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PREFACE

Fiscal Year 2015 saw achievement in many areas, as the following report attests. Here's a sampling of the accomplishments of our gifted staff, advisors, and consultants during that period:

- MedlinePlus debuted a new responsive design, joining AIDS*info* and other NLM websites that provide information in a format optimized for desktop, tablets, and phones, as it continued to grow and deliver essential health information to the public.
- With encouragement from the President and Congress, seven other government agencies have followed in the steps of NIH and are adopting PubMed Central (PMC) as a platform for their public access policies.
- In close partnership with NLM, NIH and HHS took steps to enhance the transparency of clinical trial results by issuing a Notice of Proposed Rulemaking. The proposed rule clarifies requirements for registering trials and submitting results information to ClinicalTrials.gov.
- Influenced by the success of DailyMed, the FDA again turned to NLM, this time to make a new medical device registration database, AccessGUDID, available to the public.
- In a positive step for public health, we enhanced the database and analytic tools that process high throughput sequencing data to support our joint effort with CDC, FDA, and USDA to identify more rapidly and accurately pathogens causing foodborne illnesses.
- We created a system to detect tuberculosis in X-rays of HIV patients in Kenya and piloted a machine learning tool to speed malaria diagnosis.
- We continued to develop information and tools relevant to disasters. We provided trustworthy information about the Ebola outbreak and launched a web-collecting initiative to capture and preserve selected born-digital content documenting that event.
- We strengthened and expanded partnerships to deliver health information to underserved populations and to encourage young people to consider careers in medicine and science. Examples include our Mentoring in Medicine events and our expanding K-12 resources.
- We digitized more rare and unique items from NLM's rich historical collections and showcased these collections in special public events, new *Profiles in Science*, and traveling exhibitions.
- Our researchers collaborated on the revolutionary CRISPR-*Cas* DNA editing tool, using a computational strategy to discover three systems that have the potential to revolutionize bioengineering.
- Our computer systems continued to deliver information reliably and effectively in response to billions of searches from our millions of users worldwide.
- We saluted Dr. Donald Lindberg and his remarkable career as NLM Director with a series of special events and by renaming the NLM Board Room in his honor.

Thanks to all involved for your outstanding public service, dedication to duty, and boundless creativity.

Betsy L. Humphreys
Acting Director

The End of an Era: Donald Lindberg, MD, Retires After 31 Years as NLM Director

March 31, 2015 marked Director Dr. Donald A.B. Lindberg's last day heading the National Library of Medicine. Retiring after more than 31 years of service, he was the library's longest serving director and one of the longest serving leaders at the National Institutes of Health, the library's parent organization.

On his penultimate day on the job, he was saluted by hundreds of people from NLM, the NIH, and across the country, who gathered at NIH's Natcher Center to celebrate his many contributions to the world's largest medical library and, through its work and that of its partners, to the health of people around the globe.

A prescient leader

The retirement ceremony included a video clip of the speech he gave at his 1984 swearing-in ceremony. In it, Dr. Lindberg predicted a time when "the book or journal on the shelf will become increasingly too remote for immediate patient-care decisions" and the computer will become increasingly useful; when "medical informatics will emerge as a formal research field and academic discipline;" and when progress in "cancer research and molecular biology will be to the average citizen not an idle curiosity or newspaper headline, but a matter of immediate personal concern."

NIH Director Francis Collins, MD, PhD, found Dr. Lindberg's 1984 speech to be a fascinating testimony to his vision—remarkably true and prescient. He said, "Don created programs that transformed our approach to information."

Other NIH colleagues, like NIAID Director Anthony Fauci, MD, echoed this sentiment. "The kind of capabilities you put at our fingertips made what we do possible," said Fauci, adding that Dr. Lindberg's influence at NLM and NIH had been profound.

Congressional tribute

In a *Congressional Record* tribute to Dr. Lindberg, Senator Tom Harkin pointed out that "NLM had no electronic journals in its collection when Don joined NLM in 1984." Sen. Harkin went on to highlight some of Dr. Lindberg's achievements, including the creation of the National Center for Biotechnology Information (NCBI) in 1988. "Its work," said Sen. Harkin, "was essential to the mapping of the human genome. Today, NCBI is home to GenBank, PubMed Central, and dbGaP, and is an indispensable international repository and software tool developer for genetic sequences and other scientific data, and a pioneer and leader in linking data and published research results to promote new scientific discoveries."

Board resolution

Dr. Lindberg's career was perhaps best summarized by the following resolution approved by the Board of Regents of the National Library of Medicine and presented to him by its chair, Trudy MacKay, PhD:

Board of Regents of the National Library of Medicine Resolution

Approved and presented on February 10, 2015

To congratulate and commend Donald A. B. Lindberg, MD, Director of the National Library of Medicine, NIH, for more than 30 years of visionary and transformative leadership.

Whereas:

Dr. Donald A.B. Lindberg, a pioneer in applying computers to health care with expertise and outstanding accomplishments relevant to NLM's mission, was appointed its Director in 1984;

He engaged the Board of Regents and the library's many constituent groups in highly effective long range planning that built on NLM's unique strengths and guided decades of spectacular innovations and accomplishments;

His focus on long-term technology trends, user engagement, strong partnerships, and public policy led to a steady stream of high impact services, including free Internet access to MEDLINE via PubMed, MedlinePlus, ClinicalTrials.gov, PubMed Central, PubChem, dbGaP, free use of clinical terminology standards for electronic health records (EHRs), and many specialized genomic, toxicology, health services research, public health, consumer health, disaster and emergency response, and history of medicine resources;

He played a leading role in establishing the National Center for Biotechnology Information (NCBI) at NLM in 1988, thereby ensuring effective links between gene sequences and the published literature and providing key infrastructure for the Human Genome Project and many subsequent scientific "big data" initiatives;

He advanced the field of biomedical informatics by expanding research training programs and increasing research funding; integrating biomedical and health applications into the multi-agency High Performance Computing and Communications initiative; developing unprecedented research resources, such as Unified Medical Language System, lexical tools, Visible Humans, ITK, and the pill image collection; pushing the field to embrace molecular biology, public health, disaster response, and patient contributions; and mentoring many;

He made NLM services available outside of academic institutions and hospitals, reaching health professionals, patients, and the public wherever located; expanded the scope of the National Network of Libraries of Medicine to provide outreach to underserved populations; built enduring partnerships with minority-serving institutions, tribal and community based organizations, and the public health and emergency response communities; and used a vibrant historical exhibit program to interest diverse young people in biomedical careers;

He expanded NLM collaborations with other NIH Institutes and Centers, other HHS agencies, and other federal departments and ensured that the library provided critical support to NIH, HHS, and US-government priorities, including the Multilateral Initiative on Malaria, clinical trials registration and results submission, public access to the results of government-funded research, response to disasters, and electronic health records;

He ensured that NLM data were "open" to external developers and researchers via applications programming interfaces (APIs) and bulk downloads, as well as via interactive web interfaces, mobile devices, and social media, to fuel the development of value-added products and services;

He believed in the power of multidisciplinary teams at NLM and elsewhere; embraced diversity; championed expanded roles for health sciences librarians in biomedical informatics, clinical research, consumer health, public health, disaster preparedness and response, and data management; and expanded their training and career development opportunities;

He attracted, retained, and invested in outstanding people; promoted innovation and efficiency in all NLM activities, including high-volume production operations and administrative functions; and maintained and upgraded facilities, computer reliability and security, and high speed connections to keep pace with demand for NLM services;

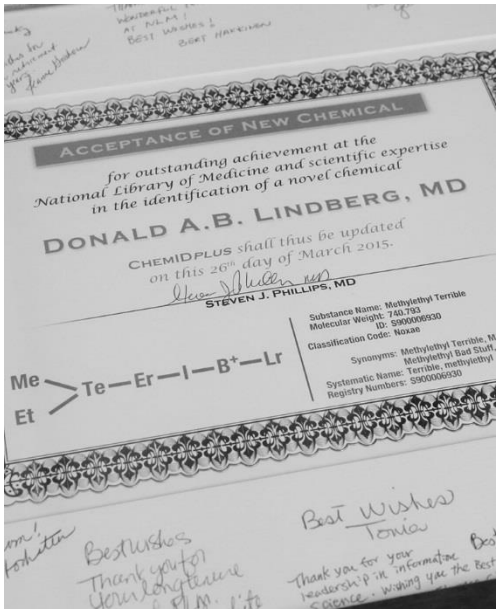
In sum, his vision, uncanny judgment, courage, and perseverance have resulted in free, robust Internet access to vast quantities of trusted consumer health

information, published biomedical knowledge, chemical and drug information, clinical trials information, and scientific data that are used every day by millions of people and thousands of computer systems across the country and around the globe;

He will depart from NLM on March 31, 2015, having changed fundamentally the way biomedical knowledge and health information is collected, organized, and made available for public use—in small villages in Alaska and Mali as well as in laboratories of Nobel Prize winners. He has therefore empowered the public and transformed the conduct of research, the education of students, and the care of patients.

Now, therefore, be it

Resolved, that the Board of Regents of the National Library of Medicine salutes and thanks Dr. Donald A. B. Lindberg for his outstanding public service and for translating the promise of computers and telecommunications into robust systems that deliver biomedical and health information around the world to advance research, clinical care, and the public's health.



Certificate announcing Methylethyl Terrible now included in ChemID*plus*


Dr. and Mrs. Donald Lindberg share a laugh at his NLM retirement event.


The library in winter

Lofty Goal, Amazing Discoveries: NCBI's Work with CRISPR-*Cas*

"We are interested in understanding the evolution of life."

So begins the statement of research interests for the Evolutionary Genomics Research Group, headed by Eugene Koonin, PhD, in NLM's National Center for Biotechnology Information (NCBI). It's a lofty, even audacious, goal, perhaps not fully achievable, but the progress toward it has the potential to uncover amazing things.

In fact, it already has.

Since the late 1990s, Koonin and his team have proposed theoretical models and uncovered genetic elements that have propelled biotechnology forward. Among their notable work is that related to the CRISPR system, a revolutionary tool for editing DNA.

This year, working together with NIH-funded researchers Feng Zhang, of the Broad Institute and MIT, and Konstantin Severinov, of Rutgers University and the Skolkovo Institute of Science and Technology in Russia, they identified three new CRISPR-*Cas* systems. Perhaps even more exciting—the computational approach that led to those discoveries can potentially unlock more.

