmental data that contribute to health and disease. Together, these investments will help usher in a future of data-powered health. ■



Publishers Embrace DIY for Citation Corrections

Given all the time, thought, and effort that go into getting his or her research published, the last thing an author wants to see is an error in the citation to that research. After all, those few elements—name, affiliation, article title, date of publication, journal title—all serve as crucial pointers to work that has, in many cases, taken years to complete and has the potential to change minds or save lives. But an error in just one of those elements can render that research unfindable—or at least hidden. And even at its most innocuous, such an error irritates and offends. After all, what can be simpler than getting a name and title correct?

But even the simplest things are prone to error, especially in a high-volume database like PubMed. In fact, one of the most common requests the PubMed team gets concerns misspellings in authors' names. NLM customer services staff estimate that 45% of the quality control requests received this year were to correct such mistakes.

But those errors are not NLM's to correct. They originate with the journal publishers and are digitally transferred to PubMed during the citation download process.

This year, with the release of the PubMed Data Management System (PMDM), publishers can quickly and directly correct errors to nearly all elements of their citations.

In the past, articles had to clear NLM indexing before staff could manually correct citation errors—a process that, combined, could take months—but this year, with the release of the PubMed Data Management System (PMDM), publishers can quickly and directly correct errors to nearly all elements of their citations. PubMed then reflects those changes within a day or two of their submission via the PMDM.

The new system has been exceedingly well-received.

Within a few months of PMDM's launch, more than 90% of publishers working with PubMed were actively using it. And the NLM staff who previously fixed citation errors were freed to focus on indexing, yielding a welcome boost to production and efficiency.

So, what do you do if you're an author who has found a mistake in a PubMed citation?

Contact the publisher, providing key details about the citation (including PMID) and what needs to be corrected. The publisher, working with PMDM, will take it from there.

It couldn't be simpler. ■



Library Responds to the Opioid Crisis

The opioid epidemic is happening in all regions of the country, in communities of all sizes, and without discrimination for age, ethnicity, or income. It is ending lives, destroying families, and turning public librarians into first responders.

More than 2 million people in the US are estimated to be dependent on prescription opioids or heroin, but the true impact of that dependency is staggering, involving countless others, including families, friends, employers, and health professionals. According to the CDC, the economic burden of prescription opioid abuse alone is \$78.5 billion a year in the US, tallying health care costs, lost productivity, addiction treatment, and the toll on the criminal justice system.

The cost in lives is also growing steadily. Drug overdose is now the leading cause of death among people under age 50, and overdoses involving opioids killed more than 42,000 people in 2016.

In response, NLM is developing tools to educate and support those on the front lines in this epidemic.

This year NLM developed an online portal on opiate addiction and treatment to provide easy access to reliable information from key NLM resources like PubMed and MedlinePlus, as well as from relevant organizations, such as the National Institute on Drug Abuse (NIDA), the Substance Abuse and Mental Health Services Administration, and the CDC. Targeted to the public, health

Drug overdose is now the leading cause of death among people under age 50, and overdoses involving opioids killed more than 42,000 people in 2016.

professionals, and first responders, the portal provides links to resources about:

- Understanding addiction
- Opioid overdose
- Opioid drugs
- Medications to treat opioid addiction
- Opioid prescribing
- Pregnancy, opioid use, and neonatal abstinence syndrome
- Recovery

NLM staff also joined the National Network of Libraries of Medicine (NNLM) in helping HHS determine the best consumer information to include on its opioids resource page, while the NLM HealthReach team produced 22 easy-to-read, English-language handouts, videos, and audio recordings to teach people about opioids and opioid misuse.

In an effort to more actively engage with citizens, NLM partnered with NIH, NIDA, the National Institute of Neurological Disorders and Stroke, and the American Society for Addiction Medicine to co-host a Twitter chat on opioid stigma (#OpioidAwareChat) during National Recovery Month in September. Our partners in the National Network of Libraries of Medicine, New England

Region, launched a four-part webinar series on substance use disorders in August. And NLM staff worked with NIH to lay the groundwork for an opioid symposium and code-a-thon challenge to be held early in FY2018. These joint events will apply data and technology to the tasks of uncovering issues and identifying solutions to the opioid epidemic.

NLM's work behind-the-scenes is also supporting the assessment of those at risk for or experiencing substance abuse disorders.


Staff augmented RxNorm, NLM's system of normalized names for clinical drugs, with codes for identifying Abuse-Deterrent (AD) drug products in electronic health records (EHR) and claims data. These changes make it easier to identify and track AD and non-AD opioid drug products—along with AD alternatives—within EHR and

other prescription systems.

In collaboration with the Centers for Medicare & Medicaid Services, NLM added 63 value sets related to opioids to the Value Set Authority Center. These additions included value sets for medications containing opioids and conditions associated with opioids, making it easier for EHR users to identify, for example, patients who have been prescribed opioid products and/or those treated for opioid-related conditions.

These enhancements, coupled with the Common Data Elements repository and observational datasets such as the Medicare Virtual Research Data Center (VRDC), have helped NLM scientists—in collaboration with NIDA—uncover ways to use the scientific literature and data to help better understand substance abuse patterns and address the opioid crisis. For example, NLM staff calculated the prescription frequencies of AD opioids, all opioids, and all drugs using the Medicare VRDC dataset, which contains information on 1 billion prescriptions for 4.8 million beneficiaries during the period 2006-2014. Analyzing a 10% random cohort, the researchers found a steady increase from 20 to 30 opioid prescriptions per 1,000 prescriptions between 2006 and 2012, demonstrating a potential factor contributing to the rising epidemic.

These findings, along with other research going on across NLM and NIH, are expected to help identify ways to address the opioid crisis and find better ways to manage pain. ■



Analyzing a 10% random cohort, the researchers found a steady increase from 20 to 30 opioid prescriptions per 1,000 prescriptions between 2006 and 2012, demonstrating a potential factor contributing to the rising epidemic.



NLM Supports People in Hurricanes' Paths

The unprecedented 2017 hurricane season wreaked havoc in the United States and challenged NLM's provision of disaster information.

Three Category 4 hurricanes—Harvey, Irma, and Maria—hit between August 25 and September 20, taking hundreds of lives, leaving hundreds of thousands homeless or displaced, disrupting key services, and causing billions of dollars of damage across Texas, Florida, Puerto Rico, and the US Virgin Islands.

NLM, together with its National Network of Libraries of Medicine (NNLM), responded by ensuring timely access to critical health information for health care providers, academic health science libraries, and the public.

The NNLM focused on ensuring that patients, families, and the public had access to needed health information wherever they were—whether in evacuation shelters, community centers, or branch libraries. By working with library associations and state libraries, they helped maintain library services, sometimes in temporary locations, and fulfilled critical interlibrary loan requests when local libraries had to close in the face of the storms.

Back in Bethesda, staff focused on providing quick access to NLM's resources for public health professionals, emergency responders, and health care facilities. The Library's Disaster Information Management Research Center (DIMRC) developed a webpage of hurricane-related health information resources, including sites that addressed hurricane-specific health considerations, hazardous materials

management, and health information in Spanish. At the CDC's request, NLM also activated the Emergency Access Initiative to serve responders from the US Public Health Service who were working in the affected regions and were otherwise unable to access key medical literature. An as-needed collaboration between NLM and publishers, the Emergency Access Initiative provides temporary free access to major biomedical books, journals, and databases for those affected by disaster.

The Library's role did not end with the rain, however.

Within weeks of Hurricane Harvey, DIMRC collaborated with the National Institute of Environmental Health Sciences to support scientific research into the medical and public health aspects of the disaster. As part of the NIH Disaster Research Response (DR2) program, researchers in Texas implemented data collection protocols from the NLM-managed DR2 website to track the health of responders and recovery workers in affected areas. By using those existing protocols, researchers saved precious time in the days and weeks following the disaster, when critical information evaporates quickly as flood waters recede and health issues shift. Their findings are expected to shine a light on hurricane-related health issues and improve our response to disasters.

In doing their part, conservators in the Library's History of Medicine Division provided technical assistance to those libraries struggling to salvage their paper-based collections damaged by the three storms, important and painstaking work that will continue into the coming year. ■



New ClinicalTrials.gov Policies Boost Transparency

Clinical trials are the most publicly visible aspect of the clinical research enterprise, translating laboratory findings into clinical care.

NIH-funded clinical trials consistently advance the diagnosis, treatment, and prevention of diseases, but opportunities exist to enhance the efficiency, accountability, and transparency in clinical trial research.

With an eye toward those opportunities for improvement, HHS and NIH implemented policies this year that will help provide to the public more information about clinical trials via the ClinicalTrials.gov website, which NLM manages. That additional information includes both details about the clinical trials themselves and the results of those trials, including adverse events.

In late FY2016, after significant study and public input, HHS issued the final rule on “Clinical Trials Registration and Results Information Submission,” and NIH issued a complementary policy on the “Dissemination of NIH-Funded Clinical Trial Information.” Both policies went into effect in January 2017.

The new policies require qualifying studies to register with ClinicalTrials.gov within 21 days of enrolling their first trial participants. This expanded trial registration improves people’s ability to find clinical trials in which they may be able to participate and to access investigational therapies.

The policies also dictate these studies share their summary results, regardless of outcomes, a requirement that has the potential to change the research landscape.

Traditionally, researchers have made clinical trials results available only via journal articles, but that approach has left the results of a huge percentage of medical research studies unknown or only partially reported. Researchers reluctant to publicize the ineffectiveness of their proposed clinical interventions have kept those results under wraps, or—even when they do publish—have sometimes omitted information that doesn’t fit the desired narrative, such as certain side effects.

But information about those failures—as with successes—is critical to advance scientific research and to prevent others from spending limited resources pursuing those same ideas. Sharing the full results of clinical trials also honors their participants, who chose to take part hoping to advance our knowledge of what works and what doesn’t.

The HHS and NIH enhancements to the stewardship and transparency of clinical trials are expected to impact people at every stage of the research enterprise, from investigators looking to initiate human studies to organizations and institutions who fund or oversee research to patients and their health care providers exploring treatment options. The policies also promise a better return on the research investment by avoiding unnecessary study duplication, highlighting areas in need of study, and helping to improve study design.

To encourage compliance, the new regulations come with stricter penalties. Failure to comply can result in civil and criminal fines and other penalties for all parties responsible for the clinical trial, from the investigators to their parent organizations. ■

NLM Shapes Standards for Codes in Lab Test Industry

The Lister Hill National Center for Biomedical Communications (LHC) continues to shape and implement clinical message and vocabulary standards and to advocate for their use. The long-term goal is to have all clinical data available in a standard, widely-accepted format.

This year, LHC moved closer to that goal by helping develop a standard format for mapping internal laboratory instrument codes to the appropriate LOINC code(s). LOINC refers to Logical Observation Identifiers Names and Codes. LHC worked with the CDC, FDA, and laboratory equipment vendors to establish and coordinate the use of this standard, known as the LIVD specification. Published in June 2017 by the IVD Industry Connectivity Consortium, the LIVD specification has already been adopted by all the large manufacturers of in vitro diagnostics (IVD).

By referencing the LIVD mappings, laboratories will know which LOINC codes to use for each test their instruments run. Investigators can then pool laboratory results from those tests, either by patient or by test across different laboratories.

Instituting such standards can have positive ripple effects across health care and biomedical research.

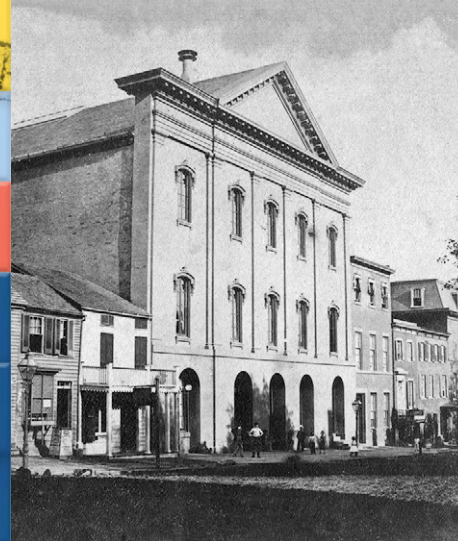
As these standards become universal, they will enable people to automatically gather data from their many care sources into their own personal health record as easily as they import bank statements into budgeting software.

Vocabulary standards allow researchers to aggregate electronic health records, enabling major initiatives such as the NIH *All of Us* program and Sync for Science to gather needed data from those records. Such data, in turn, are the grist for many large national research projects, including the Cancer Moon Shot, Patient Centered Outcome Research, and the FDA's post-marketing surveillance.

But the role of standards can also be felt closer to home. As these standards become universal, they will enable people to automatically gather data from their many care sources into their own personal health record as easily as they import bank statements into budgeting software. Having such information at hand will help people better monitor their health and participate in their own care. ■



Newly Published Work Illustrates NLM's History



The images...bring to light people and places, documents and events, and the ever-evolving technologies that have been a part of the Library's existence for nearly two centuries.

Many individuals—including world-renowned heart surgeon Dr. Michael E. DeBakey and former NLM Directors Drs. Frank Rogers and Donald A.B. Lindberg—have celebrated NLM's growth into the world's largest biomedical library from its humble beginnings as a shelf of books in the Office of the US Army Surgeon General. In fact, Wyndham D. Miles' sweeping 1982 work, *A History of the National Library of Medicine: The Nation's Treasury of Medical Knowledge*, traced nearly 150 years of that history.

But where those physicians, historians, and scholars relied upon words—in Miles' case, nearly 500 pages of them (sans appendices)—the latest look back delivers over 170 images that document the broad history of this storied institution.

Images of America: US National Library of Medicine, co-edited by Jeffrey S. Reznick, PhD, and Kenneth M. Koyle, both of the Library's History of Medicine Division (HMD), covers NLM's development from its early years through its many locations and leaders to Dr. Patricia Flatley Brennan's swearing in and an inspiring glimpse forward into the Library's third century. The book reveals the work of generations of visionary leaders and dedicated individuals who shaped this Library and its services through the course of the American Civil War, the world wars, the Cold War, and the dawn of the Information Age. The images, drawn from NLM's own rich collections, bring to light people and places, documents and events, and the ever-evolving technologies that have been a part of the Library's existence for nearly two centuries.

Issued on June 26, 2017 as part of Arcadia Publishing's *Images of America* series, this new illustrated history speaks to a general audience, delivering vintage photos with detailed captions. While a hardback version of the book is available for purchase, the complete book and original versions of all photos are freely available through the NLM Digital Collections.

To mark the book's release, the Library hosted a public symposium in mid-July that featured remarks by the co-editors, Dr. Brennan, and HMD staff members Drs. Stephen J. Greenberg and Susan L. Speaker. The global videocast of the proceedings was archived and is available for viewing. In addition, to help raise public awareness of the book, HMD's blog, *Circulating Now*, serialized the entire work over nine days in July and August.