CRISPR's origins

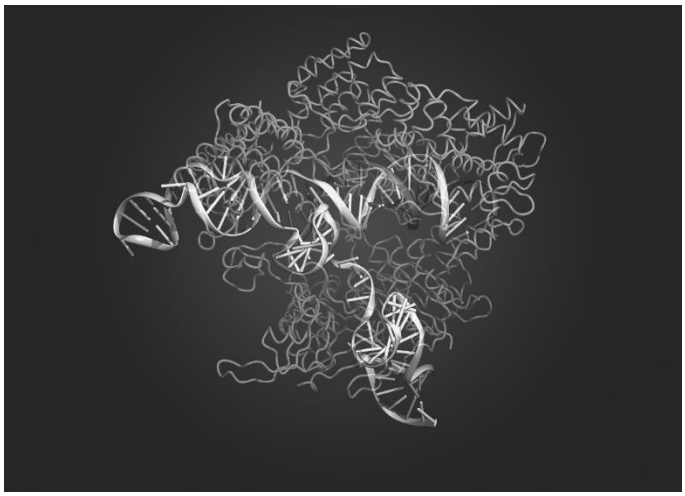
The repeating gene sequences and distinct pattern that comprise CRISPR were first discovered in bacteria in 1987, but no one knew what they meant.

As technology advanced and more genes could be sequenced, scientists found the distinctive pattern in a number of microbial species and matched them to viruses known to infect bacteria. The pattern's role was still unknown, but in 2002 it finally got a name—CRISPR—for "clustered, regularly interspaced short palindromic repeats."

Since then, CRISPR-based research has advanced quickly.

Researchers discovered that CRISPR sequences were part of a system bacteria use to defend against invading viruses. Bacteria with CRISPR-based immune systems recognize viruses they were previously exposed to and command proteins to attack, cutting their DNA strands so the virus cannot replicate.

The job of cutting the DNA, scientists learned, fell to specific enzymes, and these enzymes resulted from specific genes—dubbed *Cas*, for CRISPR associated genes—that were always near a CRISPR sequence.



CRISPR-*Cas*9 system (Credit: B. Wong, Broad Institute)

Putting CRISPR to work

The precision and effectiveness of the CRISPR-*Cas* combo outpaced any genetic engineering tool science had known up to that point, so it was only a matter of time before researchers learned to control it.

The first step in 2012 involved snipping a microbe's DNA at a precise location using *Cas*9. The next step came quickly, cutting a specific piece of human DNA and replacing it with another in 2013.

The pace hasn't slowed since.

Scientists have shown that the CRISPR-*Cas* system can be used as a programmable editing tool, efficiently and precisely modifying the genomes from mammals and other organisms. Thousands of labs now use it for a wide range of applications, including creating animal models for human diseases, identifying genes underlying biological processes, and modifying plants to increase yield.

The possibilities are astounding.

Using data to hunt *Cas*

NCBI's discovery of three new *Cas* systems in 2015 multiplies those possibilities. And the way they discovered them suggests more are on the way.

Koonin and his team used a computational strategy to examine large sets of DNA to locate CRISPR sequences similar to *Cas*9 and predict their function. Then Zhang's lab at MIT put those predictions to the test.

The Cpf1 enzyme discovered this way shows unexpected characteristics that can make it a powerful tool in bioengineering. It's smaller, cuts DNA differently, and recognizes different types of strands, which means it can be put to different uses.

The same computational approach allowed the team of collaborators to identify an entirely new type of CRISPR system, proteins they called Class 2 candidates 1, 2, and 3 (C2c1, C2c2, and C2c3). (Class 2 systems use one large *Cas* protein to carry out the snipping function. Class 1 systems use multiple, smaller proteins.)

This trio of systems shares some features with *Cas*9 and Cpf1, but they have unique properties that open up the possibility of novel genome-editing applications.

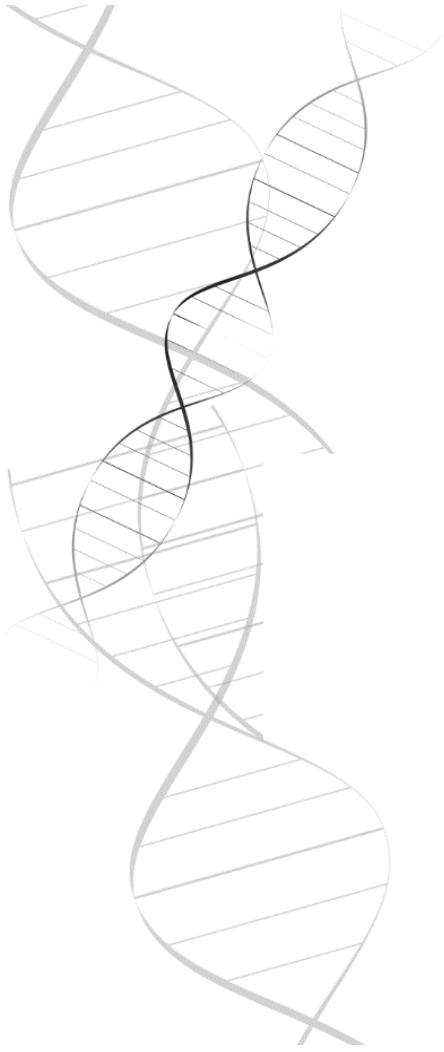
But Koonin and his team aren't done yet.

Because there are multiple ways to modify the search algorithm they ran against NCBI's genomic databases, they expect to discover additional distinct CRISPR-*Cas* systems in the near future.

The evolution of life

As for how it all relates to the evolution of life, Koonin has some ideas, largely related to the battle between bacteria and the viruses that infect them, each side adapting to what the other threw in its path.

That their ancient struggle has resulted in a way to alter human DNA is the leap no one could have foreseen.



Patient Care Goes Mobile: Diagnosis through Image Analysis

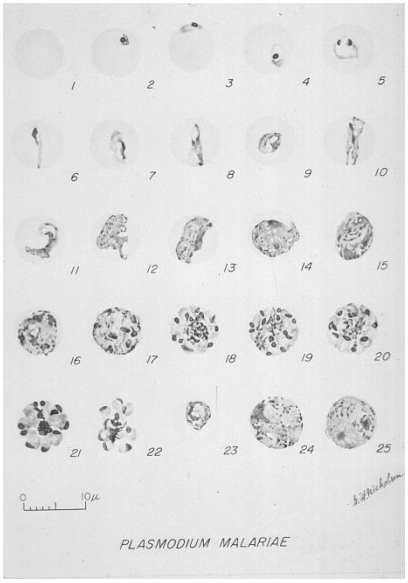
Malaria is caused by parasites transmitted through the bites of infected mosquitoes. In 2015, over 214 million cases of malaria occurred worldwide, and an estimated 438,000 people died. While existing drugs make malaria a curable disease, inadequate diagnostics and emerging drug resistance keep mortality rates high.

Efforts to fight malaria have traditionally included mosquito control, new vaccines, and better treatment, but NLM is working a different angle: developing a fast, reliable diagnostic test.

The standard method for malaria diagnosis is light microscopy, which involves manually counting parasites on blood films. It is tedious and prone to error. Nevertheless, about 170 million blood films are examined this way every year.

Machine learning for malaria diagnosis

NLM seeks to cut that number dramatically while improving diagnostic accuracy. The library's Lister Hill National Center for Biomedical Communications, in collaboration with national and international partners, is developing a fully-automated system to detect and count parasites in blood films. The system relies upon image analysis and machine learning algorithms to discriminate between parasite-infected and uninfected red blood cells.



Growth stages of a malaria parasite

How does this happen?

Just as a person must learn to recognize malaria on a blood film, so, too, does the system.

First, the system learns the typical shape and appearance of parasites based on training images of red blood cells acquired from patients with and without malaria. Then machine learning methods detect whether parasites are present, discriminate between infected and uninfected cells, and determine the parasite count per microliter of blood, which is reported to the microscopist.

As complex as that sounds (and is), tests of the system show the automated parasite counts correlate highly with those conducted by human experts.

Results were so promising that the project received financial support in 2015 from the HHS Ventures Fund, a highly selective process for taking proven but still early-stage ideas to the next level.

That funding paid to adapt the system's software to a smartphone, which was attached to the eyepiece of a conventional microscope.

These readily available pieces—a smartphone plus standard light microscopy equipment and a low-cost adapter—make the system well-suited for resource-poor regions where malaria is common and microscopists, often working in isolation, struggle to maintain their skills.

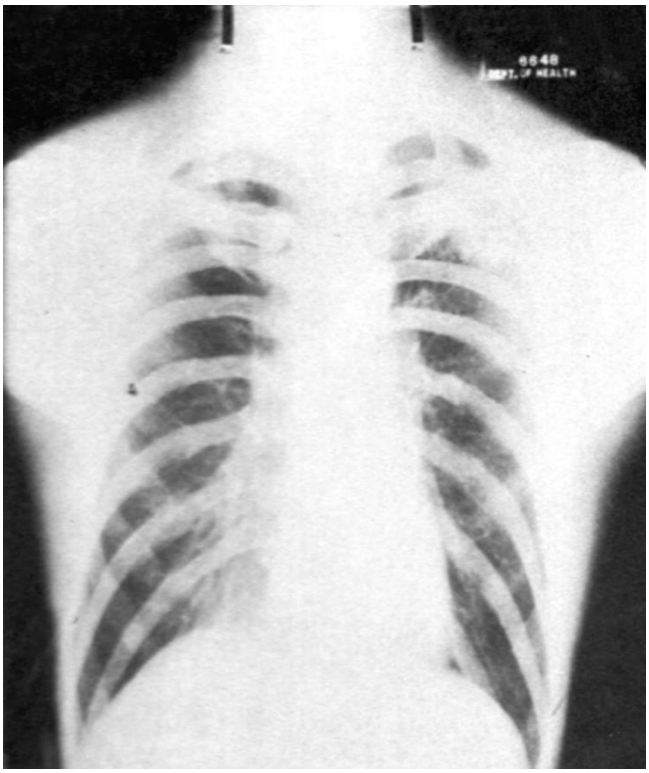
In the coming year, the software and smartphone will be field tested in Bangladesh and Thailand, and then, assuming success, made widely available.

With an estimated 3.2 billion people in 95 countries and territories at risk of being infected with malaria, this reliable, affordable, and automated diagnostic system has life-saving potential.

Road-tested tuberculosis screening

A second project coming out of the Lister Hill National Center for Biomedical Communications followed a similar path to success. Combining machine learning, image analysis, international collaboration, and HHS funding, computational scientists developed a system to automate the screening of digital chest X-rays for tuberculosis and other pulmonary diseases.

Not to be outdone by the portable smartphone technology of the diagnostic system for malaria, these scientists adapted their work for the road. Literally.