Together, the book and these events showcase the notable, mundane, and sometimes surprising moments and movements in NLM's evolution from a small collection of medical texts to a leader in medical information innovation. It's a journey worth reviewing, one that portends great things for the future of medicine and medical information. ■



NLM Launches DeBakey Fellowship

Early in 2016, the National Library of Medicine received a generous gift from the DeBakey Medical Foundation to support enhanced access to the Michael E. DeBakey Archives and to establish the Michael E. DeBakey Fellowship in the History of Medicine.

A legendary American surgeon, educator, and medical statesman, Michael E. DeBakey, MD (1908-2008) led an exemplary 75-year career. His work transformed cardiovascular surgery, raised medical education standards, and informed national health care policy. He pioneered dozens of cardiovascular operations, such as aneurysm repair and coronary bypass, and his inventions—such as the artificial heart and ventricular assist pumps—continue to save lives. He was also a driving force in building Houston's Baylor College of Medicine into a premier medical center, where he trained several generations of top surgeons from all over the world.

The Michael E. DeBakey Archives, which are held by NLM's History of Medicine Division, reflect a range of subjects from DeBakey's professional career, including surgery, medical technology, military medicine, health care policy, medical ethics, and medical libraries. The types of materials held in the archives reflect his life, achievements, and interests, from awards and audiovisual materials to correspondence, diaries, photographs, speeches, and more.

The five inaugural Michael E. DeBakey Fellows, who conducted their research onsite using these materials, were:

His work transformed cardiovascular surgery, raised medical education standards, and informed national health care policy.

Justin Barr, MD, PhD
General Surgery Resident
Duke University Medical Center
Research project: *Michael E. DeBakey and his Seminal Role in the Creation, Adoption, and Application of Arterial Repair*

Kurt Dasse, PhD
President & CEO
GeNO, LLC
Research project: *Inside the Creative Mind of Dr. Michael E. DeBakey and His Everlasting Impact on Medical Technology*

Craig A. Miller, MD
Scholar-in-Residence
Medical Cultural Heritage Center
The Ohio State University
Research project: *A Comprehensive Biography of Michael E. DeBakey*

Heidi Morefield, MSc
Doctoral student
Department of the History of Medicine
Johns Hopkins University
Research project: *Making Technology Appropriate: Health, Development, and Modernization in the Global Cold War*

Andrew Simpson, PhD
Assistant Professor of History
Department of History
Duquesne University
Research project: *Making the Medical Metropolis: Health Care and the Post-Industrial Transformation of Pittsburgh and Houston*

The DeBakey Fellows also shared their expertise with NLM staff to improve the Library's knowledge of the DeBakey collection and contributed posts about their research to *Circulating Now*, the blog of the NLM's History of Medicine Division.

Thanks to another generous gift by the Michael E. DeBakey Medical Foundation, NLM held this year the first annual Michael E. DeBakey Lecture in the History of Medicine. Shelley McKellar, PhD, from Western University in Ontario, Canada, offered

a presentation titled "'Intentional Impact:' The Legacy of Michael E. DeBakey Beyond the Operating Room." She was joined by George P. Noon, MD, from Baylor College of Medicine, who spoke about DeBakey's role in establishing the current National Library of Medicine. Both talks were live-streamed globally and archived for future viewing by NIH Videocast. ■



Around the Horn with NLM Training

An Insider's Guide to Accessing NLM Data

It is often said, "Ask, and you shall receive."

This year, that adage proved true for PubMed users looking to obtain customizable views or particular data sets from within the popular research database.

These advanced users independently submitted questions to NLM around a common theme: "I want *this kind of data* from PubMed in *this format*." Such data was there, they knew, but not through the standard search interface.

That gap between access and knowledge prompted NLM staff to step into the breach and develop a course for those who needed more than the standard search could deliver.

Called "Insider's Guide to Accessing NLM Data," this innovative educational program taught

attendees what was possible and how to make it happen. Two web-based classes, supplemented by training documents and a website, guided the students from the basic concepts to hands-on work extracting data from PubMed.

The initial class, "Welcome to E-utilities for PubMed," introduced the topic of E-utilities and APIs (application programming interfaces), walking users through the principles and acquainting them with Entrez Direct (EDirect), the E-utilities API for the Unix environment. This introduction had the goal of helping attendees generate and sustain interest and confidence in extracting PubMed data and preparing them for the hands-on work to come.

That work came via the second class, a three-part workshop called "EDirect for PubMed." These

sessions took attendees deeper into the syntax and strategies for extracting customized results, helping them control what fields to search, the specific data elements retrieved, the format of the data retrieved, and how results are shared. Exercises prepared them for working on their own after the course.

By all measures, the course was a success.

NLM offered the two classes twice this year to a combined 639 students who wrestled with the concepts, learned the tools, and asked thoughtful questions. A sizable majority of attendees rated the experience positively, with one even describing the course as “life-changing.”

But the classes did more than change that one life. They also changed the nature of the questions from this advanced cohort, who are now asking how to extract data from PMC and from GenBank—pushing the envelope even further for NLM staff and instructors.

And NLM staff are responding, building the technical knowledge and skills necessary to deliver what users are asking for.

As a result, the coming year promises more classes, more NLM users putting these sophisticated tools to work, and more insights from the rich resources NLM provides. ■

Well over 90% of those who attend our classes and webinars indicate they’ve learned at least one new skill they intend to use in the future.

ToxTutor

NLM Specialized Information Services has made it easier to learn the basic principles of toxicology. ToxTutor, a self-paced tutorial delivered in plain language with plenty of helpful illustrations, was updated and expanded this year. The original topics regarding doses, toxic effects, interactions, toxicity testing methods, risk assessment, and exposure guidelines remain, but the tutorial now includes sections on basic physiology, toxicokinetics, absorption, distribution, biotransformation, excretion, and cellular toxicology.


Original animations supplement the content, including “From a Gel to a Cell,” which follows the journey of a chemical ingredient in a shower gel through several bodily membranes and into a cell. *Did you know?* boxes reveal noteworthy events in the history of toxicology, and the tutorial’s glossary covers over 300 toxicology-related terms.

The tutorial, which takes about three hours to complete, will help those who take it better understand the content within TOXNET, NLM’s chemical and toxicology databases.

PubMed Quick Tours

With the assistance of the National Network of Libraries of Medicine (NNLM) PubMed Training Working Group, staff re-wrote 11 PubMed Quick Tours, making them more interactive. Rather than a short video with a quiz at the end, the new tutorials require users to perform the tasks they are learning, with the interface providing immediate feedback.

“Unbelievably thorough presentation of PubMed – so many things I was unaware of. Looking forward to passing this along to my doctoral students!”



Every 24 hours, one million people turn to MedlinePlus.gov or its sister site, MedlinePlus.gov en Español.

Thirty-five students completed the Disaster Information Specialist courses this year.

Disaster Information Specialist Certificate Program

One of the core competencies in disaster health is to be able to “communicate effectively with others in a disaster or public health emergency, including identifying authoritative sources for information and strategies for appropriate sharing of that information.” To help librarians gain those skills, the Disaster Information Management Research Center (DIMRC), together with the Medical Library Association (MLA), offers the Disaster Information Specialist Certificate Program, comprised of a series of continuing education courses and other activities at both basic and advanced levels.

This year, DIMRC updated and enhanced this program, shifting from live webinars (with archived recordings) to self-paced, online courses. Along the way, all course material was reviewed and refreshed, and its layout converted to responsive design. In addition, staff developed a new course addressing chemical, biological, radiological, nuclear, and explosives-related health information resources. Another course on social media analysis during disasters is in development.

Thirty-five students completed the Disaster Information Specialist courses this year, bringing to 428 the total number of people who have earned the Disaster Information Specialist certificate.

Biomedical Informatics Course Retired

After 24 years the NLM Biomedical Informatics course was retired this year. Over the course's two-plus decades, NLM and its partners introduced more than 1,600 participants to biomedical informatics.

First hosted by the Marine Biological Laboratory in Woods Hole, Massachusetts, the immersive, one-week course moved to Young Harris, Georgia, in 2014, where it was hosted by the faculty and staff of Augusta University through Fall 2017.

Over the coming year NLM will be shaping a successor to the course, one that will take into account NLM's singular strengths and goals, and that will integrate the needs of the biomedical library and informatics communities.

By the Numbers: Selected NLM Training

IN PERSON NLM TRAINING

Course or Conference	Participants	Subject
American Association of Nurse Anesthetists	500	Genetics/Genomics & PubMed
Five two-day modular NCBI Workshops at several major universities and the FDA National Center for Toxicology Research	414	Datasets
United States Conference on AIDS	93	HIV/AIDS
Human Genomic and Genetic Researchers at the American Society for Human Genetics	55	Genome Data Viewer
National Environmental Health Association	39	Toxicology/Environmental Health
Jackson State University	27	Toxicology/Environmental Health
Student National Medical Association	19	Medical Health
National Black Nurses Association	19	Medical Health
National Medical Association	18	Medical Health
National Conference on Health Disparities	14	Medical Health
NCBI Hackathons (9)		Data Science

ONLINE NLM TRAINING

Course or Conference	Participants	Subject
27 short, focused webinars on NLM/NCBI products	1,100	NCBI
Disaster Information Specialist (6 courses combined)	393	Disaster Health Information
ToxTutor	286	Toxicology
PubMed for Clinicians	240	PubMed
Advanced PubMed: Medical Subject Headings	110	PubMed
2017 MeSH Highlights	86	MeSH
HIV/AIDS Information Resources from the National Library of Medicine	13	HIV/AIDS
Bioinformatics for Librarians	286	Bioinformatics

RECORDED/ONLINE NLM TUTORIALS

Course or Conference	Participants	Subject
PubMed Tutorial	120,000	PubMed
Quick Tour video tutorials of NLM products	67,000	NLM
ToxTutor	34,725	Toxicology
27 short, focused webinars on NLM/NCBI products	26,240	NCBI
Basics of Medical Subject Headings (MeSH) in MEDLINE/PubMed	18,000	MeSH
UMLS	8,000	UMLS



New Happenings Online

ONESearch

In December 2016, the National Information Center on Health Services Research and Health Care Technology (NICHSR) released NICHSR ONESearch, a search engine that allows researchers to mine the valuable and varied health services and public health research information NLM holds. The single search point has the potential to save valuable research time and to bubble up content that might otherwise have gone unnoticed.

The consolidated resource offers a single interface to NICHSR's four key products: its two databases—Health Services Research Projects in Progress (HSRProj), which collects information about ongoing health services research and public health projects, and Health Services and Sciences Research Resources (HSRR), which holds datasets, instruments, and software for health services research and public health research—and its two web portals—Health Services Research Information Central (HSRIC), which links to high-quality news, data, tools, methods, and grey literature for the health services research community, and Partners in Information Access for the Public Health Workforce (PHPartners), which provides access to selected public health resources.

Search results specify where each item came from among the four sources and how many total results reside in each source, allowing users to home in on the right resource for their needs. ■

ClinicalTrials.gov

NLM redesigned the ClinicalTrials.gov website based on stakeholder feedback to both the original website and proposed features.

Changes focused on improving the ability to search, display, and review information about the clinical research studies registered with the site. The new design added two optional fields to the primary search—one focused on the condition or disease of interest, the other on the country in which the studies are or were conducted—and the search results page now offers new ways to manage and refine those results. The redesign also improved overall site organization, provided more information about what the database is and is not, and adjusted how pages are displayed across devices. ■

Changes focused on improving the ability to search, display, and review information about the clinical research studies registered with the site.



2017

Divisional Reports



Office of the Director



Patricia Flatley Brennan, RN, PhD
Director

Jerry Sheehan
Deputy Director

The Office of the Director provides policy guidance, program development and evaluation, and overall operational and administrative coordination for NLM. It is the focal point of the Library's relationships with the NIH director, the HHS Office of the Secretary, other HHS and government agencies, Congress, professional societies, health agencies, and other public groups. The Office of the Director also coordinates liaison and collaborative activities with professional societies, health advocacy groups, private industries, and state and local governments.

On November 14, 2016, NLM Director Patricia Flatley Brennan, RN, PhD, launched her blog, *Musings from the Mezzanine*, the first for an NLM director. She published every Tuesday afternoon, touching on subjects from data science to citizen science, from civil rights history to One NLM, from employee engagement to management issues. Her posts shared some of her ideas regarding NLM's future, gave readers a glimpse into her thinking, and touched on matters both personal and professional—from her admiration for retiring Deputy Director Betsy Humphreys to the essential role NLM must play in managing biomedical data.

But Dr. Brennan was not alone in sharing her ideas. Sixteen of the 46 posts published this year came from guest authors, most from across NLM but a few from notable outsiders, including Vint Cerf, who is considered one of the “fathers of the internet,” and Lincoln Weed, co-author (with his late father, Dr. Lawrence Weed) of the book *Medicine in Denial*.

The blog logged nearly 69,000 views in its inaugural year and offered readers a chance to engage with the NLM Director in a way not previously available.

Office of Health Information Programs Development

The Office of Health Information Programs Development (OHIPD) is responsible for four major functions:

- establishing, planning, and implementing the NLM Long Range Plan and related program planning, analysis, and evaluation activities;
- coordinating, conducting, and supporting outreach and consumer health programs to improve access to NLM information services by all, including minority, rural, and other underserved populations;
- planning, conducting, and evaluating NLM's international programs; and
- contributing to trans-NIH data science initiatives.

Beginning in Fall 2016, OHIPD led NLM's 10-year strategic planning process. OHIPD staff worked closely and fruitfully with members of the Strategic Planning Subcommittee of the Board of Regents over the course of the year to guide the planning process. As part of that process, OHIPD engaged many diverse stakeholders using a request for information (RFI), staff suggestion boxes, two NLM-wide town halls, five expert panels, and an internal strategic planning committee with NLM leadership.

OHIPD received and analyzed more than 100 responses to the RFI coming from scientists, librarians, clinicians, publishers, editors, and the public, as well as more than 100 responses from NLM staff through online and hard copy suggestion boxes. The staff suggestions were supplemented by two NLM town halls, with nearly 500 NLM staff participating in each. The town halls provided updates on the strategic planning process and gave staff the opportunity to ask questions and comment on NLM's future direction.

The five expert panels of about 20 people each focused on NLM's future roles in data science, discovery and translation, the public's health, and collections, and on strategic directions from an NLM perspective. These two-day workshops on the substance and process of the future of NLM produced voluminous content and comment, which OHIPD—in conjunction with NLM staff and members of the expert panels—shaped into reports that provided background information to the issues, NLM context, key findings, and panel recommendations.

In the fall of 2016, as the role of NLM in trans-NIH data science activities was increasing, the Data Science Coordinating Unit (DSCU) was formed within OHIPD to support communication, collaboration, and coordination of data science activities in the areas of strategic engagement, workforce excellence, and best practices.

As one of their first activities, DSCU staff prepared a report that looked at data science training at NIH, charting both extramural and intramural activities from 2014 to 2017.