This chest X-ray shows signs of tuberculosis.

Their X-ray generator is rugged, inexpensive, and lightweight—only 65 kilograms—and travels by truck across Kenya, bringing much-needed tuberculosis screening to hard-to-reach rural communities.

The first truck outfitted with the X-ray generator began making the rounds in late 2014. Formal deployment followed in early 2015.

The low-power computer system NLM scientists developed communicates with an X-ray imaging system to ingest and analyze a digital chest X-ray image. Advanced image processing and machine learning algorithms then kick in to read the X-ray for abnormalities.

The machine learned by reviewing large sets of example X-rays from patients with and without tuberculosis or other lung diseases. The sample X-rays came from around the corner and around the world—from NLM's home in Montgomery County, Maryland, to Indiana, China, India, and Japan—so they originated from a range of X-ray machines and reflected an array of cases.

As the system learned, the developers made adjustments so its approach mimicked human radiologists, favoring sensitivity over specificity without jeopardizing overall accuracy. When screening, false positives are preferred to missed cases.

The resulting mobile X-ray system is inexpensive, reliable, and easy to use—even for people with little or no background in radiology—which means more of the population can be tested despite the lack of formal screening sites and trained radiologists.

A mobile X-ray truck in Kenya

Ebola: Documenting an Outbreak

What is the lifespan of a webpage? How about a social media post?

The answer varies wildly, but anyone who has searched online for a news story published last year, or even last month, knows content changes, websites move, and web pages disappear.

In the fall of 2014, as the Ebola outbreak peaked, NLM staff contemplated the treasure trove of information about the outbreak being published online daily and understood the challenges of preserving it for those who will want to study it in the future.

News, public health information, and first-hand experiences about the disease shared on websites, blogs, Twitter, YouTube, and elsewhere documented the personal, community, national, and international perception and response to the outbreak. As contemporaneous coverage or dynamic interactions, this web content had served its purpose, but as source documents for future researchers, its usefulness was just beginning—that is, assuming the content can be saved.

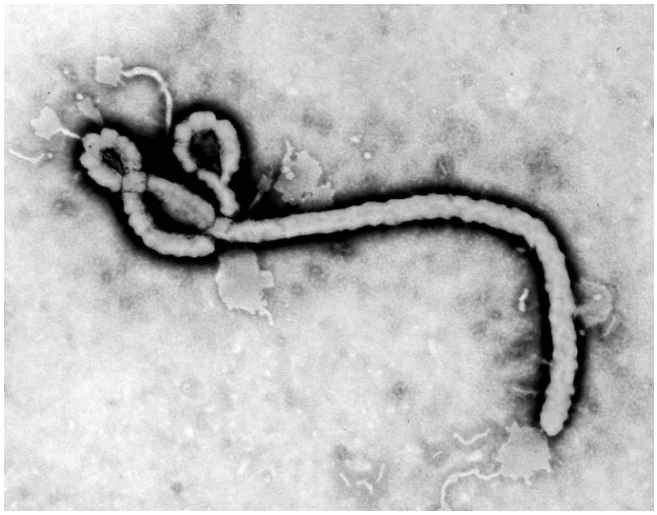
Saving for the future

Enter the library's Web Collecting and Archiving Working Group, who stepped in to capture and preserve selected web pages on the Ebola outbreak.

When they started their work in October 2014, the group did not fully understand the scope of information they'd be collecting. They were initially guided by the NLM Collection Development Manual, and they looked to the library's Disaster Information Management Resource Center (DIMRC) for input, using DIMRC's then newly created page, Ebola Outbreak 2014-2015: Information Resources as a starting point.

Throughout 2015, the group identified new content to collect, conducting monthly crawls of ever-changing web sites. But as the Ebola outbreak evolved, so did their scope of collection.

They retroactively established August 8, 2014—the date the World Health Organization officially declared Ebola a Public Health Emergency of International Concern—as the date their collection would begin. Starting at that fixed point, they pulled content from across the spectrum, hitting web pages created by government and non-government organizations, journalists, health care workers, and scientists in the United States and around the world. They preserved



The Ebola virus under an electron microscope

content from the USAID, the CDC, the NIH, Doctors Without Borders, and the World Health Organization, as well as independent blog posts, news, and social media.

They knew the Ebola story was big, but they did not know how big it would get or how long it would go on, so they aimed simply to preserve a diversity of

perspectives addressing varying aspects of the epidemic.

Capturing global perspectives

As of October 2015, the resulting collection included 270 websites, social media feeds, and hashtagged Twitter threads.

Among the many resources included in the Ebola Outbreak collection are:

- The homepage of the Centers for Disease Control and Prevention on October 2, 2014, confirming the first Ebola case diagnosed in the United States
- The Twitter account of the United Nations Mission for Ebola Emergency Response, the UN's first-ever emergency health mission, that published 2,717 tweets over the 10 months it was active (September 2014-July 2015)
- Perspectives from those on the front lines, including a blog post by an epidemiologist describing her experience volunteering with Doctors without Borders in Sierra Leone, captured October 28, 2014

The Web Collecting and Archiving Working Group built this collection as part of a broader web archive on Global Health Events using the Archive-It service, a tool developed by the Internet Archives to harvest, curate, and preserve collections of digital content. Those interested may search the Global Health Events collection through the Archive-It site. Eventually, the collected websites will be available via the NLM Digital Collections.

As for the research arising from these collections, no one knows what or where that will be, but the NLM collection will be here, waiting to be used in whatever way future researchers can imagine.

The BBC covered the Ebola crisis.

NLM Ebola Response

The Ebola outbreak of 2014-15 was the largest in history, with 40% of those who contracted Ebola dying, and total cases reaching 28,652.

In late FY2014 and into FY2015, NLM stepped up to provide trustworthy health information to a concerned public and to health care providers here and abroad.

The library activated the Emergency Access Initiative for health professionals and libraries in West Africa. A collaborative partnership between NLM, participating publishers, and medical librarians, the initiative provided three months of free access to full text from over 650 biomedical journals and over 4,000 reference books and online databases.

The Disaster Information Management Research Center (DIMRC) developed a disaster topic page on Ebola. The web page, which organized resources in health care, public health, and emergency management, was routinely updated—often daily—during the height of the outbreak. DIMRC also expanded its Disaster Lit database, adding over 900 documents on Ebola such as guidelines, reports, training classes, and legislation.

MedlinePlus.gov released a consumer-oriented page on Ebola in both English and Spanish.

The National Center for Biotechnology Information (NCBI) created and released a focused Ebolavirus database that provides protein and nucleotide sequences related to this pathogen, along with links to Ebolavirus data at NLM.

Key NLM databases saw an influx of Ebola-related content. Over 20 human clinical studies opened in FY2015 and made their way into ClinicalTrials.gov, and more than 2,300 articles on Ebola were cited in PubMed (more than the total number of PubMed articles on Ebola from 1977 through 2013 *combined*).

During the outbreak, Ebola content consistently occupied the top spots among the PubMed Commons trending articles.

And NIH neighbor Suburban Hospital, a member of John Hopkins Medicine, collaborated with NLM to explore developing virtual training tools for hospital staff to manage patients with highly infectious diseases such as Ebola. The first training prototype, designed in 2015, uses computer gaming technology and a high degree of interactivity to simulate the process of putting on personal protective equipment. NLM will develop additional prototypes in the coming year.

Got Medical Devices? AccessGUDID Has Your Number

Each year, the US Food and Drug Administration (FDA) receives reports of deaths and injuries resulting from medical device malfunctions. Determining whether such malfunctions resulted from issues in manufacturing and recalling related devices was hamstrung by the industry's inability to identity and locate those related devices. Unlike drugs, most medical devices lacked a unique identifier that made it possible to distinguish one device from another or, when looking at the same device, one manufacturing lot from another.

To close this gap, Congress authorized the FDA to establish a unique device identification (UDI) system.

The resulting regulation, issued in September 2013, calls for devices to be marked with a UDI composed of two parts:

- a device identifier that corresponds to the type of device and its manufacturer, and
- a production identifier that conveys its lot, batch, serial number, expiration date, and date of manufacture.

The information is intended to help regulators and companies trace their devices more easily and, when needed, take corrective action more quickly and effectively.

But the UDI fills only a portion of the gap.

Health care providers had no way to access the UDIs or the additional information manufacturers provided about their devices, including critical details such as its recall status or the safety of using it in an MRI.

This year the FDA partnered with the National Library of Medicine to solve that problem. Together they developed and released AccessGUDID, a website providing information about and access to the FDA's Global Unique Device Identification Database (GUDID, pronounced *good-ID*). Through AccessGUDID anyone—including patients, caregivers, health care providers, hospitals, and industry—can search or download information submitted by medical device companies about their products.

ACCESS GUDID

Because the UDI system is being phased in over the next several years, AccessGUDID currently holds information on only the highest risk medical devices, such as heart valves and pacemakers, but eventually the records of all medical devices required to have a UDI will be included. Such devices range from hip implants to contact lenses, from CT scanners and surgical instruments to wheelchairs and blood glucose test devices.

With such an array of devices included–and integration with electronic health records anticipated–AccessGUDID has the capacity to help transform patient care. For example, before using a device on a patient, a health professional could scan its code to learn if it has been recalled or discontinued, how it should be stored or handled, if it needs to be sterilized before use, and if the device is safe for use in an MRI. Such information has the potential to reduce medical errors at the point of care, to catch counterfeit devices in the market, to support research into device use and effectiveness, and to facilitate innovation.

Other benefits are likely to be realized as UDIs are more thoroughly integrated into the health care delivery system, a step NLM expects to be a part of by connecting AccessGUDID with existing vocabularies like SNOMED CT (Systemized Nomenclature of Medicine—Clinical Terms).

Holding a Piece of History—Virtually: Honoring Marshall Nirenberg

A "scientist's scientist." A "mentor's mentor." And a Nobel Prize winner. All describe Marshall Nirenberg (1927-2010), an American biochemist who was an NIH researcher for four decades. Nirenberg shared the 1968 Nobel Prize in Physiology or Medicine for deciphering the genetic code. He and his laboratory staff discovered how nucleotide sequences of RNA direct ribosomes to assemble amino acids into proteins, opening new frontiers in genetics and medicine.

Nirenberg enhances NLM collections

A prolific collector, at least of his own records, Nirenberg began donating his papers to NLM in 1999. Over time, that collection grew to 159 boxes. His wife completed the process in 2014, four years after her husband's death, by donating his Nobel Prize certificate and medal to the NLM History of Medicine Division.