DSCU staff also coordinated the Open Science Prize, with input from NIH staff across nearly all the NIH Institutes and Centers. The Open Science Prize promotes the development of innovative solutions that unleash the power of open content

and data to advance biomedical research and its application to health. This international competition was developed and carried out collaboratively by NIH, the Wellcome Trust (United Kingdom), and the Howard Hughes Medical Institute. The Real-Time Evolutionary Tracking for Pathogen Surveillance and Epidemiological Investigation team won the grand prize, taking home \$230,000 for Nextstrain, a prototype designed to facilitate the open sharing of viral genomic data and to harness this data to make epidemiologically actionable inferences.

OHIPD and DSCU staff co-authored several papers:

- Zhang X, Pérez-Stable EJ, Bourne PE, Peprah E, Duru OK, Breen N, Berrigan D, Wood F, Jackson JS, Wong DWS, Denny J. "Big Data Science: Opportunities and Challenges to Address Minority Health and Health Disparities in the 21st Century." *Ethnic Disparities*, 2017 Apr 20; 27(2): 95–106.
- Bradley PV, Hall LJ, Hannigan GG, Wood FB. "Native Voices: Native Peoples' Concepts of Health and Illness in New Mexico: Opening a Local Conversation by Hosting a National Traveling Exhibit." *Journal of the Medical Library Association*, 2017 Jul; 105(3): 243–248.
- Kitzrie E, Atienza AA, Kiley R, Carr D, MacFarlane A, Pai V, Couch J, Bajkowski J, Mietchen D, Bourne PE. "Developing International Open Science Collaborations: Funder Reflections on the Open Science Prize." *PLoS Biology*, 2017 Aug 1; 15(8): e2002617.

OHIPD led the NLM Evaluation task force, which comprehensively reviewed the tools and approaches used to evaluate NLM's public-facing electronic resources, with the goal of improving information dissemination and its uptake by users.

The task force pulled together expert staff from across NLM to:

- inventory the tools and approaches currently in use;
- identify other tools and approaches that would be desirable to use;
- develop recommendations for future directions; and
- develop implementation plans for those recommendations.

Office of Communications and Public Liaison

The Office of Communications & Public Liaison (OCPL) is a point of contact for a variety of information about NLM programs—in written, electronic, and graphic forms. OCPL staff answer requests for information about NLM, create brochures and fact sheets, manage printing procurements, coordinate publicity for NLM events, and give tours.

The Library's blog, *NLM in Focus*, started a question-and-answer column to highlight NCBI scientists and began posting profiles of individual scientists, one of which also ran in the *NIH Catalyst*. The blog celebrated milestones including MedlinePlus' 1,000th health topic and DOCLINE's 40 millionth request. In response to the NLM Director writing about rock star librarians in her blog, *Musings from the Mezzanine*, *NLM in Focus* featured rock star medical librarians from all over the country. *NLM in Focus* also ran two week-long series, one on reference librarians at NLM and one

on the medical artists in the Lister Hill National Center for Biomedical Communications. The blog's 74 posts this fiscal year attracted 30,964 visitors and generated 82,920 views.

The NLM Tour Office saw the number of special tours (i.e., tours offered to individuals and groups upon request) double from FY2016 to FY2017. In addition, the number of visitors to NLM increased 72% over FY2016 (from 1,824 to 3,131), with international visitors coming from 82 countries. (See Table 11, page 38, for complete tour statistics.)

Office of Administration

The Office of Administration plans and directs administrative management functions of the Library including financial management, personnel management, acquisitions management, administrative services, management analysis, and ethics. The Office also advises the NLM Director and the Divisions on developments in administrative management and their implications, and develops Institute-wide policies and procedures on administrative matters.

The NLM Office of Acquisitions (OA) created two new systems to improve acquisitions processes. The first, a contracts management system called MERLIN, enables OA to track all contracts, funding, and contract actions in a single location. The system also minimizes redundant data entry in other IC and enterprise systems and includes a number of other helpful features, such as a library of electronic contracts; a solicitation collaboration workspace; a streamlined workflow for invoice review and approval; and a deliverables portal for data input and storage. The second system,

created jointly with the NLM Office of Computer and Communications Systems (OCCS), enhances the process for obtaining contract clearances in accordance with Federal Information Technology Acquisition Reform Act (FITARA) and HHS policy. In addition, the system improves collaboration between the OA, OCCS, and NLM program offices; streamlines the review and approval of Acquisition Strategy and FITARA documents; tracks the dollars associated with each document, thereby ensuring compliance with thresholds; and serves as a repository of approved clearances.

FINANCIAL RESOURCES AND ALLOCATIONS, FY2017

Program Area	Budget Allocation (Dollars in Thousands)
Extramural Program	\$56,629
Intramural Programs	337,273
Library Operations	(80,305)
Computer and Communication Systems	(40,992)
Lister Hill National Center for Biomedical Communications	(42,685)
National Center for Biotechnology Information	(153,751)
Specialized Information Services	(19,540)
Research Management and Support	14,702
Total Appropriation	408,604
Plus: Reimbursements	22,230
Total Resources	\$430,834

APPOINTMENTS

Name and Title	Appointment Date
Stephen Greenberg, PhD Head, Rare Books and Early Manuscripts Section <i>History of Medicine</i>	January 2017
Amanda Wilson Head, National Network Coordinating Office <i>Library Operations</i>	January 2017
Mark Ziomek Chief, Public Services Division <i>Library Operations</i>	January 2017
James Ostell, PhD Director <i>National Center for Biotechnology Information</i>	September 2017

FULL-TIME EQUIVALENTS, FY2017 (ACTUAL)

Office/Division	FTE
Office of the Director	8
Office of Health Information Programs Development	6
Office of Communications and Public Liaison	10
Office of Administration	49
Office of Computer and Communications Systems	37
Extramural Programs	19
Lister Hill National Center for Biomedical Communications	54
National Center for Biotechnology Information	295
Specialized Information Services	35
Library Operations	221
Total FTEs	734

DEPARTURES AND RETIREMENTS

Name and Title	Departure Date
Arthur Petrosian, PhD Chief Scientific Review Officer <i>Extramural Programs</i>	December 2016
David Lipman, MD Director <i>National Center for Biotechnology Information</i>	May 2017
Betsy Humphreys Deputy Director <i>Office of the Director</i>	June 2017

DIRECTOR'S EDUCATION FUND

Institutions	Enrollees
George Washington University	1
Georgetown University	1
Strayer University	1
University of Maryland system	10
University of Virginia	1
Washington Adventist University	1
Total Staff Enrolled	15
Total Courses	23

NLM ASSOCIATE FELLOWS, 2017-2018

Name and University
Gabrielle Barr MSI, University of Michigan BA, Johns Hopkins University
Shannon Sheridan MLIS, University of Pittsburgh BA, Lycoming College
Nicole Strayhorn MLIS, Florida State University BA, Georgia State University

AWARDS: NLM AND NIH

Award	Recipient	Accomplishment
The Regents Award for Scholarship or Technical Achievement	Dr. Thomas C. Rindflesch	In recognition of his exceptional leadership in the development of methods and tools for extracting facts from biomedical text.
Frank B. Rogers Award	Dr. Anthony Y. Tse	For his extraordinary contributions in making ClinicalTrials.gov a more effective program.
NLM Director's Honor Award	Paul V. Kiehl	For his valuable insight, understanding, knowledge, positive attitude, and leadership to administrative management, policy, and operational activities at NLM.
	Mary Ann Leonard	For her outstanding work in reinventing, managing, designing, and maintaining a number of highly-visible digital and online resources for Library audiences.
	Dr. Barbara A. Rapp	For superior leadership and service to the National Library of Medicine's strategic planning process.
Phillip C. Coleman Award	Dr. David C. Landsman	In recognition of exemplary leadership and excellence in mentoring.
	Elizabeth A. Mullen	For outstanding public service to the National Library of Medicine through her commitment to mentorship and career development.
EEO Special Achievement Award	Dr. Myra Derbyshire & Dr. Rezarta Islamaj Dogan	In recognition of service for the advancement of women in science.
NIH Merit Award	Terry T. Ahmed	For superior leadership to NLM and unwavering commitment to the development of consumer health products and services.
	Mary Ann Hantakas	For leadership and commitment to providing NLM users with quality MEDLINE data and NLM terminologies.
	Dr. Stefan R. Jaeger	For outstanding leadership of research and development in image analysis and deep learning toward malaria screening technology.
	Kenneth M. Koyle	For outstanding leadership and dedication to NLM and History of Medicine Division staff, operations, and mission.
	Dr. Dar-Ning Kung	In recognition of his exceptional leadership of NLM's IT security program.

(table continues)

Award	Recipient	Accomplishment
	Huei Chung Lee	For providing excellent technical oversight of systems that provide critical data to multiple NLM products and services.
	Stephanie M. Morrison	In recognition of sustained, excellent leadership in the development of Genetics Home Reference, a consumer-friendly resource about the effects of genetic variation on human health.
NIH Director's Award	Dr. Dennis A. Benson	For his outstanding scientific and administrative leadership in program development, policy formulation, and operational management of the NCBI and his dedicated service to NLM.
	Donald J. Potvin, Jr.	For exceptional leadership in helping NIH meet its federal security obligations.
	CIT Group - NIH FITARA Working Group Ivor L. D'Souza	For exceptional leadership and resourcefulness in coordinating NIH's implementation of the Federal Information Technology Acquisition Reform Act (FITARA).
	NIDCR Group/OMB M-16-02 Implementation Workgroup Dianna L. Adams Ivor L. D'Souza Thomas J. O'Hare	In recognition for developing and delivering a successful response to the initial requirements of OMB's desktop and laptop category management policy, M-16-02.
	NIGMS Group - Cell Line Authentication Working Group Dr. Tanya Barrett	For their outstanding efforts in developing guidelines and best practices for cell line authentication.

AWARDS: OUTSIDE ORGANIZATIONS

A number of NLM staff were recognized by outside organizations for their outstanding efforts this year.

Award	Recipient	Accomplishment
MLA Carla J. Funk Governmental Relations Award	Betsy L. Humphreys	In recognition of outstanding leadership in the area of governmental relations at the federal, state, or local level, who has furthered the goal of providing quality information for improved health.
DHHS Public Health Services Achievement Medal and Unit Commendation	Commander Gelio Alves, PhD	For exemplary performance of duty.
2017 FedHealthIT 100	Ivor L. D'Souza	Recognized by his peers in the field for driving change and advancement in the Federal Health Information Technology market.
Institute of Electrical and Electronics Engineers (IEEE) IEEE Senior Member	Dr. Sameer K. Antani	In recognition of his leadership and scientific contributions to advancing the role of computational sciences, R&D in biomedical research, education, and clinical care.



Library Operations



Joyce E.B. Backus

Associate Director

The Division of Library Operations (LO) ensures access to the published record in biomedicine and related areas of the life sciences. LO acquires, organizes, and preserves NLM's comprehensive archival collection of biomedical literature; creates and disseminates controlled vocabularies and a library classification scheme; produces authoritative indexing and cataloging records; builds and distributes bibliographic and full-text databases; provides national backup document delivery, reference service, and research assistance; helps people use NLM products and services; and coordinates the National Network of Libraries of Medicine to equalize access to health information across the United States.

Library Operations also develops and mounts historical exhibitions; produces and manages a travelling exhibition program; creates and promotes resources for K-12, undergraduate, and graduate students and educators; carries out an active research program in the history of medicine and public health; collaborates with other NLM program areas to develop, enhance, and publicize NLM products and services; conducts evaluation related to current operations; directs and supports training and recruiting programs for health sciences librarians; and manages the development and dissemination of national health data terminology standards.

COLLECTIONS

NLM Digital Collections added two new collections: Incunabula and World War II US government documents. Incunabula is a collection of over 40 books and broadsides printed in Europe before 1501 to which additional items will be added over time from the Library's world-renowned collection of more than 580 incunabula.

Profiles in Science added the Louis Sokoloff papers. An American physician and neuroscientist, Sokoloff's (1921-2015) innovative research transformed the study of brain structure and function. His papers cover 1923 to 2015.

The NLM Classification moved from an annual

spring update to twice-yearly updates. The winter version encompassed changes to the NLM Classification resulting from new and changed Medical Subject Headings (MeSH) terms for 2017. The summer version focused on the review of specific classification schedules.

NLM chose to stop receiving materials from the Library of Congress Surplus Books Program and will no longer redistribute materials to US medical libraries. NLM ended the program to save staff time due to other libraries' decreasing reliance on print collections and the decreasing number of items needed for the NLM collection.

DATABASES

The NLM Value Set Authority Center (VSAC), in collaboration with the Centers for Medicare

& Medicaid Services (CMS) and the Office of the National Coordinator for Health Information

Technology (ONC), published updates in January and May to the electronic clinical quality measure (eCQM) value sets for eligible hospitals, eligible professionals, and eligible clinicians.

The National Information Center on Health Services Research and Health Care Technology (NICHSR) released “NICHSR ONESearch” in late 2016. This consolidated search tool allows people to simultaneously search four resources: Health Services Research Projects in Progress (HSRProj), Health Services and Sciences Research Resources (HSRR), Health Information Central, and PHPartners.org.

NLM broadened researcher access to HSRProj, making it available through XML file download. HSRProj provides access to almost 34,000 descriptions of “just-funded” health services research investments from more than 350 funders spanning two decades. A first-ever graduate student competition required entrants to use the database to assess trends and gaps in health

services research, with the winner presenting their study at the annual AcademyHealth meeting.

In support of NLM's increased involvement in data, the NLM publication *Citing Medicine* was updated to include information on how to cite datasets. Chapter 24 was renamed “Databases/ Retrieval Systems/Datasets on the Internet” to reflect this emphasis.

NLM implemented a terms and conditions statement for the Data Distribution Program, allowing easier use and reuse of NLM datasets. The terms and conditions replace all existing licenses, and no annual renewal is required.

NIHSeniorHealth.gov was retired in August. Launched in 2003 by the National Institute on Aging and NLM, it was the first government website designed for older adults. Fourteen years later, the features and content it once uniquely provided are available to seniors in many other ways, eliminating the need for the site.

TERMINOLOGY

MeSH saw updates to its structure, usability, and browser display in 2017. A joint NLM-FDA project added over 50 descriptors and rearranged the MeSH tree locations of descriptors related to tobacco and smoking. NLM promoted MeSH RDF from beta to production and added actionable Uniform Resource Identifiers (URI) to MeSH terms in NLM authority and bibliographic records, contributing to the library community's effort to prepare bibliographic data for a linked data environment.

MeSH on Demand (MoD) released a new version that highlights the text corresponding to a MeSH term, gives a quick view of MeSH descriptor term definitions, improves the interface for those using MeSH to search PubMed, automatically expands MeSH terms and MeSH tree-based searches, and displays similar article titles from PubMed.

RxNorm's April 2017 release contained Prescribable Names (term type=PSN) for all RxNorm normal forms for active human drugs sold in the United States, with a few exceptions.

PSNs are user-friendly synonyms of certain RxNorm concepts, such as Semantic Clinical Drugs (SCD), Semantic Branded Drugs (SBD), Generic Packs (GPCK), or Brand Name Packs (BPCK). PSNs are used as display names in e-prescribing systems. RxNorm also added the CDC's Prevention Vaccines Administered (CVX) Data, which help facilitate the electronic exchange of vaccine information in electronic health records.