In 2001, the library shared hundreds of carefully selected and curated items from the Nirenberg collection via *Profiles in Science*, an ongoing project dedicated to promoting the lives and works of prominent 20th century biomedical scientists. But in March 2015, the collection took an innovative step forward.

Virtually handling a piece of history

In honor of the 50th anniversary of Nirenberg's "First Summary"—one of the most significant scientific documents of the 20th century—the NLM Lister Hill National Center for Biomedical Communications and the History of Medicine Division launched a new *Turning the Pages* project featuring that groundbreaking chart. Created by Nirenberg on January 18, 1965, the chart provides the first summary of the genetic code at a point when more than half of the code had been deciphered.

In the era before spreadsheets and data entry software, Nirenberg and his laboratory colleagues improvised by constructing their chart on lined graph paper pieced together with transparent tape. With pencil and ball-point pen, they recorded the final results of the various laboratory experiments used to decipher the three-letter codons that make up the genetic code.

Integrating the "First Summary" into *Turning the Pages* means that anyone can experience—virtually, anyway—holding that humbly assembled piece of history.

Visitors can zoom in to view the chart's details and examine the relationship Nirenberg and his team found between the 20 amino acids that form proteins and the 64 RNA triplets, called codons. The figures on the chart, which reflect the amount of radioactive aminoacyl-tRNA bound to an RNA triplet, map to specific experiments recorded in Nirenberg's laboratory notebooks, which were also donated to the library.

While the "First Summary" is the main attraction, *Turning the Pages* delivers additional documents and background to round out the experience. Notes set the chart in historical context, exploring its scientific and social implications. They also describe the library's efforts to preserve the chart, and nature's impact on the ink, tape, and paper. Later drafts of the genetic code chart were also digitized and compiled into a gallery.

Honoring a legend

The library unveiled the interactive "First Summary" as part of the *Tribute to Marshall Nirenberg*, a public program marking the 50th anniversary of his accomplishment. Hosted by NLM, the event included presentations from his wife, Dr. Myrna Weissman; former colleague Dr. Frank Portugal, who recently wrote a biography of Nirenberg; cultural historian in medicine Dr. David Serlin, who curated Nirenberg's papers for *Profiles in Science*; and Dr. George Thoma, chief of the NLM unit responsible for *Turning the Pages.*

PubMed Central and Public Access to Biomedical Information

Public access to government-sponsored research took a big leap forward this year, and PubMed Central provided the springboard.

This full-text database of biomedical and life sciences articles now houses federally funded research coming out of the Centers for Disease Control (CDC), the National Institute of Standards and Technology (NIST), and the Department of Veterans Affairs (VA).

And more articles from across the science spectrum are in the offing now that the HHS Office of the Assistant Secretary for Preparedness and Response (ASPR) and the National Aeronautics and Space Administration (NASA) signed agreements this year to add their published research findings as well.

Contributions from the HHS Agency for Healthcare Research and Quality (AHRQ) and the US Food and Drug Administration (FDA), both of whom signed agreements in 2014, are still pending.

Making public access easy

PubMed Central provides free permanent electronic access to the full text of biomedical and life sciences journal articles, with links to related scientific data contained in the 40-plus interlinked databases managed by the NLM National Center for Biotechnology Information (NCBI). Connecting the biomedical literature with a variety of genomic and other scientific data provides a rich information space for users to explore and make discoveries that lead to new medical treatments and diagnostics.

Though PubMed Central has been around since 2000, it was not until 2008 that Congress required that investigators submit their NIH-funded manuscripts once accepted for publication. Then in 2013, the White House broadened the scope of public access to scientific research arising out of all federal agencies with more than $100 million in expenditures for research and development. In both cases, free public access to federally funded research was required within 12 months of publication.

PubMed Central's existing infrastructure, including the NIH Manuscript Submission System, has made it relatively easy for NIH and other federal agencies to comply with these public access requirements.

Access by the numbers

The numbers bear this out.

Of the 400,000 or so papers now added annually to PubMed Central, over 100,000 result from federal funding, whether from NIH or other federal research funders.

And the numbers add up.

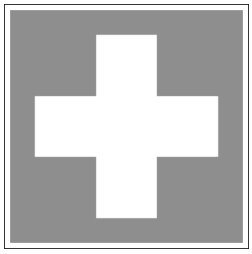
At the end of FY2015, PubMed Central included approximately 3.6 million articles.

With over 1 million daily visitors—including scientists, researchers, clinicians, and consumers—coming to the site, these freely available articles are expected to spur scientific progress, catalyze innovation, and increase the health of our population and our economy.

Disaster Research Response

Beyond physical devastation, disasters injure and even kill. But the health effects of disasters often extend well past the time of destruction.

That is why NIH has been committed to research into disaster resilience for more than three decades. Multiple NIH Institutes, Centers and grantees examine issues of disaster preparedness, response, and recovery to better understand disaster risks and recovery and to provide critical information when disaster strikes.



The NIH involvement in disaster preparedness and response also led to the creation of the NIH Disaster Research Response Program (DR2). That program aims to create a national framework for research on the medical and public health aspects of disasters and public health emergencies by developing and providing access to data collection tools and a network of trained research responders.

Disaster website launched

Since DR2 was established in 2013, the National Library of Medicine has partnered with the National Institute of Environmental Health Sciences (NIEHS) in defining and achieving the program's objectives. This year, in January 2015, NLM and NIEHS launched the NIH Disaster Research Response website. The website, managed by NLM, delivers protocols for conducting disaster research, field-tested data collection tools, and practical training materials to prepare scientists to conduct research post-disaster.

The new website integrates with another NLM resource, Disaster Lit: The Resource Guide for Disaster Medicine and Public Health, which was expanded this year in support of DR2 to include surveys, interview scripts, and other tools to collect data in the field following disasters.

Disaster Lit draws from over 700 non-commercial organizations to provide direct access to literature and materials published online to meet the time-sensitive needs of disasters. These non-journal materials include guidelines, government and technical reports, training materials, websites, and maps, in addition to the DR2-focused data collection tools.

To promote the website, NLM and NIEHS staff co-presented at the Forum on Medical and Public Health Preparedness for Catastrophic Events, hosted by the National Academies of Sciences, Engineering and Medicine. In addition, NLM staff and our partners from the National Network of Libraries of Medicine spoke about the site to attendees at the 2015 Preparedness Summit in Atlanta and the 2015 Disaster Research Response Tabletop Exercise in Houston.

A reliable tool, a solid foundation

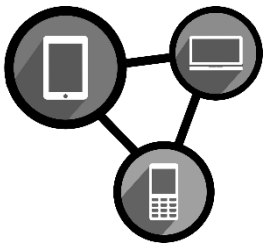
Together the new DR2 website and Disaster Lit provide the foundation for the DR2 infrastructure. By pulling together these key resources, NLM will help disaster response researchers collect critical information—information often lost in the days, even hours, following an event. The training materials will ensure responders and data professionals are prepared to perform disaster research well before bad weather, terrorist attacks, chemical spills, or other disasters strike. And the carefully selected offerings will save scientists on the ground precious time reinventing tools and protocols.

The resulting data collections will be timelier and more effective, helping researchers better understand a disaster's impact on people’s health, including the health of responders; improve our response to disasters to prevent illness and injuries; and support recovery.

Standardizing Big Health Data for Patient Care and Clinical Research

NLM plays an important role in national efforts to achieve interoperable electronic health records (EHRs). The goal is to ensure that patient data created in one EHR system can be easily transmitted and then correctly interpreted by another EHR system to support patient care, public health, and research.

Achieving this goal requires different EHR systems to export and import data that adhere to the same standards, including standard terminology for important elements of patient data, such as medications, tests, and diseases. As the coordinating body for clinical terminology standards in the Department of Health and Human Services, NLM provides funding and technical support for key terminologies—LOINC (for tests), RxNorm (for medications), SNOMED CT (for symptoms, diseases, organisms, anatomy, procedures), and UCUM (for units of measure)—required for use in certified EHR products and in health information exchange in the United States. NLM's financial support allows these standards to be used free-of-charge in US health care, public health, and product development—and, to the extent relevant, in biomedical research.



Standards enhance usefulness

Use of the same data standards in EHRs and in clinical research studies can increase the usefulness of EHR data for researchers and speed the translation of important research findings into routine clinical practice. For example, a clinical research study involving 200 patients determines that the result of a particular test, identified by the LOINC standard, indicates that a particular drug, identified by the RxNorm standard, will not be effective for patients with a particular disease, identified by the SNOMED CT standard. Since LOINC, RxNorm, and SNOMED CT are now used to identify tests, drugs, and diseases in routine health care, the researchers may be able to test the validity of this finding by analyzing EHR data for thousands of patients with that disease who received that test and were prescribed that drug.

The researchers will not need to know the identities of the patients to do this. If the research finding is valid, the use of the same standards in the research study and in EHRs will make it easier to insert an alert in EHR systems that the specific drug should not be used for patients with that disease and test result.

Common data elements ease sharing

Beyond the use of the standard terminology, there is great potential value in using "common data elements," that is, capturing and structuring data in the same way for different clinical research studies and in EHRs. To use a simple example, if different clinical studies and EHRs define and capture the marital status of people in the same way (e.g., never been married, married living with spouse, married not living with spouse, divorced, widowed, etc.), then any effect of marital status on health outcomes can be more easily evaluated across different studies and in large stores of EHR data.

Of course, paper questionnaires or forms were used to collect related groups of such data elements from research participants and patients long before automated research systems or EHRs became common, and many of them were carefully tested and validated in the pre-automated era. These forms and their underlying data elements must be transformed into standardized electronic formats that can be easily incorporated and used in clinical research systems and EHRs.