DrugBank was added to the Unified Medical Language System (UMLS) for the 2016AB release in November and to RxNorm for the December release. The DrugBank database is a unique bioinformatics and cheminformatics resource that combines detailed drug data (i.e., chemical, pharmacological, and pharmaceutical) with comprehensive drug target information (i.e., sequence, structure, and pathway).

NLM implemented the use of the SNOMED international editing tools for the SNOMED CT production maintenance process.

OUTREACH AND PUBLIC SERVICES

NLM began collaborating with NIH's *All of Us* Research Program to raise awareness about the program, a landmark effort to advance precision medicine. The National Network of Libraries of Medicine (NNLM) received a \$4.5 million award to support community engagement efforts by public libraries across the United States and to improve participant access to health information.

NLM launched two traveling exhibitions this year. *Physician Assistants: Collaboration and Care*, created in partnership with the Physician Assistant History Society, describes how the profession developed as a solution to meet the social and health care needs of the mid-20th century and continues to evolve today. The exhibition highlights how physician assistants serve as part of a health care team, working within diverse communities to treat patients and improve lives by addressing health care shortages. The second exhibition, *Fire and Freedom: Food and Enslavement in Early America*, looked at the Chesapeake region during the early colonial era, when European settlers survived by relying upon indentured servants, Native Americans, and African slave labor for life-saving knowledge of farming and food acquisition.

NLM entered into an agreement with the Landstuhl Regional Medical Center, a US Army hospital in Landstuhl, Germany, that will expand NLM's traveling exhibition services abroad. Over the next five years (2017-2021), the medical

center will showcase 12 NLM traveling banner exhibitions in its library and coordinate a tour of the exhibitions to US military bases and libraries throughout Germany, bringing NLM resources to new audiences and supporting military personnel and their families.

In May 2017, the National Network of Libraries of Medicine launched NNLM RD3: Resources for Data-Driven Discovery, an online space for librarians, information professionals, students, and interested individuals to learn about and discuss research data management throughout the data lifecycle and in support of biomedical and scientific research.

NLM implemented a new web-based customer portal that offers answers to frequently-asked questions, giving the public faster and more direct self-service access to needed information about NLM products and services.

NLM suspended the Biomedical Informatics Course following the September 2017 session to allow time to restructure the program in ways that will help attendees accelerate research and better leverage NLM resources for discovery and accountability. The course had offered participants a week-long immersive experience in biomedical informatics taught by experts in the field. The restructured course will be developed and piloted in 2018.

COLLECTIONS

TABLE 1: PHYSICAL COLLECTIONS

Item	Total ¹	FY2017	FY2016	FY2015
Monographs ² : Before 1500	601	1	1	1
1501–1600	6,081	17	6	0
1601–1700	10,367	7	6	7
1701–1800	272,818	33	12	32
1801–1870	257,204	70	196	150
1871–present	920,908	10,929	11,052	12,893
Bound Serial Volumes ³	1,557,096	18,950	23,127	34,723
Microforms ⁴	606,250	11	99	14
Audiovisuals and Computer Software	101,104	1,812	1,577	2,359

(table continues)

1. *Items Processed: Serial issues, monographs and nonprint receipts processed.*
2. *Monographs (pre-1914) includes historical manuscripts (those written prior to the year 1600).*
3. *Monographs (1914-): The number of monographs processed from FY2016 to FY2017 substantially decreased due to the decision to stop receiving materials from the Library of Congress Surplus Books Program. In addition, this number no longer includes any items processed as duplicates or discards.*
4. *Audiovisuals became a separate tracking category in FY2012. For prior year reports, Audiovisuals were grouped with Monographs (1914-).*

TABLE 4: ARCHIVAL MATERIALS ACQUIRED

Item	FY2017	FY2016	FY2015
Modern Manuscripts (in linear feet)	1,431	357	583

TABLE 5: EXPENDITURES

Item	FY2017	FY2016	FY2015
Publications	\$12,058,269	\$12,906,563	\$11,587,588
Rare Books, Manuscripts, and Other Historical Materials	\$327,855	\$299,568	\$300,214
Total¹	\$12,386,124	\$13,206,131	\$11,887,802

1. *Used to be reported in "Publications" prior to FY2012 and "Rare Books" was a portion of the amount.*

TABLE 6: PRESERVATION ACTIVITIES

Item	FY2017	FY2016	FY2015
Volumes Bound	18,245	21,628	33,028
Volumes Repaired Onsite ¹	448	499	684
Audiovisuals Preserved	332	532	731
Historical Volumes Conserved	652	614	713
Pages Digitized ²	302,806	125,456	187,585

1. *Volumes Repaired Onsite: General Collection monographs and serials only.*
2. *Pages Digitized: Number excludes digitization projects not associated with the Digital Collections Repository, e.g., Profiles in Science.*

CATALOGING AND INDEXING

TABLE 7: CATALOGING

Item	FY2017	FY2016	FY2015
General Collection Items ¹	14,830	20,248	17,935
Historical Monographs (pre-1914)	2,189	2,535	3,815

(table continues)

Item	FY2017	FY2016	FY2015
Modern Manuscripts (in linear feet) ²	313	489	364
Prints and Photographs ³	8,297	6,922	2,920
Historical Audiovisuals	2,260	1,572	227

1. *General Collection Items: Includes monographs, serials, nonprint, and integrating resources.*
2. *Number reflects manuscripts that are fully processed and have a catalog record.*

3. *Number includes accessioned prints and photographs that are described by finding aids.*

TABLE 8: INDEXING

Indexing	FY2017	FY2016	FY2015
Citations Indexed for MEDLINE	813,598	869,666	806,326
Journals Indexed for MEDLINE	5,617	5,623	5,618

SERVICES TO THE PUBLIC

TABLE 9: DOCUMENT DELIVERY

Request Type	FY2017	FY2016	FY2015
Interlibrary Loan Requests Received	149,727	153,252	180,733
Interlibrary Loan Requests Filled	121,324	128,748	146,123
General Reading Room Requests Received	58,059	68,195	67,482
General Reading Room Requests Filled	54,207	62,068	61,602
History of Medicine Reading Room Requests Filled	2,564	10,369	7,996

TABLE 10: CUSTOMER SERVICE INQUIRIES

Inquiry Type	FY2017	FY2016	FY2015
Offsite Inquiries ¹ : General	16,947	44,702	53,508
History of Medicine	2,989	4,357	6,234
Onsite Inquiries ² : General	3,583	5,595	6,314
History of Medicine	4,711	7,314	8,133

1. *Offsite Inquiries: Inquiries via telephone, fax, US mail, and e-mail. Includes BSD interactions with data licensees. Beginning in FY2015, ILL requests are no longer included in the Customer Service Inquiry statistics.*

2. *Onsite Inquiries: In person.*

TABLE 11: TOURS AND VISITORS

Tours and Visitors	FY2017	FY2016	FY2015
Exhibitions: Visitors	753	99	1,571

(table continues)

Tours and Visitors		FY2017	FY2016	FY2015
Daily Tours:	Tours	150	131	107
	Visitors	952	873	552
Special Tours:	Tours	140	64	75
	Visitors	2,179	1,824	1,121

WEB SERVICES

TABLE 12: SELECTED WEB RESOURCES

Resource	Statistic	FY2017	FY2016	FY2015
ClinicalTrials.gov	Number of Studies	259,858	228,385	199,725
	Page Views ¹	2,068,221,821	2,426,183,020	2,405,844,998
	Visitors ²	16,413,217	14,233,210	13,731,543
DailyMed	Number of Labels	97,385	90,548	78,394
	Page Views	222,020,395	317,036,446	268,793,206
	Visitors	12,437,988	17,024,042	14,633,833
Genetics Home Reference	Summaries	2,666	2,505	2,515
	Page Views ³	39,805,599	39,256,315	41,781,084
	Visitors	20,253,013	18,899,479	19,027,155
Household Products Database	Number of Products	17,000	16,000	15,000
	Page Views	30,393,602	31,655,224	26,669,097
	Visitors	924,457	861,993	900,468
MEDLINE/PubMed	PubMed Citations	27,641,032	26,482,097	25,375,421
	Page Views ⁴	2,996,915,824	2,986,881,905	3,017,779,466
	Unique Visits ⁵	829,154,946	799,497,585	752,310,089
	Searches ⁶	3,317,018,039	3,133,664,852	2,796,260,949
MedlinePlus	Number of Topics (English/Spanish)	1,011/1,088	989/977	969/958
	Page Views ⁷	810,400,000	928,200,000	932,300,000
	Visitors	354,900,000	416,100,000	404,500,000
NLM Main Web Site	Page Views ⁷	13,600,000	21,000,000	19,300,000
	Visitors	5,200,000	8,200,000	5,300,000
ToxTown	Page Views	11,682,087	12,196,787	7,942,465
	Visitors	434,695	310,822	377,772

1. Page Views: Number of times that a single page is viewed or downloaded.
2. Visitors: Number of people visiting a website in a defined period of time.
3. Genetics Home Reference changed web analytics reporting tools and, beginning in FY2015, reports Page Views rather than Page Hits.
4. The PubMed Page View totals for FY2015 and FY2014 have been corrected to reflect the change in analytics reporting tools.

5. Unique Visits: Total number of times that all users visit a website, regardless of the number of individual pages viewed.
6. Searches: Number of searches performed.
7. NLM changed web analytics reporting methodology and tools beginning in FY2015, resulting in more accurate numbers of Page Views.



Specialized Information Services



Florence Chang

Acting Associate Director

The Division of Specialized Information Services (SIS) was created in 1967 to focus on toxicology, chemistry, and drug information. Today, SIS offers publicly accessible, free, online, and mobile information resources and services in toxicology, environmental health, chemistry, HIV/AIDS, disaster medicine and public health emergencies, minority health, and other specialized topics of interest to NLM and the public.

DATABASES

American Indian and Alaska Native Health launched a responsive redesign. The site, which features indigenous artwork donated by our Native partners, provides information on Alaska Native health from the former Arctic Health website.

HealthReach, a database of multilingual and multicultural health information, added two significant collections of low-literacy consumer information: HIV/AIDS and opioid abuse and addiction. The HealthReach team completed an API that provides MedlinePlus.gov with foreign language materials.

Staff enhanced the HIV/AIDS suite of information resources. The *AIDSinfo* database, now mobile optimized, provides more links and offers the ability to search ClinicalTrials.gov directly from the *AIDSinfo* site. The site's drug search has also been improved with key terms, auto-complete, and an A-Z index, while the *AIDSinfo* glossary search now ranks results based on relevancy and includes an auto-complete feature. Its Spanish-language partner site, *infoSIDA*, is better organized to ease use. *AIDSource* launched an equivalent site in Spanish, while adding to its English-language site pages on HIV Navigation and PrEP Navigation, an audience menu, selected resources in multiple languages, and improved search.

The Hazardous Substances Data Bank (HSDB) added UNII codes—unique ingredient identifiers—to its records. Free, unique alphanumeric identifiers for many substances, including drugs,

foods, devices, and biologics, UNII codes can identify substances across multiple databases and platforms. UNII codes are generated and made available to the public by the FDA in partnership with NLM and the United States Pharmacopeia.

Tox-App, a new native mobile app, brings some of the TOXMAP experience to iPhone and iPad users. Tox-App lets users search the EPA's Toxics Release Inventory for industrial facilities that reported releasing certain chemicals into the environment or browse for these facilities by chemical, state, or county. The app was developed for educational and research purposes related to toxicology and environmental waste.

ChemIDplus expanded to include over 417,500 compounds in the biomedical literature, with priority given to drug analogs and chemicals of interest in toxicology. Staff also enhanced the database's locator field to improve connections with other relevant sources, adding links to PubMed Central, EPA CompTox, the European Medicals Agency, the European Chemicals Agency, Drug Bank (Canada), and eChemPortal from the Organisation for Economic Co-operation and Development.

The NLM Drug Information Portal, updated daily, contains over 71,900 drug records, and offers a separate mobile version.

A new version of the Tox Town homepage debuted this year, and a new Port scene features content on gyres and microplastics, both topical

issues in environmental health. The Tox Town team also evaluated the site's usability, user satisfaction,

and user information needs in preparation for a full redesign next year.

OUTREACH

SIS completed the final year of the National AHEC Teen Health Information Literacy program. The program introduced the Project SHARE curriculum, developed by the University of Maryland Health Sciences and Human Services Library, in three AHEC sites: Atlanta, Philadelphia, and Willimantic, Connecticut. Project leaders collected pretest and posttest quantitative and qualitative data about participants' gains in knowledge, health information literacy skills, leadership skills, and more. Key findings indicate that students perceived they could affect social change in their communities, acquired oral communication skills, expanded knowledge of health disparities, and gained interest in health careers.

SIS funded eight projects this year through the AIDS Community Information Outreach Program. The HIV/AIDS service organizations in Texas, Pennsylvania (x2), New York (x2), California, Massachusetts, and North Carolina designed local programs to improve access to information for patients, caregivers, and the community, with several using apps, interactive tutorials, social media campaigns, videos, and other innovative approaches to reach their clients, many of whom

come from underserved populations in minority or rural communities.

The Digital Communications team conducted monthly social media campaigns across multiple social media platforms (Twitter, Facebook, GovDelivery, and Pinterest). Created around SIS products and services, these campaigns were tied to health observances, current events, or updated resources. Google Analytics showed the number of users directed to SIS health resources through campaign links increased steadily for each campaign.

The Disaster Information Management Research Center (DIMRC) developed Virtual Highly Infectious Disease Emergency Management Training that provides methods and tools to enhance the preparedness of hospital caregivers for disasters involving patients with highly infectious diseases.

The 21 representatives of the Environmental Health Information Partnership met at NLM April 11-12, 2017. The theme of the partnership's 26th meeting was "Transition, Challenges, and Opportunities of Precision Medicine."



Lister Hill National Center for Biomedical Communications



Clement J. McDonald, MD

Director



The Lister Hill National Center for Biomedical Communications (LHC) is an intramural research and development (R&D) division of NLM working in the following areas:

- imaging data science
- health IT terminology and standards
- natural language processing data science
- big data analysis
- training the next generation of medical informaticians

IMAGING DATA SCIENCE

LHC continued to conduct advanced imaging research, augmented by deep learning techniques, to expedite research into and the diagnosis and treatment of diseases, including malaria, pulmonary diseases, and neurology.

Addressing the global health burden of malaria, LHC made several improvements to the LHC MalariaScreener, an Android app that automatically counts parasite-infected red blood cells in blood smears once the smartphone is connected to a microscope's eyepiece. Enhancements include hands-free image capture, deep learning models for cell discrimination, a cleaner interface, cloud storage, and Chinese language compatibility.

LHC researchers also improved their mobile screening system for tuberculosis, using novel multiscale image analysis to improve diagnostic sensitivity on chest X-rays. Researchers also upgraded elements within the truck in Kenya that houses the mobile X-ray system, switching to digital radiography for better image quality and reduced power consumption, and adding cellular communications to transmit the chest

X-ray images and screening results to the hospital. To expand use of this innovative system, LHC publically released four sets of chest X-rays it used in training the diagnostic algorithms. So far, over 250 researchers from academic and industrial research labs worldwide have downloaded them.

The Open-*i* database grew to 3.7 million biomedical images extracted from 1.2 million PubMed Central articles. As part of this growth, Open-*i* ingested 80,000 images from NLM's History of Medicine Division, 1,600 orthopedic illustrations from the University of Southern California, and over 8,000 images from MedPix. MedPix, a free open-access database and teaching tool, holds over 12,000 patient case scenarios and nearly 59,000 images covering 9,000 clinical topics. To simplify case submissions, the MedPix team developed a Case Upload Server for clinicians and researchers.

LHC imaging scientists won a Best Paper Award at the 2017 IEEE 30th International Symposium on Computer-Based Medical Systems for a novel, content-based video retrieval technique

developed for Open-*i*. The technique uses both visual and transcribed audio content to summarize and index videos.

LHC participated in a systematic evaluation of the state-of-the-art in multilingual and multimodal information access systems. For the 2017 ImageCLEF challenge, the LHC team ranked first and second among 71 submissions

from 11 international teams, using deep learning approaches to label medical images with biomedical concepts and automatically generate image captions.

LHC researchers released SimpleITK, which provides image processing algorithms in multiple programming languages, notably Python and R, to support biomedical image research.

HEALTH IT TERMINOLOGY AND STANDARDS

LHC continued to help support, develop, and speed the adoption of universal standards for representing electronic medical data for the benefit of patient care, public health, and research.

In FY2017, LHC staff, in conjunction with the National Institute of Biomedical Imaging and Bioengineering, helped unify the names of radiology test reports from LOINC and the Radiological Society of North America.

LHC participated in a series of public meetings with the FDA, CDC, and the laboratory equipment industry to develop a standard electronic format to map from internal test codes to the appropriate LOINC test codes. Known as the LOINC to IVD (LIVD) Specification Agreement, it is supported by

a consortium of laboratory systems vendors and is already implemented by one of the largest vendors of in vitro diagnostic (IVD) tests. It is in the works to become a FHIR (Fast Healthcare Interoperability Resources) standard as well.

The RxNav browser and its APIs—for navigating RxNorm and other NLM-developed medication resources—received over 800 million queries in FY2017. Staff also launched RxNav 2.0, a new mobile-responsive version of the browser, and developed new API functions to better support analytics.

LHC developed web browser software to validate the Unified Code for Units of Measure and convert between commensurate values.

NATURAL LANGUAGE PROCESSING DATA SCIENCE

As part of an agreement with the FDA, LHC is developing a natural language processing pipeline to extract drug-drug interactions from drug labels (i.e., package inserts) and to codify them in standard terminologies. This conversion of narrative to code is essential to effectively apply the interaction information to clinical decision-making.

This year, LHC worked with the FDA to facilitate extracting and coding Adverse Drug Reactions (ADRs) in Structured Product Labels (SPLs). LHC created a collection of SPLs annotated for ADRs and coded to the medical terminology MedDRA. LHC staff also organized a community-wide evaluation of extraction methods as part of a National Institute of Standards and Technology (NIST) Text Analysis Conference. The challenge attracted 13 international teams from academia and industry.

LHC added several new approaches to a prototype for a free-text consumer health information and question-answering system. Staff improved question understanding by applying deep learning to identify a question's focus. As part of training and evaluating the system, staff used it to annotate over 1,700 short questions submitted to MedlinePlus. In addition, LHC co-organized a community challenge within the NIST Text Retrieval Conference 2017 to spark researchers' interest in developing methods for consumer health question answering and to gauge the state of the art.

LHC developed an innovative privacy protection tool, NLM-Scrubber, which removes patient identifiers from text, allowing scientists to use large clinical datasets without breaching patient privacy. Scientists from various organizations across academia, government, and industry—including Google and IBM—have been testing the tool.

BIG DATA ANALYSIS SCIENCE

LHC's work in big data analysis focused this year on Medicare data; on the relationship between Alzheimer's disease and anti-androgen therapy in prostate cancer patients; on metformin's effect on longevity; and on the impact of cardiovascular protective drugs on both Alzheimer's disease and dementia. In collaboration with colleagues from the National Institute on Drug Abuse, LHC researchers have analyzed Medicare data to investigate the impact of opioid prescription on elderly patients.

As part of its work evaluating the quality of

large health care datasets used in research, LHC investigated trend-detection and characterization. LHC contributed to the development of the Achilles data quality tool maintained by the Observational Health Data Sciences and Informatics consortium. LHC researchers also analyzed policies, data formats, and semantic integration of data from completed trials used by current data-sharing platforms. In addition, staff studied how Common Data Elements can be annotated with routine health care terminologies.

TRAINING

In 2017, our Medical Informatics Training Program hosted 20 postdoctoral fellows (three MDs, 11 PhDs, four MD/PhDs, one nurse PhD, and one PhD dental surgeon) plus one master's trainee, along with 12 visiting scientists and students from NLM-sponsored university training programs, medical schools, graduate schools, colleges,

and high schools. Students came from eight US states and nine countries: Brazil, Canada, China, France, India, Japan, the Philippines, Spain, and Taiwan. Each participant spent between a few months and several years working on a research project under a mentor's guidance.



National Center for Biotechnology Information



James Ostell, PhD
Director

The National Center for Biotechnology Information (NCBI) was established by law in 1988 as biotechnology was taking off and lawmakers and scientists recognized the need to harness the large volume of data that would be generated by the genetic revolution.

To fulfill its mission, NCBI:

- creates automated systems for storing and analyzing molecular biology and genetic/genomic information and associating it with related information in the biomedical literature;
- performs research into advanced methods of analyzing and interpreting molecular biology data;
- facilitates the use of databases and software by researchers and health care personnel; and
- coordinates efforts to gather and disseminate biotechnology information worldwide.

NCBI has developed a vast array of resources, ranging from genetic/genomic databases to medical literature, analysis tools, and educational programs. These resources include about 40 integrated databases, such as the GenBank collection of all publicly available DNA sequences,

and PubMed and PubMed Central, which comprise the biomedical and life sciences journal literature. Each day these and other NCBI resources are used by a median of 4.6 million people who download about 100 terabytes of data per day, the equivalent of more than 140,000 compact discs.

FOODBORNE PATHOGENS AND ANTIMICROBIAL RESISTANCE PROJECTS

NCBI is collaborating with federal partners and others to combat foodborne diseases and antimicrobial resistance, two serious public health problems that affect millions of Americans each year. This year NCBI built a system that reports within one hour a list of the nearest genetic neighbors to submitted sequences of *Listeria* and *Salmonella*. That rapid turn-around helps public health agencies more quickly link cases

involved in an outbreak and potential sources of contamination. NCBI also released an improved version of its pathogen detection isolates browser. The browser is used for the antimicrobial resistance project, as well as for foodborne pathogens, and integrates antimicrobial resistance genes, antibiotic susceptibility data, and relevant metadata.

GENOMIC, PROTEIN, MEDICAL GENETICS, AND CHEMISTRY RESOURCES

In FY2017 NCBI introduced several new tools and enhancements to its genome, gene, protein, medical genetics, and chemistry resources. Among these developments, NCBI staff:

- Improved the GenBank submission process.
- Implemented automatic release of prokaryotic genomes following annotation using NCBI's Prokaryotic Genome Annotation Pipeline. Submitters receive their annotated genome data within one day of submitting the genome, and the data are automatically released in five days unless the user requests additional time.
- Added a submission wizard that allows users to submit up to 400 genomes at once.
- Implemented a process that allows outside submitters to utilize FTP or high-performance Aspera data uploads and preload the data in advance.
- Automated the processing of ribosomal RNA submissions.
- Annotated representative genomes of 147 organisms, including organisms critical to human health such as mosquito vectors of Zika and dengue fever, via the RefSeq eukaryotic annotation pipeline.
- Released in RefSeq a new, curated dataset of non-genic functional elements found in the human and mouse genomes, including gene regulatory regions (e.g., enhancers, silencers),

structural elements, replication origins, clinically significant sites of DNA recombination and genomic instability, and other experimentally validated elements.

- Comprehensively re-annotated over 85,000 prokaryotic RefSeq genomes following an update to the annotation pipeline that leveraged more than 27,000 curated Hidden Markov Models for the prediction of protein structures.
- Released an update of the Conserved Domain Database (Version 3.16), which contains 1,659 new or updated NCBI-curated domains, including models specifically built to annotate structural motifs. The database now mirrors Pfam version 30.
- Added capabilities for archiving mycobacterial antimicrobial resistance data to the BioSample database.

- Added expression data to NCBI's Gene resource for human, mouse, and rat genes. This project generated code to determine quantitative gene expression data per tissue or developmental stage as determined from RNA-seq alignment data.
- Redesigned dbSNP's underlying database architecture and reference SNP build process to improve efficient processing, annotation, and dissemination of human variation data.
- Released a new Reference SNP (RefSNP, rs) Report web page that provides enhanced performance and presentation of individual RefSNP records.
- Expanded PubChem spectral content with the addition of information on more than 80,000 compounds from BioRad, a commercial publisher of spectral databases.

TOOLS

NCBI released several new or updated tools during the year, including the following:

- Released a new tool in the Assembly database that makes it easy for users to download multiple genomes without having to write scripts.
- Enhanced the Genome Data Viewer, which supports the need to visually browse genome-scale data, including annotation, variation, histograms of aligned RNAseq reads, and more. Improvements include a tool home page with an interactive taxonomic tree.

- Released stand-alone BLAST software used by external researchers to perform searches on their own hardware.
- Added QuickBLASTP, an accelerated protein sequence search tool, to BLAST web pages.
- Released Genetic Relationship and Fingerprinting (GRAF), a tool developed by the dbGaP team to detect when there is data from the same individual or close relatives within and across studies.

LITERATURE INFORMATION RESOURCES

NCBI continued to grow and improve its literature resources during the year. Achievements include:

- Introducing a new data management system for PubMed that allows publishers to update and correct their citations and add conflict of interest statements to PubMed records (see page 12);
- Expanding PubMed Central support for other agencies' and organizations' public access policies, including agreements with the Bill and Melinda Gates Foundation and the Department of Homeland Security;

- Releasing in PubMed Central the complete back issues of a number of historically significant biomedical journals—encompassing more than 45,000 articles and a half million pages—as part of a biomedical journal digitization project with the Wellcome Trust; and
- Rolling out the NCBI GrantHub service to provide access to and management of award data across NCBI grant applications.

RESEARCH

NCBI's Computational Biology Branch focuses on computational approaches to a broad range of fundamental problems in evolution, molecular biology, genomes, biomedical science, and bioinformatics. The branch conducts independent research and contributes to improving and developing NCBI resources.

Among NCBI's independent research projects this year, scientists extensively mined genomic and metagenomic sequence databases in search

of novel viruses and antivirus defense systems. These analyses substantially expanded the known diversity of both viruses and defense mechanisms, including CRISPR-Cas systems. NCBI researchers also developed a tool for analyzing cancer mutations (see page 9), developed a new method for quantifying deleterious effects of regulatory variants, and developed BeWith, a method for extracting gene modules characterized by specific mutational patterns from large sets of patient data.

TRAINING AND OUTREACH

Each day the NCBI website serves millions of users with a wide range of interests and backgrounds. To keep users abreast of updates, changes, and improved features, the NCBI User Services staff provided workshops, courses, and webinars;

responded to customer questions; and managed social media sites. NCBI also hosted several genomics hackathons focused on advanced bioinformatics analysis of next-gen sequencing data.



Extramural Programs



Valerie Florance, PhD
Director

The Extramural Programs Division (EP) administers extramural grant programs for NLM as authorized by the Medical Library Assistance Act and Public Health Service Act. EP issued its first grant awards in 1965.

Grant funds are expended as grants-in-aid and cooperative agreements to the extramural community in support of the Library's mission. Review and award procedures conform to NIH policies.

Each year, NLM makes new or continuing awards in five grant categories: Research Projects, Information Resources, University-based Training for Research Careers or Career Transition, Small Business Innovation, and Research and Development. Awards for research projects, small businesses, training, and career development focus on biomedical informatics and data science. Resource grants and cooperative

agreements target information management, delivery, and use. All categories support research in the context of human health and disease.

Applications are received through parent NIH funding opportunity announcements (FOAs) or through special FOAs issued by EP.

GRANTS SUMMARY

EP’s FY2017 base budget for grant awards was \$44,254,899. NLM awarded 140 grant awards this year, 58 of them new grant awards. In addition to grants funded with NLM’s appropriated funds, EP administers extramural grants funded by other NIH entities (see Figure 2 for details).

Because the fiscal year began under a continuing resolution, NLM did not issue new awards or launch new initiatives until June 2017, following passage of the appropriations/funding bill.

SUCCESS RATES

Success rate describes the likelihood of a project getting funded, not the success of the individual application submission. Success rates are computed by dividing the number of awards in a given fiscal year by the number of

unique applications reviewed that year. Therefore, the number of applications NLM receives in a year affects the overall Success Rate for NLM applications.

TABLE 1: SUCCESS RATE OF CORE NLM GRANT PROGRAMS, FY2015–2017

Grant Type	Activity Code	FY2015 apps	FY2015	FY2016 apps	FY2016	FY2017 apps	FY2017
Research ¹	R01	81	24%	83	16.2%	84	21.5%
	R21	32	10%	43	7.5%	50	13%
Career ²	K99	11	30%	6	N/A ⁴	6	N/A ⁴
	K01	6	17%	17	17%	17	21.4%

1. Research grants, funded with appropriated funds, support basic and applied informatics projects.

2. Career grants, funded with appropriated funds, support for basic and applied informatics projects.

3. No applications were received.

4. No applications were funded.

FY2016 HIGHLIGHTS

- New five-year awards were made to 16 universities to support pre- and postdoctoral training in biomedical informatics and data science. Three of the 16 were new programs. Six have special slots in environmental exposure informatics funded by the National Institute of Environmental and Health Sciences.
- Fourteen of NLM’s university-based training programs received one-year grant supplements for enhancing curriculum and faculty expertise in the area of biomedical data science. Jointly, they

are defining the core curriculum for this important area.

- The University of California-San Diego in La Jolla hosted the annual Informatics Training Conference June 5-6, 2017. Approximately 230 people attended.
- As part of its strategic planning process this year, NLM staff visited 11 of its university-based training program sites to gather input about trends, problems, curriculum, trainee pool, and future directions.