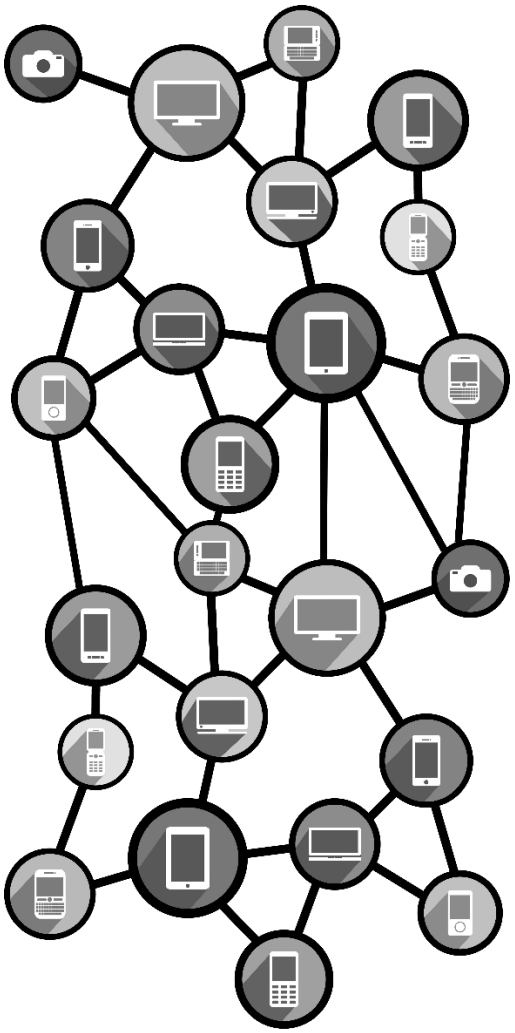
Partners expand reach

NLM works with many federal agencies, other stakeholders, and domain experts to ensure the standard clinical terminologies it supports work together as an interlocking, non-overlapping set and that they remain consistent, reliable, and relevant by reflecting new medical knowledge and innovations in tests, medications, medical devices, and procedures. The library is also engaged with many partners in promoting the use of common data elements and standard forms and representing them in standardized electronic formats. Equally important, NLM collaborates with the Office of the National Coordinator for Health Information Technology (ONC), other Federal agencies, and standards development organizations to produce a range of tools and services that help EHR system developers and researchers obtain and implement standard terminologies and common data elements.

In FY2015, NLM's partners in these activities included the ONC, the Centers for Medicare and Medicaid Services, the Food and Drug Administration, the Veterans Health Administration, the National Institute of Biomedical Imaging and Bioengineering, the Centers for Disease Control and Prevention, the National Eye Institute, the Regenstrief Institute, the International Health Terminology Standards Organization, the National Council for Prescription Drug Programs, and the Radiological Society of North America.

Together with these partners, the library accomplished the following:

- expanded and refined SNOMED CT coverage;
- published the LOINC/SNOMED Technology Preview to demonstrate how the two terminologies align in their representation of lab test attributes and some clinical measurements;
- advanced the unification of radiology standards (RadLex and LOINC);
- modified the presentation of injectable medications and dose forms in RxNorm;
- updated the Value Set Authority Center (VSAC), which defines the medical code sets required to collect quality reporting measures across EHR systems;
- launched the NIH Common Data Elements Repository, which provides access to sets of common data elements supported and recommended by different NIH Institutes and Centers for use in research;
- introduced NLM-Forms, a free widget that helps clinicians and researchers build online patient forms, lab panels, or survey instruments that automatically pull in standard terminology (e.g., LOINC, RxTerms, ICD-10-CM) and NCBI genomic data and terminology; and
- increased LOINC coverage in many areas, including research survey instruments, pharmacogenomics test results, and eye disease genotyping and phenotyping.



Health Literacy as a Path to Health and Health Careers

When it comes to health information literacy, NLM takes its teaching role seriously—especially when it comes to reaching young people.

In 2015, NLM reached out to tweens and teens with several initiatives to help them learn to locate, evaluate, and effectively use needed information and to share NLM's enthusiasm about careers in health and medicine.

Serious message, fresh method

The NLM Teen Health Information Literacy program used NLM resources to teach research skills at schools throughout the country.

Science Pathfinders Day excites and motivates.

The program promoted health information literacy overall and health information outreach to family and community—two factors that contribute to encouraging careers in health-related fields.

Developed in conjunction with partner institutions, this NLM program offered several projects from which the students could choose. Students picked topics they were interested in and believed were relevant to their communities, and then determined how best to report their findings.

In South Carolina, for example, students from three high schools crafted four full-color comic books that explored health issues they confront in their lives or that were in the news: childhood obesity, anabolic steroid use in athletes, personal disaster preparedness, and preventing and controlling the spread of Ebola.

Students researched the topics, interviewed health professionals, developed the characters and storylines, and crafted the final products. Along the way, they improved their verbal and writing skills, critical thinking, teamwork communication, and leadership abilities.

Motivating and mentoring

NLM partnered with Mentoring in Medicine, a program designed to inspire disadvantaged and low-income students to become health care professionals. The library hosted Science Pathfinders Day, which brought hundreds of middle and high school students from the Washington, DC area to the NIH campus.

Through presentations from doctors, researchers, and other leaders, students got to experience what it might be like to work in a clinical setting, a lab, and, of course, a medical library, while hands-on activities demonstrated scientific concepts and highlighted the diversity of science research.

Tinkering in health

Geared toward underserved middle and high school students, a Seattle-based project brought NLM together with the University of Washington to create a

curriculum on health literacy and health careers for low income and immigrant youth in the city's High Point neighborhood.

The 10-week curriculum, "Making and Tinkering in Health," used body systems as the framework to teach about health topics and careers related to nutrition, physical fitness, and disease. Featuring NLM materials and interactive experiences, the curriculum connected participants to local community groups.

Final projects ranged from planting a vegetable garden to compiling a cookbook, from making a physical fitness video to creating an interactive model of the body. The students also shared their lessons by developing health tips for their families and community.

From confidence to career

Such hands-on learning also sits at the core of HackHealth, an afterschool outreach program for middle-schoolers offered through the University of Maryland. HackHealth targeted disadvantaged or underserved students with an eye toward increasing their interest in careers in the health sciences and STEM.

Each participant selected a personally relevant health topic to research throughout the 12-week program. Through a variety of activities students developed and strengthened digital health literacy skills, such as conducting online searches for health information, making informed decisions regarding their search results, and assessing the credibility of what they found.

At the program's end, participants came to the University of Maryland campus to present their findings to an audience of family, friends, and fellow participants. Presentations ranged from traditional slide decks—on asthma, brain cancer, sports injuries, and breast cancer—to the unique—an interpretive dance on Kawasaki disease, a play featuring a girl with sickle cell anemia, and a song about thyroid disease adapted from a Taylor Swift hit.

Together these programs build students' health and digital literacy skills. That development, in turn, encourages a sense of self-efficacy around health, and ultimately—organizers hope—will improve their long-term health and perhaps influence their career choices.

Comic books explore health issues.

Traveling Exhibitions Tell Powerful Stories

Traveling exhibitions—and the associated public programs sponsored by partner institutions—feature compelling stories and highlight the library's resources for new audiences across the US and around the world.

The story of a movement

Confronting Violence: Improving Women's Lives is a recent addition to NLM's portfolio of traveling exhibitions. Launched in the fourth quarter of 2015, the display is scheduled to travel to libraries and cultural centers through 2019.

Confronting Violence tells the story of a vanguard of nurses who, beginning in the late 1970s through the 1990s, pushed the larger medical community to identify victims of battering, adequately respond to their needs, and work toward preventing domestic violence. With passion and persistence, these nurses and their allies successfully reformed medical practice and ultimately improved the lives of millions of women nationwide.

In 2012, the NLM acquired the papers from members of this movement, with the bulk of the materials coming from Daniel Sheridan, RN, PhD, and Jacqueline Campbell, RN, PhD, two faculty members at Johns Hopkins University. The collection documents the work of these nurse reformers who were on the front lines in shelters and emergency rooms across the country, conducting studies, analyzing data, and developing protocols for the identification and treatment of patients who had experienced domestic violence.

A leading scholar of women's history and gender violence served as guest curator for the project. Catherine Jacquet, PhD, an assistant professor of history and women's and gender studies at Louisiana State University, conducted in-depth research using the archival materials to develop *Confronting Violence.* She later delivered a lecture at the exhibition's opening in which she set the larger historical and cultural context for the exhibition and revealed in greater depth how nurses changed the medical establishment's attitudes toward and treatment of domestic violence.

Confronting Violence: Improving Women's Lives comprises a special display in the History of Medicine Division reading room and a companion website. The website features an online version of the exhibition's content along with links to related resources, including focused offerings at NLM.

Support for research

Among those offerings: a new topic page on domestic violence developed by the NLM National Information Center on Health Services Research and Health Care Technology specifically to complement the *Confronting Violence* exhibition. Targeted to health services researchers, policy makers, educators, and students, the topic page provides links to new and high quality datasets, guidelines, analyses, and other resources, focusing on major categories of domestic violence research and practice: intimate partner violence, reproductive and sexual coercion, child abuse and maltreatment, and elder abuse. In addition, the topic page offers detailed search queries on domestic violence for key NLM databases such as PubMed,

PubMed Health, HSRProj (Health Services Research Projects in Progress), and HSRR (Health Services and Sciences Research Resources), thereby greatly enhancing users' abilities to search and discover the valued and relevant content they contain.

Making an impact

Confronting Violence: Improving Women's Lives resonates with communities across the country. One measure of its significance came in the vivid response by institutions wanting to borrow the traveling banner exhibition. Within 24 hours of announcing its availability, the NLM received 33 requests for the 48 available booking slots for the traveling exhibition. By the end of two weeks, all slots were filled and reservations confirmed.

While the speed by which *Confronting Violence* became a fully booked traveling exhibition is notable, this kind of response is not unusual. In fact, NLM traveling exhibitions are a remarkably popular and effective means of reaching new audiences and promoting the library's historical collections. During FY2015, 154 traveling exhibitions opened in communities around the world. These exhibitions were featured in 135 institutions in 115 cities, 39 states, and 3 countries (including the US).

Institutions that host a NLM traveling banner exhibition are a critical part of this outreach and promotion effort. Public programs aligned with the exhibition's topic inform and enhance the experience for visitors while drawing new and diverse audiences to the host institution and to NLM resources. These programs, often created through partnerships with colleagues and neighboring organizations, also have a demonstrable and positive effect on communities.

This year, the Schusterman Library at the University of Oklahoma-Tulsa epitomized this spirit of partnership, diversity, and community-building. In late 2014, while hosting another NLM traveling exhibition, *Surviving and Thriving: AIDS, Politics and Culture*, the library brought in a second, related exhibition, *Reframing Positive: A PhotoVoice Study on the Strengths and Needs of Oklahomans living with HIV/AIDS.* The latter exhibition was developed by Tulsa CARES, an organization that works to achieve quality health outcomes for those living with HIV/AIDS, and the University of Oklahoma, College of Public Health. Together the two exhibitions told a powerful story, offering different perspectives on living with HIV/AIDS and bringing together a community to share resources and experiences around this important health issue.

Confronting Violence, *Surviving and Thriving*, and the other NLM traveling exhibitions—along with the educational resources that accompany them—encourage visitors of all ages to learn more about themselves and their communities by exploring the social and cultural history of medicine. Through compelling stories, these exhibitions reach new audiences, promote health literacy, encourage careers in health and science, and contribute to the reduction of health disparities worldwide.