- The first three awards were made in NLM’s new research grant program, Data Science Research: Personal Health Libraries for Consumers and Patients (PAR 15-159).
- Three new cooperative agreements were made in the NIH Big Data to Knowledge (BD2K) program “Enhancing the Efficiency and Effectiveness of Digital Curation for Biomedical Big Data” (RFA LM 17-001). NLM issued the Request for Applications (RFA) on behalf of BD2K and will administer the grants.
 - Crowd-Assisted Deep Learning (Cradle) Digital Curation to Translate Big Data into Precision Medicine
 - Unifying Templates, Ontologies, and Tools to Achieve Effective Annotation of Bioassay Protocols
 - Streamlined Capture and Curation of Unpublished Data
- On behalf of the NIH Common Fund, EP will administer a new NIH Director’s Transformative Research Award on N-of-1 clinical trials.
- The National Network of Libraries of Medicine (NNLM) Regional Medical Libraries, funded by eight cooperative agreements from NLM, received \$4,481,500 in supplemental funding from the NIH *All of Us* Research Program to support community engagement and education about the *All of Us* program.

GRANT PROGRAMS

NLM receives applications through two types of funding opportunity announcements: those issued by NLM itself, and those issued by NIH on behalf

of all Institutes and Centers. NLM also participates selectively in topic-focused, multi-institute funding announcements.

TABLE 2: CORE GRANT PROGRAMS: NLM ONLY

Announcement	Title	Expiration
PAR-16-404	NLM Express Research Grants in Biomedical Informatics (R01)	September 8, 2019
PA-16-294	NLM Informatics Conference Grants (R13)	May 8, 2019
PA-17-090	NLM Administrative Supplements for Informationist Services in NIH-funded Research Projects (Administrative Supplement)	March 16, 2017
PAR-16-417	NLM Grants for Scholarly Works in Biomedicine and Health (G13)	February 24, 2018
PAR-16-204	NLM Career Development Award in Biomedical Informatics (K01)	May 8, 2019
RFA-LM-17-002	NLM Information Resource Grants to Reduce Health Disparities (G08)	December 17, 2016
PAR-17-159	Data Science Research: Personal Health Libraries for Consumers and Patients (R01)	March 20, 2018

TABLE 3: CORE GRANT PROGRAMS: NIH PARENT

Announcement	Title	Expiration
PA-16-160	Research Project Grant (NIH Parent R01)	May 8, 2019
PA-16-161	NIH Exploratory/Developmental Research Grant Program (Parent R21)	May 8, 2019
PA-16-200	Academic Research Enhancement Award (AREA) (Parent R15)	May 8, 2019
PA-16-193	NIH Pathway to Independence Award (K99/R00)	May 8, 2019

(table continues)

Announcement	Title	Expiration
PA-15-321	Research Grant Supplement to Promote Reentry to Health-Related Research (Administrative Supplement)	September 30, 2018
PA-15-322	Research Grant Supplement to Promote Diversity in Health-Related Research (Administrative Supplement)	September 30, 2018
PA-16-309/308/306	Ruth L. Kirschstein National Research Service Award Individual Predoctoral Fellowships (F30/F31)	May 8, 2019
PAR-16-302/303	Small Business Innovations Research Grants (Parent SBIR R43/R44) (STTR R41/R42)	April 6, 2017

TABLE 4. FY2017 GRANT BUDGET EXPENDITURES BY NIH ACTIVITY CODE

Activity Code	Number of Awards (New & Continuing)	Funding from NLM
DP1: Pioneer Award ^{CF}	1	\$241,660
G08: Information Resource Grants to Reduce Health Disparities	8	\$778,806
G13: Scholarly Works in Biomedicine and Health	6	\$363,481
K01: Career Development Award in Biomedical Informatics	8	\$1,186,675
R00: Pathway to Independence	7	\$1,026,426
R01: Research Project Grants	62	\$18,008,698
R13: Conference Grants	3	\$59,205
R21: Exploratory/Developmental Grants	9	\$1,184,435
UG4: National Network of Libraries	9	\$9,718,687
R42: Small Business Technology Transfer (STTR)	0	\$117,152
R43: Small Business Innovation Research (SBIR)	3	\$415,436
R44: Small Business Technology Transfer (STTR)	1	\$343,411
R56: High Priority, Short-term Grants	1	\$217,500 ¹
U01: BD2K Collaborative Center ^{CF} (University of Miami School of Medicine ^{FOS} and Howard/Hopkins Collaboration ²)	1	\$3,499
T15: University Biomedical Informatics Research Training Programs	16	\$10,391,348
F31: NRSA Individual Predoctoral Fellowships	5	\$200,480
UL1: Protein Data Bank Administrative Support	0	\$25,000
EP budget excluding TAPS & Operations	140	\$44,254,899

1. Award co-funded by NIGMS. NLM is Administering IC.
2. Award co-funded with NIH/HLBI. NLM is not Administering IC; not counted as an NLM award.

CF. Grant co-funded by NLM and another NIH entity.
FOS. Funding from other source.

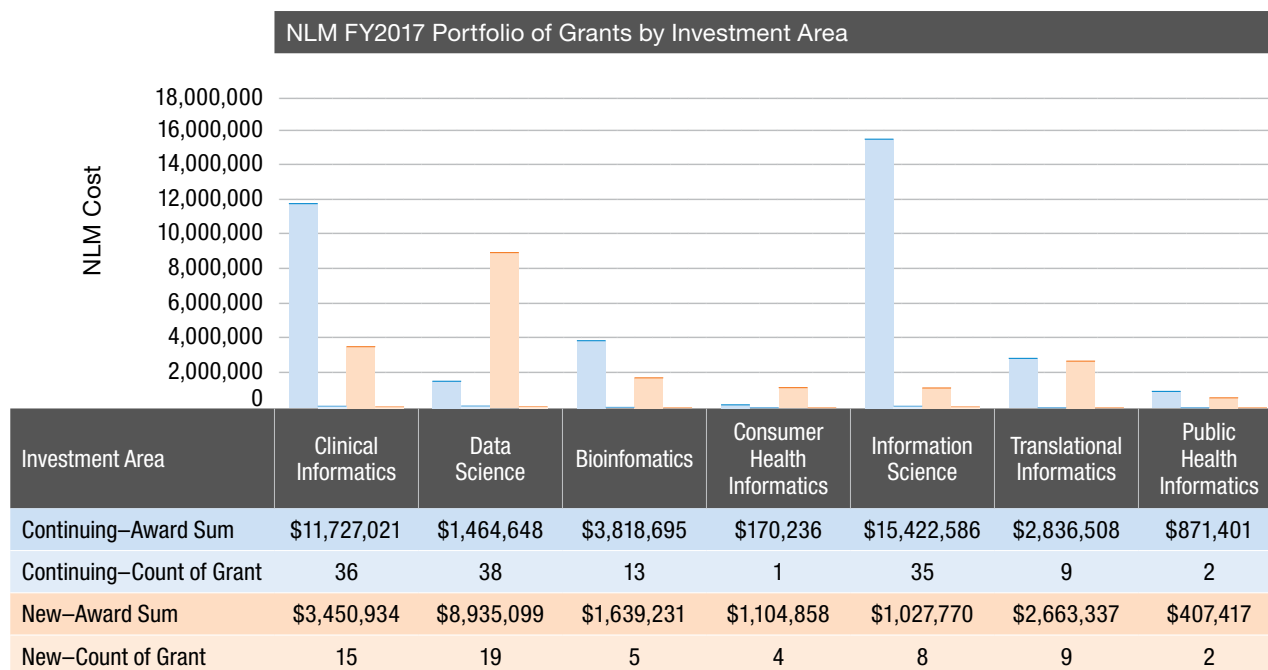
TABLE 5: FY2017 NLM CO-FUNDED GRANTS BY NIH ACTIVITY CODE

Activity Code	Number of Awards (New & Continuing)	Funding from NLM
DP5: Early Independence Award ^{CF}	0	\$211,875 ¹
R01: Research Project Grants	0	\$72,281 ²
R25: BD2K Research Education Award	5	\$0 ^{FOS}
T32: Predoctoral Training in Biomedical Big Data Science	14	\$0 ^{FOS, 3}
R42: Small Business Technology Transfer (STTR)	0	\$117,152 (1 NICHD award)
U24: Cooperative Agreement Resources Grants ^{CF}	0	\$250,000 ⁴ (1 NCATS award)

1. Funding from NLM to NIH OD for this one award. NLM is not Administering IC.
2. Co-funding for two informationist supplement awards with NIEHS and NINR. NLM is not Administering IC.

3. NLM is Administering IC but manages these grants.
 4. NLM is Administering IC but supports NCATS award.
- FOS. Funding from other source.

TABLE 6: NLM FY2017 AWARDS BY INVESTMENT AREA



TRAINING AND CAREER AWARDS

University-based Biomedical Informatics Research Training Programs (T15)

NLM remains the principal US source of support for research training in biomedical informatics and data science through its five-year institutional training grants that support predoctoral, postdoctoral, and short-term informatics and data science research trainees at 16 universities across

the country. Predoctoral trainees receive up to five years of support; postdoctoral trainees receive up to three years of support. The short-term trainee positions, which target undergraduate and graduate students interested in research careers in biomedical informatics and data science, provide up to three months of support.

In FY2017, NLM supported 126 predoctoral and

90 postdoctoral fellowship slots, plus 41 short-term training positions. In addition, the National Institute of Environmental and Health Sciences supported an additional 12 trainees in environmental exposure informatics through the NLM training programs.

NLM also manages 14 pre-doctoral training programs in biomedical big data science. Six of these are located at universities that also house NLM-funded training programs in biomedical informatics. Approximately 84 trainees are supported in these settings. These programs provide from one to three years of support for coursework and practicum experience in areas of data science. Trainees usually complete their degree in a biomedical domain.

TABLE 7: BIG DATA TO KNOWLEDGE (BD2K)/COMMON FUND GRANTS

Award	NLM Cost	Non-NLM Cost	Awardee
Predocotrinal Training in Biomedical Big Data Science (T32)	\$0	\$3,854,384	<input type="checkbox"/> Dartmouth College <input type="checkbox"/> Harvard School of Public Health <input type="checkbox"/> Northwestern University <input type="checkbox"/> Pennsylvania State University <input type="checkbox"/> Stanford University <input type="checkbox"/> University of North Carolina-Chapel Hill <input type="checkbox"/> University of California, Berkeley <input type="checkbox"/> University of California, Los Angeles <input type="checkbox"/> University of Missouri <input type="checkbox"/> University of Texas, Austin <input type="checkbox"/> University of Virginia <input type="checkbox"/> University of Washington <input type="checkbox"/> University of Wisconsin-Madison <input type="checkbox"/> Vanderbilt University

GRANT REVIEW ACTIVITIES

This year NLM renamed the grant-review committee to NLM Biomedical Informatics, Library, and Data Sciences (BILDS) Review Committee, reflecting its expanded role in data science. NLM has seen an almost 10% increase in the number of applications assigned to it. NLM continues to review between 75% and 80% of the applications

assigned to it, with the remaining applications handled by the Center for Scientific Review. In addition, the Center for Scientific Review provided a scientific review officer to help with NLM’s efforts this year due to the retirement of an NLM Scientific Review Officer.

TABLE 8: GRANT REVIEW ACTIVITIES BY PANEL

Review Panel	FY2015	FY2016	FY2017	% of applications (FY2017)
NLM Biomedical Library and Informatics Review Committee*	107	114	144	39%
NLM Special Emphasis Panels	105	115	135	37%
NIH Center for Scientific Review	0	0	88	24%
Total of NLM Reviewed Grants	212	229	367	100%

TABLE 9: GRANT REVIEW ACTIVITIES BY GRANT MECHANISM

	Grant Mechanism	FY2015	FY2016	FY2017	% of applications (FY2017)
NLM Review	R01: Research Grant	75	74	109	39%
	R13: Research Grant	3	4	2	1%
	R21: Research Grant	32	44	49	18%
	K01: Career Development	8	16	18	6%
	K99/R00: NIH Pathways	9	5	5	2%
	G08: Resource Grants	47	N/A	57	20%
	G13: Scholarly Works	36	34	34	12%
	F31: Predoctoral Fellowship	2	7	5	2%
	UG4: National Network of Libraries of Medicine	N/A	11	N/A	N/A
	T15: National Training Program	N/A	34	N/A	N/A
CSR Review	R41/42/43: SBIR	0	0	29	33%
	T32	0	0	19	22%
	U01	0	0	34	39%
	R15	0	0	5	5%
	Special Program: AIDs Application	0	0	1	1%

*In August 2017, NLM's peer review study section was renamed the Biomedical Informatics, Library and Data Science (BILDS) Review Committee.

NLM NEW GRANTS AWARDED IN FY2017

Research Projects (R01)

Albers, David J.

Mechanistic Machine Learning

1 R01 LM012734-01

Columbia University Health Sciences

Burns, Gully A.

Evidence Extraction Systems for the Molecular Interaction Literature

1 R01 LM012592-01

University of Southern California

Chen, Yong

A General Framework to Account for Outcome Reporting Bias in Systematic Reviews

1 R01 LM012607-01

University of Pennsylvania

Davidson, Karina W.

Re-Engineering Precision Therapeutics Through N-of-1 Trials

1 R01 LM012836-01

Columbia University Health Sciences

Davuluri, Ramana V.

Informatics Platform for Mammalian Gene Regulation at Isoform-Level

2 R01 LM011297-05A1

Northwestern University

Dexheimer, Judith W.

Personal Health Records for Youth Emancipating from Foster Care

1 R01 LM012816-01

Cincinnati Children's Hospital Medical Center

Gillis, Jesse

Heuristics to Evaluate Biomedical and Genomic Knowledge Bases for Validity

1 R01 LM012736-01

Cold Spring Harbor Laboratory

Hoehn, Anne G.