The *Confronting Violence* traveling exhibition

Information as a Weapon in the Fight Against HIV/AIDS

The AIDS epidemic is declining. In the last decade, the number of new HIV diagnoses fell 19%, and deaths have decreased 45%. The world has made remarkable progress reversing the spread of HIV and reducing the number of AIDS-related deaths. Yet HIV/AIDS remains, and so the National Institutes of Health and the National Library of Medicine remain committed to ending this decades-long pandemic.

The library's role in that fight stretches back to the epidemic's beginning in the early 1980s. NLM produced the first AIDS bibliography in 1983. And since 1989, the NLM Specialized Information Services (SIS) Division has led collaborative efforts to develop free, online information resources about HIV/AIDS and to reach out to affected populations. FY2015 saw a particular push to expand and enhance this work online.

AIDSinfo

AIDS*info*, a collaborative effort across the US Department of Health and Human Services, offers access to the latest federally approved HIV/AIDS medical practice guidelines, clinical trials on HIV treatment and prevention, and other valuable information for health care providers, researchers, people affected by HIV/AIDS, and the general public.

In FY2015, NLM released a new app and updated another to make more of that information available on the go and at the point of care.

The AIDS*info* HIV/AIDS Drug Database app, made available in December 2014, provides mobile access to information on more than 100 HIV-related approved and investigational drugs. That includes drugs approved to treat HIV itself, drugs used to treat other infections or diseases common to people living with HIV, and HIV/AIDS-related drugs being studied in clinical trials.

The app integrates information from NLM's DailyMed, ChemIDplus, and the AIDS*info* Drug Database, including easy-to-navigate versions of the FDA drug labels. That information is automatically updated whenever the device is connected to the Internet, eliminating the need to update the app manually to stay current.

Each drug summary comes in two versions—one for consumers (in both English and Spanish) and one for health care professionals—and the app works even when offline, making it easy to find the latest drug information anywhere, even in health care facilities without an Internet connection.

Users can also personalize the AIDS*info* Drug App, setting pill reminders, bookmarking drugs, adding personal notes, or being notified when specific content is updated. The app is available for iOS and Android devices.

NLM updated another valuable AIDS-related app this year, along with the resource from which it is derived. AIDS*info* HIV/AIDS Glossary, which provides plain language definitions in both English and Spanish for over 700 HIV/AIDS related terms, now includes extensive images and infographics to improve understanding of the terms. NLM enhanced the iOS and Android app versions of the glossary with those same images and added an audio feature to hear a term's correct pronunciation in English and Spanish. In addition, via the app users can save frequently

referenced terms for easy access or easily share terms via email, text, or social media.

AIDSource

In another effort to get comprehensive and authoritative HIV/AIDS-related information to those who need it, NLM redesigned its HIV/AIDS web portal and renamed it AIDSource. The website, which pulls together resources from federal and non-federal sources, received a facelift in response to last year's user survey.

AIDSource now highlights topics of current interest on the homepage and features cleaner site navigation to find information more quickly. In addition the site optimizes its display across devices and functions well for desktop, tablet, and smartphone users alike. As before, the site organizes its content by topic of interest and audience, delivering reliable information for health care professionals and consumers, in both English and Spanish.

HIV/AIDS Outreach

But what good are these product releases and improvements if no one knows about them or uses them? Enter outreach.

NLM has a history of working through partnerships with libraries and non-profits across the country to connect to and foster relationships with people outside its walls, to make individuals and communities aware of how the library can help them.

In the realm of HIV/AIDS, the AIDS Community Information Outreach Project (ACIOP) has driven this effort. Since 1994, ACIOP has provided financial support to local organizations to create and deliver programs that help HIV/AIDS patients, their caregivers, and the larger community gain access to reliable information about HIV/AIDS.

In FY2015, NLM funded six such projects in Florida, Maryland, Missouri, Pennsylvania, Texas, and Utah. Each project targeted a unique population using a particular strategy or approach (e.g., training, resource development, technology, etc.), but each shared a similar purpose: to make their community members more aware of HIV/AIDS testing, prevention, and treatment.

Similarly, NLM partnered with the National Minority AIDS Council at the US Conference on AIDS to pilot test an online, self-paced training titled “Connecting Communities to HIV/AIDS Resources." Targeted toward people infected and affected by HIV/AIDS, the training familiarized participants with HIV/AIDS resources from NLM, giving them the skills and knowledge to effectively access treatment and prevention information to better serve clients, colleagues, and communities.

These larger scale efforts are supplemented by the more incremental, daily contacts NLM makes through social media. From the HIVplus50 Twitter feed, targeted toward aging adults, to the AIDS*info* At-a-Glance email update and the NLM Facebook page, the library regularly and consistently shared news and knowledge about HIV/AIDS across the country and around the world, taking us a step or two closer to a world free of HIV/AIDS.

Apps from AIDS*info* deliver accurate information to smartphone users.

The National Network of Libraries of Medicine Prepares for Change

Even the largest biomedical library in the world needs help getting its message out.

For that NLM regularly looks to the National Network of Libraries of Medicine (NN/LM), a nationwide web of over 6,400 health science libraries and information centers supported by eight Regional Medical Libraries (RMLs).

Those libraries currently serving as RMLs will see their five-year appointments end in 2016. FY2015 then offered a time of preparation and planning in anticipation of the next competition period.

Building on the input received in response to 2014's Request for Information—an extensive period of public comment on how best to reshape and redirect the network to use existing resources more effectively—NLM issued the latest funding opportunity as a cooperative agreement instead of a contract. The switch was intended to allow for greater network member involvement in decision-making.

The library also responded to comments by restructuring the three network centers focused on web services, outreach evaluation, and training into five national offices serving all eight regions:

- NN/LM DOCLINE Coordination Office (NDCO)
- NN/LM Public Health Coordination Office (NPHCO)
- NN/LM Training Office (NTO)
- NN/LM Evaluation Office (NEO)
- NN/LM Web Services Office (NWSO)

The main infrastructure comprising eight Regional Medical Libraries and their geographic areas of service remain the same.

Together the changes were intended to help the NN/LM operate more effectively on a national level, increase regional cooperation, better coordinate responses and activities from NLM, and encourage a more focused and cohesive approach to target populations and priority topics.

Awards for the new cooperative agreements will be announced in spring 2016, with the agreements beginning May 1.

DIVISIONAL REPORTS

Office of Health Information Programs Development

Michael F. Huerta, PhD
Associate Director

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.

Planning and Analysis

NLM's current long range plan, *Charting a Course for the 21st Century: NLM's Long Range Plan 2006–2016,* remains at the heart of NLM's planning and budget activities. Preparation for the next planning cycle has begun, to be continued after the new NLM Director is onboard.

OHIPD's continued involvement in website evaluation included:

- analyzing NLM website log data;
- continuing the trans-NLM web metrics program;
- implementing the online user survey known as the ForeSee Customer Satisfaction Index; and
- maintaining access to key audience measures gathered by a private sector company.

Outreach and Consumer Health

NLM carries out a diverse set of activities directed at building awareness and use of its products and services by health professionals and by particular communities of interest. Considerable emphasis is placed on reducing health disparities by reaching rural and inner city areas. An NLM-wide Coordinating Committee on Outreach, Consumer Health and Health Disparities (OCHD) plans, develops, and coordinates NLM outreach and consumer health activities. The OCHD is chaired and staffed by OHIPD.

In FY2015 OHIPD staff continued outreach initiatives intended to encourage underrepresented minority students to use NLM's health information resources and to pursue careers in medicine and the health sciences. (See "Health Literacy as a Path to Health and Health Careers" for more on these initiatives.)

OHIPD also participated in Native American outreach efforts to enhance awareness of NLM consumer-oriented resources among segments of the Native American community. As part of the NIH American Indian Pow-Wow Initiative, staff coordinated NLM exhibits at a dozen pow-wows in the Mid-Atlantic area. An estimated 6,000 persons visited the NLM booth over the course of these pow-wows.

OHIPD supported projects to enhance tribal colleges and tribal libraries. One such project, coordinated by the library at Cankdeska Cikana Community College, Spirit Lake Nation, Ft. Totten, ND, helped develop educational and community outreach activities focused on health information. A second project with the University of New Mexico Health Sciences Library and Information Center convened a tribal community health summit in September 2015, prepared an activity tool kit, and developed plans to reach out in 2016 to New Mexico tribal colleges and other tribal libraries.

OHIPD contributed to planning and implementing the pilot run of the *Native Voices: Native Concepts of Health and Illness* traveling exhibition. Pilot tests at about two dozen venues in a dozen different states laid the groundwork for the American Library Association managing the traveling exhibition in 2016.

International Programs

International programs at NLM strengthen and expand global access to health literature and information. They are intended to enhance research and healthcare systems in low- and middle-income countries through outreach, education, capacity-building, and information infrastructure development.

This year's initiatives included: the African Journal Partnership Project (AJPP), the AJPP Outreach Initiative, the Tanzanian Health Information Specialist Training Program, Medical Informatics Training in Morocco, and the Network of African Medical Librarians (NAML). NLM also supported community outreach and training for the Human Heredity and Health in Africa (H3Africa) Initiative.

Developed in 2003 in collaboration with the NIH Fogarty International Center, the African Journal Partnership Project (AJPP) pairs African medical journals with US and UK medical journals to help build the capacity to publish and maintain peer-reviewed medical journals in sub-Saharan Africa. In FY2015 the project included seven African medical journals in seven countries.

OHIPD supported the establishment of a Tanzanian Health Information Specialist Training Program, a three-year, diploma-level program to train medical information specialists for the Tanzanian Ministry of Health and Social Welfare. These health information specialists will be trained to: provide evidence-based resources to clinicians; assist medical and nursing students; locate appropriate information for patients and families; help organize medical records; and facilitate the transition to electronic systems for records management. The ministry intends to place graduates into all government clinics, hospitals, and medical and nursing schools. FY2015 activities included designing academic programs, developing curriculum, and selecting sites.

NLM continued working with the Network of African Medical Librarians (NAML) to help them build library capacity in Africa. The current network consists of eight librarians from Kenya, Zambia, Mozambique, Mali, Nigeria, Morocco, Uganda, and Zimbabwe who received training as NLM Associate Fellows or as Medical Library Association Cunningham Fellows.

OHIPD provided financial and technical support to the NAML librarians when they delivered health information resource training at the biannual meeting of the Association for Health Information and Libraries in Africa. OHIPD also funded two bioinformatics workshops in Morocco.

Library Operations

Joyce E.B. Backus
Associate Director

The Division of Library Operations (LO) ensures access to the published record within the biomedical sciences and the health professions. Library Operations:

- 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, directory, and full -text databases;
- provides national backup document delivery, reference service, and research assistance;
- helps people make effective use of NLM products and services; and
- coordinates the National Network of Libraries of Medicine to equalize access to health information across the United States.

These essential services support NLM's outreach to health professionals, patients, families, and the general public, and the development of focused programs in AIDS information, molecular biology, health services research, public health, toxicology, environmental health, and disaster planning.

LO also develops and mounts historical exhibitions including a travelling exhibition program; carries out an active research program in the history of medicine, delivers an information program in public health; collaborates with other NLM program areas to develop, enhance, and publicize NLM products and services; conducts research 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

The NLM collection, print and digital combined, now numbers over 31 million (see Table 1), aided by the launch of several digital collections, web collecting, and improved selection and review processes.

As of September 2015, the NLM Digital Collections included over 15,000 items, including books, serials, and audio-visuals. Among the notable content added were 200 pre-1800 printed items uniquely held by NLM. They were digitized as part of the library's participation with the British Library's English Short Title Catalogue (ESTC) project. LO also launched new *Profiles in Science* on the world-renowned surgeon Michael E. DeBakey and Congressman John E. Fogarty.

To improve collection management, LO awarded a new serials subscription contract; implemented a system to track the selection, review, and acquisition of new serial titles; and developed a new electronic resources management system. LO also worked collaboratively with NCBI to institute an enhanced review program for PMC journals, resulting in a more focused, efficient, and systematic review process that addresses both access to and preservation of journals.

Staff also worked with the Library of Congress and many other institutions on a replacement for the almost 50-year-old MARC format, used to encode and share bibliographic and authority data. The replacement format, called BIBFRAME, is being developed using a modular approach which can be extended to describe a range of resource types.

LO took steps to improve the collection's accessibility and preservation by binding serials at a volume more than double that from FY2014, and by upgrading DOCLINE, the NLM interlibrary loan system.

Databases

In FY2015 the Index Section indexed 806,326 MEDLINE articles, the highest production year ever reflecting a 5% increase over the 765,495 citations indexed in FY2014 (see Table 3). This gain resulted from increased use of the Medical Text Indexer First

Line (MTIFL), NLM's automated indexing tool, along with regular indexing production and automated comment indexing. This record-setting production level helped MEDLINE remain the premier biomedical database in the world.

LO revised MedlinePlus, the library's internationally accessed consumer health website, to make both its English and Spanish sites display responsively based on device size. MedlinePlus Connect, which delivers MedlinePlus content to electronic health records, was similarly redesigned. This shift to responsive design gives NLM customers an improved experience when viewing and interacting with MedlinePlus on mobile phones or tablets.

In FY2015 NLM launched the NIH Common Data Element (CDE) Repository, a public-facing tool enabling researchers and others to search, retrieve, author, and compare well-specified data elements, forms, and other standardized assessment instruments.

Terminology

LO created or maintained terminologies used in electronic health records systems, pharmacy systems, hospital information systems, and consumer resources. LO released a new edition of MeSH and updated MEDLINE with those terminology changes. The division also produced the 2014AB and 2015AA releases of UMLS; managed the release of updates to SNOMED; and reduced by 500 the number of inactive drugs in RxNorm.

The library and other NIH Institutes partnered with Apple to integrate into the Apple Health app a source of NIH- and MedlinePlus-sponsored definitions relating to health, wellness, and general fitness. Within the app, the definitions are fully attributed to MedlinePlus or the appropriate Institute, putting NIH in the company of the Mayo Clinic and several other reputable health organizations.

Outreach and public services

This year LO sought new ways to connect with its customers, particularly through social media and blogging, in history-focused lectures, and through events.

Circulating Now, the official blog of the library's History of Medicine Division, grew to over 325,000 followers.

Five History of Medicine Lectures and three related special programs highlighted the uniqueness and research value of NLM collections, drawing diverse audiences to the library and to its online resources.

The third annual DailyMed Jamboree marked DailyMed's 10th anniversary. Speakers from the federal government, industry, academia, and non-profit sectors presented, with three sessions devoted to the FDA's proposed policy on biosimilars naming. The event also featured a retrospective look at how industry made use of DailyMed over the previous decade and sessions on how to better understand and use the free drug information in RxNorm and DailyMed.

Personnel

LO hired 17 new staff, all recent library science graduates, through the federal hiring mechanism Pathways for Recent Graduates. To be eligible for the Pathways program, applicants must be a US citizen, have completed a qualifying degree within the previous two years, achieved a cumulative GPA of 3.0 or above, and have a verified school accreditation.

LO received the resumes of 275 eligible applicants. Twenty-one hiring managers screened them using a set of competency-based criteria. Staff interviewed the best 75 candidates, with 42 candidates advancing to a second round of interviews before the final 17 were selected.

Employees hired through the Pathways program are required to complete 40 hours of training within the first year of hire; receive mentorship from a leader within the organization; and establish Individual Development Plans with their supervisors. After one year of successful service, the recent graduate may be converted from temporary status to a permanent position.

Table 1: Collections

Physical	**Total[1]**	***FY2015***	***FY2014***	***FY2013***
Monographs[2]				
Before 1500	599	1	1	0
1501-1600	6,058	0	2	3
1601-1700	10,354	7	1	3
1701-1800	272,773	32	3	3
1801-1870	256,938	150	71	27
1871-Present	898,927	12,893	13,560	11,292
Bound Serial Volumes[3]	1,515,019	34,723	15,806	12,650
Microforms[4]	606,140	14	42	8
Audiovisuals and				
Computer Software	97,715	2,359	2,395	1,701
Prints and Photographs	71,378	1,147	279	300
Manuscripts[5]	24,248,893	1,152,446	4,807,740	914,025
Withdrawn Items	-138,683	-5,922	-549	-350
Total items	27,846,111	1,197,850	4,839,351	939,662

Digital	**Total[1]**	***FY2015***	***FY2014***	***FY2013***
PubMed Central Articles	3,623,566	396,187	368,111	318,316
PubMed Central Titles[6]	1,791	191	207	244
Bookshelf Titles[7]	4,075	969	1,387	323
Digital Collections Repository[8]				
Texts[9]	15,099	2,898	2,642	2,580
Audiovisuals[10]	200	38	55	37

[1] Total: Numbers are cumulative as of the end of the fiscal year.
[2] Monographs: A bibliographic resource complete in one part or a finite number of separate parts. Includes Americana, theses, and pamphlets. Starting in FY2011 numbers for these materials are reported under monographs by publication year.
[3] Bound serial volumes: A serial is a continuing resource issued in separate parts with no predetermined conclusion. Bound serial volumes include serials bound, serial pamphlets bound, and bound serial gifts.
[4] Microforms: Reduced-size reproductions of monographs and serials, including microfilm and microfiche.
[5] Manuscripts: Total manuscripts equivalent to 8,948 linear feet of material, multiplied by a common factor to provide an item number estimate.
[6] PubMed Central Titles: Only fully deposited titles.
[7] Bookshelf Titles: Titles of books, reports, databases, documentation, and collections.
[8] Digital Collections Repository: Digitized content in the public domain. In the future, it will contain born-digital items as well as reformatted items.
[9] Texts: Includes monographs and serials such as annual reports. Referred to as "Print Materials" on Digital Collections website.
[10] Audiovisuals: Referred to as "Films and Videos" on Digital Collections website.

Table 2: Collection Activities

Acquisitions and Processing	***FY2015***	***FY2014***	***FY2013***
Active Serial Subscriptions	17,556	17,439	18,343
Items Processed[1]			
Serial Pieces	75,193	94,738	99,891
Monographs (pre-1914)[2]	763	1,218	336
Monographs (1914-)	20,845	19,367	16,530
Audiovisuals[3]	481	241	683
Prints and Photographs	1,147	1,364	1,397
Total	98,429	134,367	137,180
Archival Materials Acquired			
Modern Manuscripts (in linear feet)	583	157	120
Expenditures			
Publications	$11,587,588	$11,571,597	$11,033,522
Rare Books, Manuscripts, and other Historical Materials	$300,214	$299,841	$299,948
Total[4]	$11,887,802	$11,871,438	$11,333,470
Preservation			
Volumes Bound	33,028	14,516	14,903
Volumes Repaired Onsite[5]	684	685	994
Audiovisuals Preserved	731	811	632
Historical Volumes Conserved	713	583	375
Pages Digitized[6]	187,585	413,550	540,830

[1] Items Processed: Serials issues, monographs, and nonprint receipts processed.
[2] Monographs (pre-1914) includes historical manuscripts (those written prior to the year 1600).
[3] Audiovisuals became a separate tracking category in FY2012. For prior year reports, Audiovisuals were grouped with Monographs (1914-).
[4] Used to be reported in "Publications" prior to FY2012. "Rare Books" was a portion of that amount.
[5] Volumes repaired onsite: General Collection monographs and serials only.
[6] Pages Digitized: Number excludes digitization projects not associated with the Digital Collections Repository, e.g., Profiles in Science.

Table 3: Cataloging and Indexing

Cataloging	***FY2015***	***FY2014***	***FY2013***
General Collection Items[1]	17,935	18,755	16,685
Historical Monographs (pre-1914)	3,815	4,431	4,342
Modern Manuscripts (in linear feet)[2]	364	92	303
Prints and Photographs[3]	2,920	1,326	2,083
Historical Audiovisuals	227	875	894

Indexing	***FY2015***	***FY2014***	***FY2013***
Citations Indexed for MEDLINE	806,326	765,850	734,052
Journals Indexed for MEDLINE	5,618	5,647	5,640

[1] 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 4: Services to the Public

Document Delivery	***FY2015***	***FY2014***	***FY2013***
Interlibrary Loan Requests Received	180,733	188,912	218,268
Interlibrary Loan Requests Filled	146,123	155,423	179,941
General Reading Room Requests Received	67,482	68,281	76,215
General Reading Room Requests Filled	61,602	61,713	68,486
History of Medicine Reading Room Requests Filled	7,996	8,660	7,639

Customer Service Inquiries	***FY2015***	***FY2014***	***FY2013***
Offsite Inquiries[1]			
General	53,508	95,665	99,857
History of Medicine	6,234	5,776	8,108
Onsite Inquiries[2]			
General	6,314	6,967	5,219
History of Medicine	8,133	9,750	12,183

Data Licensees	***FY2015***	***FY2014***	***FY2013***
MEDLINE	831	831	767
UMLS	10,095	12,627	8,804

Tours and Visitors	***FY2015***	***FY2014***	***FY2013***
Exhibitions			
Visitors	1,571	2,700	2,662
Daily Tours			
Tours	107	83	111
Visitors	552	508	734
Special Tours			
Tours	75	75	88
Visitors	1,121	1,952	1,660

[1] Offsite Inquiries: Inquiries via telephone, fax, US mail, and email. Includes BSD interactions with data licensees. Beginning in FY2015, ILL requests are no longer included in the count of Customer Service Inquiries.
[2] Onsite Inquiries: In person.