Multi-Omic Functional Integration Using Networks

1 R01 LM012723-01

Dartmouth College

Lin, Joshua K.
Improving Comparative Effectiveness Research through Electronic Health Records Continuity Cohorts
1 R01 LM012594-01
Brigham and Women's Hospital

Moore, Jason H.
Biomedical Computing and Informatics Strategies for Precision Medicine
1 R01 LM012601-01
University of Pennsylvania

Nho, Kwangsik T.
Integrating Neuroimaging, Multi-Omics, and Clinical Data in Complex Disease
1 R01 LM012535-01
Indiana University-Purdue University at Indianapolis

Ralston, James D.
Seeing and Sharing What Matters: Personal Health Libraries for Individuals with Multiple Chronic Conditions
1 R01 LM012813-01
Kaiser Foundation Research Institute

Sabuncu, Mert R.
Novel Bioinformatics Strategies to Study Associations between Genetic Variants and Neuroanatomical Shape
1 R01 LM012719-01
Cornell University

Shah, Nigam
From Enrichment to Insights
2 R01 LM011369-05
Stanford University

Shatkay, Hagit
Incorporating Image-based Features into Biomedical Document Classification
1 R01 LM012527-01A1
University of Delaware

Weng, Chunhua
Bridging the Semantic Gap Between Research Eligibility Criteria and Clinical Data
2 R01 LM009886-08A1
Columbia University Health Sciences

Zhao, Zhongming
Predicting Phenotype by Using Transcriptomic Alteration as Endophenotype
1 R01 LM012806-01
University of Texas Health Sciences Center, Houston

Exploratory/Developmental Research (R21)

Chu, Haitao
Joint Meta-Regression Methods Accounting for Post-randomization Variables
1 R21 LM012744-01
University of Minnesota

Edwards, John R.
Deconvolution of Epigenomic Data to Characterize Cellular Subpopulations
1 R21 LM012395-01A1
Washington University

Janulis, Patrick F.
Implementing and Evaluating a Machine Learning Tool for Entity Resolution in Drug Use and Sexual Contact Networks of YMSM
1 R21 LM012578-01
Northwestern University

Luo, Yuan
Bayesian Generative Methods for Extracting and Modeling Relations in EHR Narratives
1 R21 LM012618-01
Northwestern University

Miura, Sayaka
Bayesian Evolution-Aware Methods for Tumor Single Cell Sequences
1 R21 LM012758-01
Temple University

Yang, Xinan H.
Differential Enhancer Transcription Identifies Cis-Regulatory Elements for Disease
1 R21 LM012619-01
University of Chicago

NIH Director's New Innovator Award (DP2)

Morgan, Daniel J.
*Incorporating Bayesian Reasoning into Physician
 Testing and Treatment Decisions*
 1 DP2 LM012890-01
 University of Maryland, Baltimore

NLM Knowledge Management/Applied Informatics (G08)

Johnson, J. Aaron
*Promoting Health Literacy and Improved Self-Care
 Management of Incarcerated Populations Using
 Secure Tablet Technology*
 1 G08 LM012693-01
 Augusta University

Kukafka, Rita
*Conexion: A Localized Information Resource for a
 Low-income Hispanic Community*
 1 G08 LM012689-01
 Columbia University Health Sciences

Simon, Melissa A.
*Enhancing Clinical Trials Participation through
 Library Partnerships*
 1 G08 LM012688-01
 Northwestern University

Zoorob, Roger J.
*Reducing Health Disparities in Primary Care
 through a Family Medicine-Library Alliance*
 1 G08 LM012634-01
 Baylor College of Medicine

NLM Grants for Scholarly Works in Biomedicine and Health (G13)

Grogan, Colleen M.
Americas Hidden Health Care State
 1 G13 LM012474-011
 University of Chicago

Kwate, Naa O.
*Race and the Transformation of the Food
 Environment: Fast Food, African Americans, and
 the Color Line, 1955-1995*
 1 G13 LM012463-01
 Rutgers University

Thompson, Claudia M.
*A History of Vaccination for Smallpox in Southeast
 Asia, 1804-1945*
 1 G13 LM012475-01
 Southern Connecticut State University

NLM Career Development Award in Biomedical Informatics (K01)

Landis-Lewis, Zachary
A Knowledge-based Message Tailoring System
 1 K01 LM012528-01
 University of Michigan
 Weiskopf, Nicole G.
*Measuring and Improving Data Quality for Clinical
 Quality Measure Reliability*
 1 K01 LM012529-01A1
 Duke University

Tenenbaum, Jessica D.
*Improved Disease Stratification Using Electronic
 Health Records*
 1 K01 LM012738-01
 Oregon Health & Science University

Small Business Innovations Research (SBIR) and Small Business Technology Transfer (STTR) Awards (R41, R43, R44)

Emery, Robert W.
The Use of Organizer Software for Secure Team-Based, Clinician-to-Clinician Communication to Improve Recipient Outcomes for Solid Organ Donation Cases
1 R43 LM012575-01
Organizer

Felsovalyi, Klara O.
BD2K Product for Enhancing Phenotypic Screens
1 R43 LM012577-01
Genecentrix, Inc.
Sairamesh, Jakka
Enabling Value-based Healthcare through Automating Risk Assessment for Episode-based Care
1 R43 LM012798-01
Capsicohealth, Inc.

NLM Institutional Training Grants for Research in Biomedical Informatics and Data Science (T15)

Altman, Russ B.
Biomedical Informatics Training at Stanford
2 T15 LM007033-34
Stanford University
Brandt, Cynthia A.
Biomedical Informatics and Data Science Training at Yale
2 T15 LM007056-31
Yale University
Chapman, Wendy W.
University of Utah Biomedical Informatics Training Grant
2 T15 LM007124-21
University of Utah
Craven, Mark W.
Computation and Informatics in Biology and Medicine
2 T15 LM007359-16
University of Wisconsin-Madison
Demiris, George
Biomedical and Health Informatics Training Program
2 T15 LM007442-16
University of Washington
Dixon, Brian E.
The Indiana Training Program in Public & Population Health Informatics
1 T15 LM012502-01
Indiana University-Purdue University at Indianapolis

Elkin, Peter L.
Buffalo Research Innovation in Genomic and Healthcare Technology Education (BRIGHT Education)
1 T15 LM012495-01
State University of New York at Buffalo
Gadd, Cynthia S.
Vanderbilt Biomedical Informatics Training Program
2 T15 LM007450-16
Vanderbilt University
Hersh, William R.
Research Training in Biomedical Informatics and Data Science at Oregon Health & Science University
2 T15 LM007088-26
Oregon Health & Science University
Hochheiser, Harry S.
Pittsburgh Biomedical Informatics Training Program
2 T15 LM007059-31
University of Pittsburgh
Hripcsak, George M.
Training in Biomedical Informatics at Columbia University
2 T15 LM007079-26
Columbia University Health Sciences
Hunter, Lawrence E.
Colorado Biomedical Informatics Training Program
2 T15 LM009451-11
University of Colorado, Denver

Kavraki, Lydia E.
*NLM Training Program in Biomedical Informatics
 for Predoc & Postdoctoral Fellows*
 2 T15 LM007093-26
 Rice University

McCray, Alexa T.
*Biomedical Informatics and Data Science
 Research Training Program*
 2 T15 LM007092-26
 Harvard Medical School

Mostafa, Javed
*An Interdisciplinary Program for Advanced Training
 in Health Data Analytics*
 1 T15 LM012500-01
 University of North Carolina-Chapel Hill

Ohno-Machado, Lucila
*San Diego Biomedical Informatics Education
 & Research (SABER)*
 2 T15 LM011271-06
 University of California, San Diego

NIH Big Data to Knowledge (BD2K) Grants

Hadley, Dexter D.
*Crowd-Assisted Deep Learning (Cradle)
 Digital Curation to Translate Big Data into
 Precision Medicine*
 1 U01 LM012675-01
 University of California, San Francisco

Schürer, Stephan C.
*Unifying Templates, Ontologies, and Tools to
 Achieve Effective Annotation of Bioassay Protocols*
 1 U01 LM012630-01
 University of Miami School of Medicine

Sternberg, Paul W.
*Streamlined Capture and Curation of
 Unpublished Data*
 1 U01 LM012672-01
 California Institute of Technology

Ruth R. Kirschstein National Research Service Award Individual Predoctoral Fellowship

Donevant, Sara B.
*An Evidence-based Evaluation Tool to Assist
 Health Care Providers in Their Assessment of
 Effective mHealth Applications of the Management
 of Chronic Health Conditions*
 1 F31 LM012402-01A1
 University of South Carolina

Tian, Yuxi
*Large Scale Observational Analytics
 for Health Informatics*
 1 F31 LM012636-01
 University of California, Los Angeles



Office of Computer and Communications Systems

Ivor D'Souza

Director



The Office of Computer and Communications Systems (OCCS) provides:

- efficient, cost-effective computing and networking services, application development, and technical advice and collaboration in information sciences;
- NLM's computer networking backbone, connections to external networks, the DHS and HHS-approved "unrestricted Trusted Internet Gateway," and interconnections to divisional networks within NLM;
- the NLM Computer Data Center onsite in Bethesda, and the offsite co-location facility in Sterling, Virginia;
- coordination, integration, and standardization of the vast array of computer services available throughout NLM and for other federal organizations with biomedical, statistical, and administrative computing needs;
- creation, maintenance, and enhancement of applications and websites for controlled medical terminology systems, consumer and public health, and outreach programs, and systems that provide many types of medical data for public consumption; and
- applications and websites designed to be secure, user-friendly, and easily accessible by all.

APPLICATION MODERNIZATION AND CLOUD INFRASTRUCTURE

During 2017, OCCS modernized its overall application development platform, delivering the following benefits without compromising our rigorous testing and security standards:

- quicker and less complex software release cycles through the continuous integration and continuous deployment of application software changes across OCCS applications;
- fewer software bugs and flaws through improved automated testing; and

- seamless migration to cloud services, which offer long-term cost savings compared to on-site computing and data storage.

A redesigned NIH Common Data Elements Repository became the first application to move fully onto cloud services using the new development platform. Moving to the cloud has improved the service's availability and reliability and has reduced internet latency by being hosted closer to every user. OCCS can now flexibly scale component micro-services for performance tuning

and no longer requires service outages when deploying code changes.

AccessGUDID, developed in partnership with the FDA, was similarly reworked this year using the new development platform. It can now run on either local servers or cloud services. As part of the site's redesign, OCCS also replaced the AccessGUDID search engine, using Elasticsearch

in place of IBM Watson Explorer. Elasticsearch provides improved speed, extensibility, and scalability, along with 300% faster querying speeds, allowing us to increase maximum search results from 1,000 to 10,000. In addition, by moving AccessGUDID's database from Oracle 12c to MongoDB, we reduced maintenance costs.

CONSUMER HEALTH AND MEDICAL SUBJECT LANGUAGE

MedlinePlus Lab Tests

The most popular outbound (i.e., non-NLM and non-NIH) links in MedlinePlus are for information on lab tests. Given that level of interest, MedlinePlus introduced information on lab tests (in both English and Spanish) to fill gaps in MedlinePlus Connect, which links patient portals and electronic health records to consumer health information. Between May and August 2017, MedlinePlus lab test content received 43,139 visits and 74,397 pageviews.

OCLC Access to NLM Collections

OCCS worked with Library Operations and OCLC to increase the use of NLM's resources and support interlibrary loans. As a result, OCLC now includes the full holdings of NLM's print serials, which has increased access to NLM's collection by over 450%, from the 2,000 DOCLINE libraries to the 9,000 OCLC member libraries.

Risk Evaluation and Mitigation Strategies

DailyMed now offers for download drug Risk Evaluation and Mitigation Strategies (REMS), which provide users with the risks associated with and the safe use of a particular drug or class of drugs. As a result, REMS information will be more readily integrated into existing health care systems.

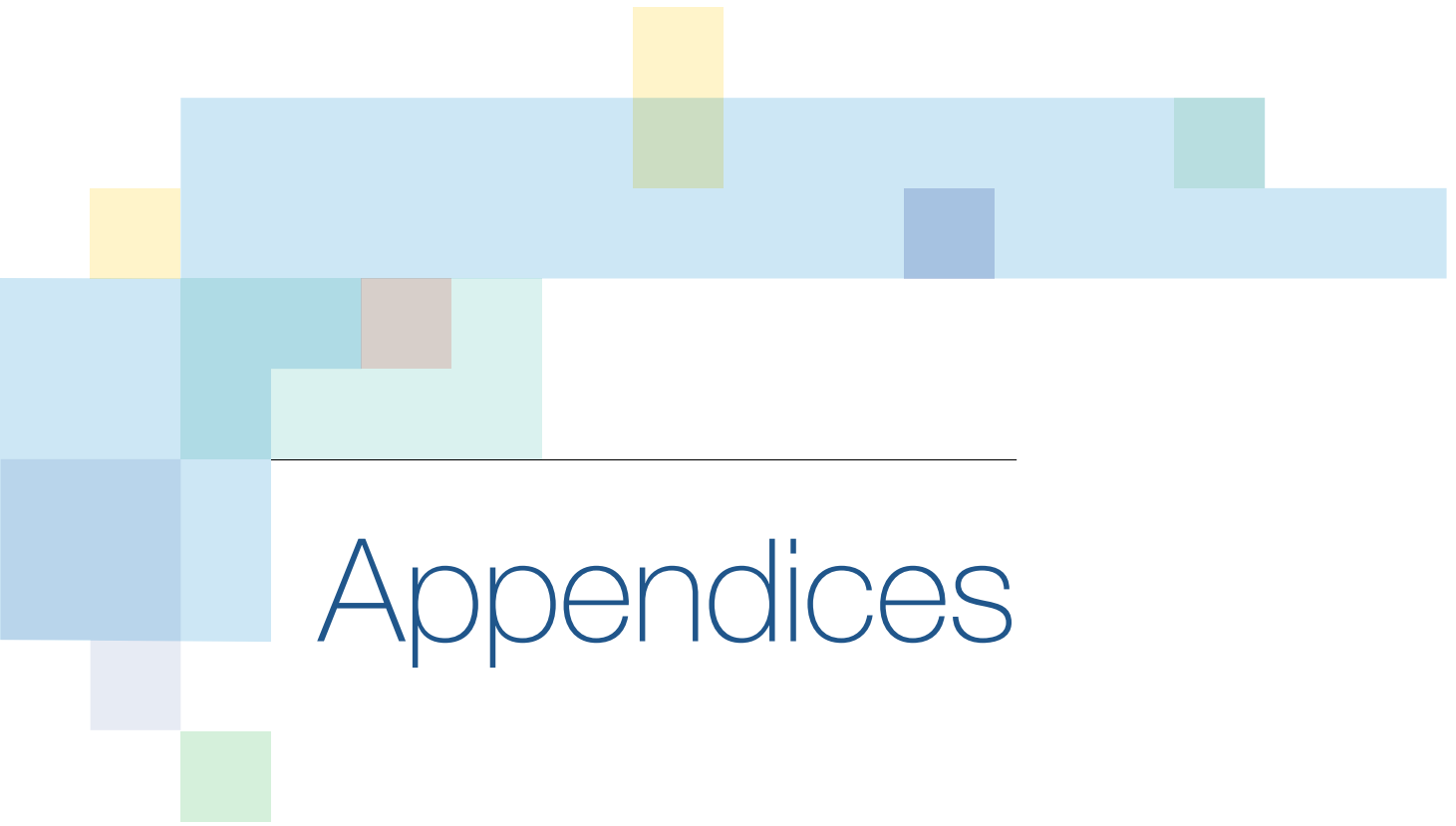
NLM IT INFRASTRUCTURE

Unified Communications and Collaboration

Collaborating with the NIH Center for Information Technology, OCCS staff coordinated the NLM transition away from ISDN telephones (and a large NIH telecom switch) to a voice-over-IP Unified Communications and Collaboration system that handles voice, text, and video communication.

NLM expects to achieve the following benefits as a result:

- a savings of about \$490,000 annually in ongoing telecommunication costs (once first-year investment costs are recouped); and
- enhanced telephone services, including:
 - integration with computer applications;
 - additional connection and collaboration options, such as video calls, instant messaging, screen sharing, and video meetings; and
 - the ability to see others' availability (i.e., available, busy, away).



Appendices

Appendix 1: Regional Medical Libraries and National Coordinating Offices

Regional Medical Libraries

MIDDLE ATLANTIC REGION

University of Pittsburgh
Health Sciences Library System
States served: DE, NJ, NY, PA

SOUTHEASTERN/ATLANTIC REGION

University of Maryland at Baltimore
Health Sciences and Human Services Library
States served: AL, FL, GA, MD, MS, NC, SC, TN, VA, WV, DC, PR, VI

GREATER MIDWEST REGION

University of Iowa
Hardin Library for the Health Sciences
States served: IA, IL, IN, KY, MI, MN, ND, OH, SD, WI

MIDCONTINENTAL REGION

University of Utah
Spencer S. Eccles Health Sciences Library
States served: CO, KS, MO, NE, UT, WY

SOUTH CENTRAL REGION

University of North Texas Health Science Center
Gibson D. Lewis Library
States served: AR, LA, NM, OK, TX

PACIFIC NORTHWEST REGION

University of Washington
Health Sciences Library
States served: AK, ID, MT, OR, WA

PACIFIC SOUTHWEST REGION

University of California, Los Angeles
Louise M. Darling Biomedical Library
States served: AZ, CA, HI, NV, and US Territories in the Pacific Basin

NEW ENGLAND REGION

University of Massachusetts Medical School
Lamar Soutter Library
States served: CT, MA, ME, NH, RI, VT

National Coordinating Offices

WEB SERVICES OFFICE

University of Pittsburgh
Health Sciences Library System

DOCLINE COORDINATION OFFICE

University of Maryland at Baltimore
Health Sciences and Human Services Library

TRAINING OFFICE

University of Utah
Spencer S. Eccles Health Sciences Library

EVALUATION OFFICE

University of Washington
Health Sciences Library

PUBLIC HEALTH COORDINATION OFFICE

University of Massachusetts Medical School
Lamar Soutter Library

Appendix 2: Board of Regents

The NLM Board of Regents meets three times a year to consider Library issues and to make recommendations to the Secretary of Health and Human Services affecting the Library.

Chairperson

Sternberg, Esther M., MD
Research Director, Arizona Center for Integrative Medicine
Director, Institute on Place & Well Being
Professor of Medicine, the University of Arizona College of Medicine

Members

Acquisti, Alessandro, PhD
 Professor
 Information Technology and Public Policy
 Heinz College
 Carnegie Mellon University

Blumenthal, Jane L., MSLS
 Director
 Taubman Health Sciences Library
 University of Michigan

Horvitz, Eric J., MD, PhD
 Director and Technical Fellow
 Microsoft Research

Martin, Sandra I., MSLS
 Director
 Shiffman Medical Library
 Wayne State University

Masys, Daniel R., MD
 Affiliate Professor
 Biomedical and Health Informatics
 University of Washington School of Medicine

Puckrein, Gary A., PhD
 Executive Director
 National Minority Quality Forum

Taylor, Jill, PhD
 Director
 Wadsworth Center
 New York Department of Health

Appendix 3: Board of Scientific Counselors, Lister Hill National Center for Biomedical Communications

The Board of Scientific Counselors provides advice on NLM's intramural research and development programs for the Lister Hill National Center for Biomedical Communications.

Chairperson

Cummins, Mollie R., PhD
 Associate Professor
 Schools of Nursing and Medicine
 University of Utah

Members

Downs, Stephen M., PhD
 Professor and Vice Chair for General
 Pediatrics and Director for Children's
 Health Services Research
 Indiana University School of Medicine

Embi, Peter J., MD
 President/CEO, Regenstrief Institute, Inc.
 Sam Regenstrief Professor of Medicine
 Associate Dean for Information & Health
 Services Research
 IU School of Medicine
 Associate Director for Informatics, Indiana CTSI
 Vice President for Learning Health Systems,
 IU Health

Hripcsak, George M., MD
 Professor of Biomedical Informatics
 Columbia University Medical Center
 Columbia University

Johnson, Kevin B., MD
 Professor & Chair of Biomedical Informatics
 Professor of Pediatrics
 Chief Informatics Officer
 Vanderbilt University Medical Center

Murphy, Shawn N., MD, PhD
 Associate Professor of Neurology
 Harvard Medical School
 Department of Neurology
 Massachusetts General Hospital
 Partners Healthcare
 Research IS & Computing

Xu, Hua, PhD
 Professor
 School of Biomedical Informatics
 The University of Texas Health Science Center

Appendix 4: Board of Scientific Counselors, National Center for Biotechnology Information

The Board of Scientific Counselors provides advice on NLM's intramural research and development programs for the National Center for Biotechnology Information.

Chairperson

De Crecy-Lagard, Valerie A., PhD
Professor
Department of Microbiology
University of Florida

Members

Boehnke, Michael L., PhD
Professor
Department of Biostatistics
School of Public Health
University of Michigan

Green, Rachel, PhD
Professor
Department of Molecular Biology and Genetics
School of Medicine
John Hopkins University

Guy, R. Kiplin, PhD
Dean, College of Pharmacy
University of Kentucky

Hripscak, George M., MD
Professor of Biomedical Informatics
Chair, Department of Biomedical Informatics
Medical Center
Columbia University

Relman, David A., MD
Professor
Department of Microbiology and Immunology
Stanford University

Zhang, Jianzhi, PhD
Marshall W. Nirenberg Collegiate Professor
Department of Ecology and Evolutionary
Biology
University of Michigan

Appendix 5: Biomedical Library and Informatics Review Committee

The Biomedical Library and Informatics Review Committee meets three times a year to review applications for grants under the Medical Library Assistance Act.

Chairperson

Holmes, Kristi, PhD
Director, Galter Health Sciences Library
Associate Professor, Department of Preventive
Medicine-Health and Biomedical Informatics
Feinberg School of Medicine
Northwestern University

Members

Archer, Kellie J., PhD
Professor and Chair
Division of Biostatistics
College of Public Health
The Ohio State University

Bahar, Ivet, PhD
Distinguished Professor and John K. Vries Chair
Department of Computational & System Biology
University of Pittsburgh

Bennett, Kristin P., PhD
Associate Director
Institute for Data Exploration and Applications
Rensselaer Polytechnic Institute

Bernstam, Elmer V., MD
 Reynolds and Reynolds Professor and
 Associate Dean for Research
 School of Biomedical Informatics
 Professor, Department of Internal Medicine,
 Medical School
 The University of Texas Health Science Center
 at Houston

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 and Practice
 Associate Director of Brown Center of
 Biomedical Informatics
 Brown University

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 Informatics Institute
 University of Alabama at Birmingham
 School of Medicine

Denny, Joshua C., MD
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 Director, Vanderbilt University Center for
 Precision Medicine
 Vice President for Personalized Medicine
 Department of Biomedical Informatics
 Vanderbilt University Medical Center

Dorr, David A., PhD
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 Department of Medical Informatics and
 Clinical Epidemiology
 Oregon Health & Science University

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 Department of Biomedical Informatics
 Columbia University

Gennari, John H., PhD
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 University of Washington

Gollop, Claudia J., PhD
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 University of North Carolina, Chapel Hill

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 Department of Biostatistics, Epidemiology,
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 Perelman School of Medicine at the University
 of Pennsylvania

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 & Medical Education
 Chief Research Information Officer,
 UW Medicine
 University of Washington School of Medicine

Page Jr., C. David, PhD
 Professor
 Department of Biostatistics & Medical
 Informatics & Department of Computer
 Sciences
 University of Wisconsin-Madison
 School of Medicine & Public Health

Seymour, Anne, MS
 Director, Welch Medical Library
 Johns Hopkins University

Shipman, Jean P., MSLS
 Health Sciences Librarian
 Vice President, Global Library Relations,
 Elsevier

Librarian Emerita & Director for Information
 Director for Information Transfer, Center
 for Transfer
 Center for Medical Innovation
 University of Utah

Smalheiser, Neil R., MD, PhD
 Associate Professor
 Department of Psychiatry
 Psychiatric Institute
 University of Illinois at Chicago

Swamidass, Sanjay, MD, PhD
 Assistant Professor
 Department of Immunology and Pathology
 Division of Laboratory and Genomic Medicine
 Washington University

Appendix 6: Literature Selection Technical Review Committee

The Literature Selection Technical Review Committee advises the Library on matters of policy related to the evaluation and recommendations of biomedical publications to be considered for indexing and inclusion in MEDLINE.

Chairperson

Nwomeh, Benedict C., MD
Attending Surgeon, Professor
Pediatric Surgery
Nationwide Children's Hospital
The Ohio State University

Members

Balasubramaniam, Sanjeeve, MD
Medical Officer
Office of Hematology Oncology Products
Center for Drug Evaluation and Research
Food and Drug Administration

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Assistant Director, Research and Informatics
Taubman Health Sciences Library
University of Michigan

Corsi, Karen F., ScD
Associate Professor
Department of Psychiatry
University of Colorado, Denver

Godoy-Vitorino, Filipa, PhD
Research Professor
Department of Natural Sciences
College of Sciences and Technology
Inter American University of Puerto Rico

Greenland, Kristen B., PhD
Science Librarian
Keefe Science Library
Amherst College

Hodge, Felicia S., DRPH
Professor and Director
School of Nursing/School of Public Health
Center for American Indian
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University of California, Los Angeles

Kalet, Adina, MD
Associate Professor of Medicine and Surgery
Division of General Internal Medicine
New York University School of Medicine

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Division of Cardiothoracic Surgery
Baylor College of Medicine

Yates, Bill J., PhD
Professor
Department of Otolaryngology and
Neuroscience
University of Pittsburgh

Yoshimura, Masami, DSc
Associate Professor
Department of Comparative Biomedical
Sciences
School of Veterinary Medicine
Louisiana State University

Appendix 7: PubMed Central National Advisory Committee

The PubMed Central National Advisory Committee establishes criteria for groups submitting materials to the PubMed system, monitors its operation, and ensures that, as PubMed Central evolves, it remains responsive to the needs of researchers, publishers, librarians, and the general public.

Members

Butter, Karen A., MLS
University Librarian Emeritus
Department of Administration
University of California, San Francisco

Cantu, Adelita G., RN, PhD
Associate Professor
Family & Community Health Systems
The University of Texas Health Science Center

Cooper, Nigel G.F., PhD
Professor
Department of Anatomical Sciences
& Neurobiology
University of Louisville

Dewey, Barbara, MA
Dean
University Libraries and Scholarly
Communications
Pennsylvania State University

Eisen, Jonathan A., PhD
Departments of Medical Microbiology
and Immunology
UC Davis Genome Center
University of California, Davis

Lively, Mark O., PhD
Professor Emeritus of Biochemistry
Director, Protein Analysis Core Laboratory
Wake Forest University Institute of
Regenerative Medicine
Wake Forest Biotech Place

McCrary, Jr., Victor, PhD
Vice President for Research and
Economic Development
Morgan State University

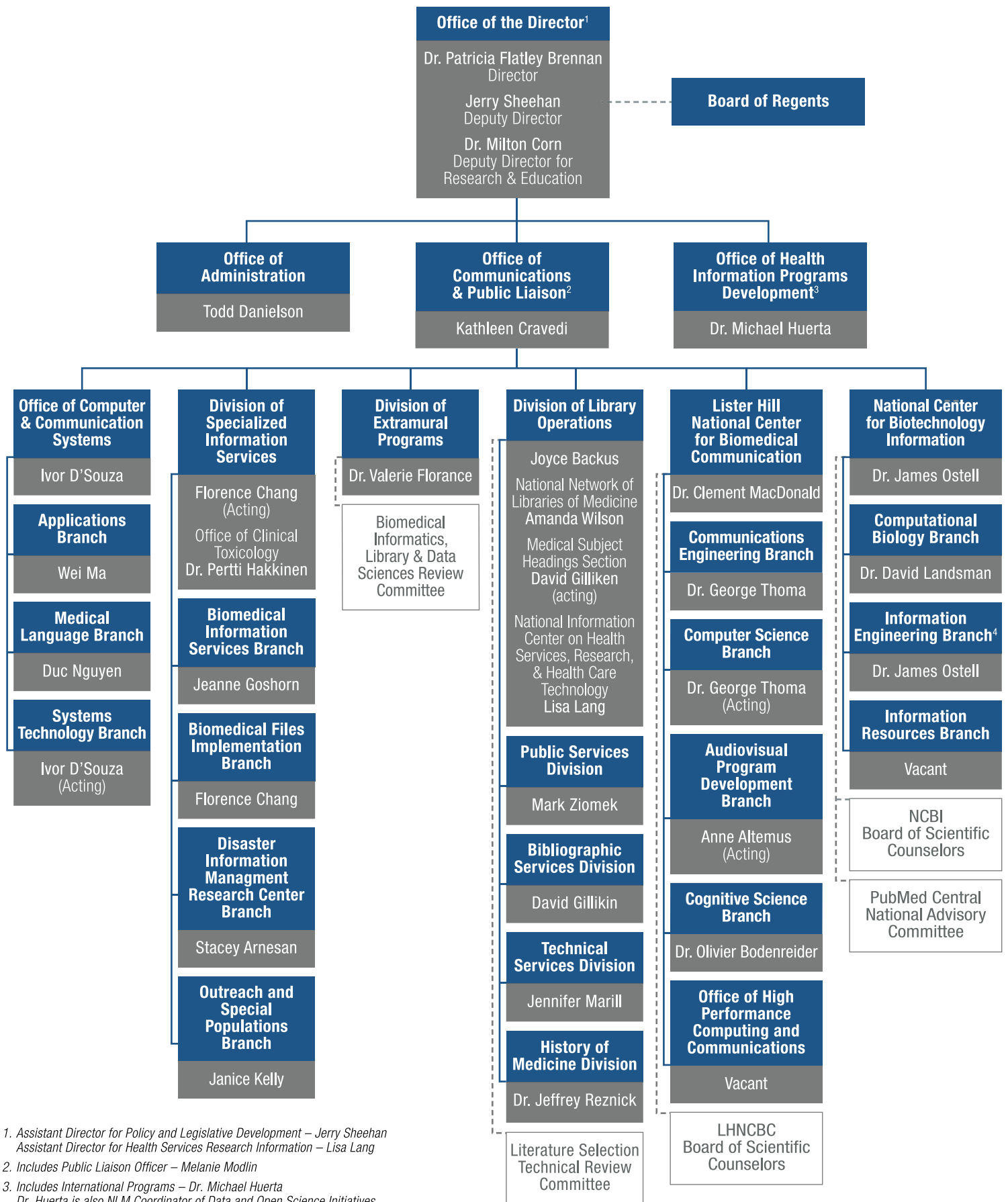
Starratt, Jay, MA
Dean of Libraries
Washington State University

Stodden, Victoria, PhD
Associate Professor
Graduate School of Library and
Information Science
University of Illinois at Urbana-Champaign

For additional information regarding the
programs described in this report, contact:

Office of Communications and Public Liaison
National Library of Medicine
8600 Rockville Pike
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1. Assistant Director for Policy and Legislative Development – Jerry Sheehan
Assistant Director for Health Services Research Information – Lisa Lang

2. Includes Public Liaison Officer – Melanie Modlin

3. Includes International Programs – Dr. Michael Huerta
Dr. Huerta is also NLM Coordinator of Data and Open Science Initiatives.

4. Includes ClinicalTrials.gov – Dr. Deborah Zarin, Director