Table 5: Selected Web Resources

Resource	*FY2015*	*FY2014*	*FY2013*
ClinicalTrials.gov			
Number of Trials	199,725	176,622	157,013
Page Views[1]	2,405,844,998	1,414,637,991	1,145,603,153
Visitors[2]	13,731,543	11,264,641	11,058,828
DailyMed			
Number of Labels	78,394	66,527	55,190
Page Views	268,793,206	182,881,007	146,216,340
Visitors	14,633,833	18,722,781	17,541,406
Genetics Home Reference			
Summaries	2,515	2,376	2,125
Page Views[3]	41,781,084	198,089,169	161,918,165
Visitors	19,027,155	14,064,110	9,719,450
Household Products Database			
Number of Products	15,000	14,000	12,000
Page Views	26,669,097	41,757,342	39,960,413
Visitors	900,468	970,643	820,718
MEDLINE/PubMed			
PubMed Citations	25,375,421	24,289,399	23,187,946
Page Views	8,537,643,903	8,094,826,103	7,573,459,637
Unique Visits[4]	752,310,089	741,750,623	716,895,000
Searches[5]	2,796,260,949	2,650,894,898	2,514,611,135
MedlinePlus			
Number of Topics (English/Spanish)	969/958	957/948	953/939
Page Views[6]	932,300,000	1,023,100,000	845,000,000
Visitors	404,500,000	409,800,000	298,500,000
NLM Main Web Site			
Page Views[6]	19,300,000	60,300,000	44,600,000
Visitors	5,300,000	14,500,000	9,100,000
ToxTown			
Page Views	7,942,465	5,443,181	5,029,713
Visitors	377,772	294,186	263,781

[1] Page Views: Number of times a single page is viewed or downloaded.
[2] Visitors: Number of people visiting a website in a defined period of time.
[3] Beginning in FY2015, Genetics Home Reference is reporting Page Views rather than Page Hits due to a change in web analytics reporting tools.
[4] Unique Visits: Total number of times that all users visit a website, regardless of the number of individual pages viewed.
[5] Searches: Number of searches performed.
[6] NLM changed web analytics reporting methodology and tools beginning in FY2015, resulting in more accurate numbers of Page Views.

Specialized Information Services

Steven Phillips, MD
Associate Director

The Division of Specialized Information Services (SIS) was created in 1967 to provide information on toxicology, chemistry, and drug information. Today, SIS offers a wide-range of free online and mobile resources and services in toxicology, environmental health, chemistry, HIV/AIDS, disaster medicine and public health emergencies, minority health, and other specialized topics.

Databases

Dietary Supplement Label Database
Collaborating with the NIH Office of Dietary Supplements, SIS developed the Dietary Supplement Label Database (DSLD) in 2013. The database now contains over 50,000 labels of dietary supplement products. Users can access the information via the web or use the new data API to build applications, mine data, and conduct research. SIS is exploring potential open data platforms for release and utilization of SIS data, and is developing a pilot program to establish platform feasibility.

Hazardous Substances Data Bank
In 2015, SIS enhanced records in the Hazardous Substances Data Bank (HSDB.) The staff created new subfields in the human and non-human toxicity excerpts data field to efficiently locate data from *in vitro* and other alternatives to animal studies. Record enhancements also included age groups for human data, more occupational exposure standards, more exposure-related information (e.g., the use of chemicals or substances in consumer products), summaries for the public, additional diagrams and images, and improved nanomaterial records. How substances are selected for addition or update also changed, with more emphasis on substances associated with current disasters, noteworthy toxicology results, and chemicals of current or emerging interest to Federal agencies.

LiverTox
LiverTox, an authoritative resource about drug-induced liver injury developed in partnership with the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), reached a milestone in FY2015. It grew to include 1,000 medication records, including drugs and dietary supplements.

REMM
A redesigned REMM (Radiation Emergency Medical Management) launched in October. The new site includes behavioral health resources and material for stakeholders. Popular features of the previous site have been enhanced and incorporated into the redesign. For example, the REMM multimedia library is now prominently featured on the homepage carousel.

TOXNET
TOXNET (TOXicology Data NETwork) began as part of the Toxicology and Environmental Health Information Program (TEHIP). This suite of databases is continually updated with current information, new features, and improved access.

Health Reach, Tox Town, and WISER
SIS completed usability studies for HealthReach, a resource for health information in many languages; Tox Town, an interactive website covering environmental concerns and toxic chemicals; and WISER, the Wireless Information System for Emergency Responders, that assists emergency responders in hazardous material incidents. The study results will inform the future redesign and improvement of these sites.

Research and development

SIS developed a new version of its Emergency Radio Email System (BMERS), incorporating a highly enhanced user interface and a smaller, more portable radio station. Standard Incident Command and other emergency communications forms are now available to users for emergency communications. The BMERS system, using the latest software from the Amateur Radio Safety Foundation, enables a low-cost, easy-to-deploy solution to keep incident command staff connected to email when Internet services—and potentially all other

external communication services—are disrupted during a disaster event.

Outreach

The K-12 team developed and launched three games for mobile devices to support classroom lessons in chemistry, genetics, and environmental health. The work involved academic gamification experts, who provided training in game theory, and regular interaction with the target audiences to ensure we met the educational objectives. The new games are:

- Bohr Thru, a chemistry-themed video game that teaches the Bohr model of the atom;
- Base Chase, a game about DNA base pairs; and
- Run4Green, a game about greenhouse gases and environmental conservation.

On March 16-17, 2015, representatives of the Environmental Health Information Partnership, a long-standing outreach partnership with over 20 minority serving institutions, convened at NLM for their annual meeting. The theme, "Challenges of Infectious Diseases," included presentations on Ebola, emerging public health infectious diseases, climate change, and NLM resources.

SIS funded three projects related to disaster health information outreach and collaboration. Those projects, based in Maine, Missouri, and Washington, sought to improve disaster medicine and public health information access for those who play a role in disaster management, and to demonstrate the role of librarians in disaster preparedness and response. In addition, SIS conducted an evaluation with a number of past recipients of such funding. The results will be used to determine the program's future direction.

The SIS Digital Communications Team continued to explore new tools and methods for reaching target populations. The team moved most SIS discussion email lists to GovDelivery, which provides tools to measure engagement and increase subscriptions. All five accounts using GovDelivery saw marked increases in the number of subscribers.

SIS staff evaluated the impact of distance learning by focusing on two NLM programs: the South Carolina Teen Health Leadership program (carried out in partnership with the Medical College of South Carolina and Communities in School, Inc.) and the Distance Learning Outreach Program (a collaboration with the NLM Lister Hill Center and four high schools across the US). They found these programs help improve health information literacy and interest in biomedical careers. Staff published their results in two separate articles in the *Journal of the Medical Library Association*.

SIS embarked upon a plan to improve access to online learning for our varied user populations. SIS selected a learning management system and developed tools, templates, and guidance documents for developing online courses. SIS staff began to develop classes and tutorials, and also collaborated with NCBI on the development of NCBI NOW!, a self-guided genetics workshop accessible via the SIS learning management system.

SIS coordinated the placement of five summer interns from the Charles Flowers High School in Prince George's County, Maryland in positions across NLM. SIS also hosted two summer interns from the Association of Research Libraries Career Enhancement Program, which provides students from traditionally underrepresented racial and ethnic minority groups an opportunity to jump-start their careers by interning in research libraries. In addition, at different points throughout the year, SIS hosted undergraduate students from the University of Maryland Behavioral and Community Health and Federal/Global Semester Programs; college students interested in gaming, computer science and microbiology; and fellows from the Uniformed Services University of the Health Sciences.

SIS coordinated the first summer intern symposium to highlight the work accomplishments of the high school and college students during their tenure at NLM.

SIS funded one Knowledge River Scholar intern at the University of Arizona Health Sciences Library. The internship allows the student to gain work experience and learn about careers in health sciences librarianship.

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 division of the NLM. To fulfill its mission, LHC:

- captures, processes, distributes, and uses high quality medical imaging data;
- develops and promotes health information technology standards to facilitate their adoption and meaningful use in electronic health records (EHRs), public health, and research;
- conducts research and development in biomedical natural language processing;
- develops mobile health and emergency response tools;
- provides health-related information to enhance patient engagement; and
- trains the next generation of medical informaticians.

Biomedical imaging research

LHC continued advanced imaging research to expedite diagnosis and treatment of diseases, support disease research, and advance 3D image modeling. (See "Patient Care Goes Mobile: Diagnosis through Image Analysis.")

A National Cancer Institute (NCI) cervical cancer biopsy study used LHC's Boundary Marking Tool to collect and annotate multiple-biopsy cervix images. (Single biopsy during colposcopy may miss 30-50% of high-grade cervix disease.) The study determined that multiple biopsies improve sensitivity of high-grade disease detection.

LHC used machine learning to improve its cervical cancer imaging tools. Staff used a support vector machine model to classify the disease severity in uterine cervix digital histology images. Performance accuracy was 95% for determining disease grade (Cervical Intraepithelial Neoplasia (CIN) 1-3 or Normal) and 88% for determining exact class (Normal, CIN1, CIN2, or CIN3). Automating classification can lessen the diagnostic burden on expert pathologists; provide a second opinion, potentially reducing inter-observer variability; and classify images more quickly.

The Open-*i*^{SM} database of biomedical images enables search and retrieval of abstracts and images (including charts, graphs, and clinical images) from the open source literature and selected biomedical image collections. In FY2015, LHC added a special collection: the Orthopedic Surgical Anatomy Teaching Collection from the University of Southern California Digital Library.

LHC continued to support and update the Insight Segmentation and Registration Toolkit (ITK), an open source image analysis software that provides segmentation and registration algorithms in two, three, and more dimensions.

Health IT terminology and standards

In FY2015, LHC collaborations to facilitate health information exchange and meaningful use EHRs included:

- National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) to develop and publish guidance for using EHRs to improve chronic disease care;
- Centers for Medicare & Medicaid Services (CMS) to standardize their data elements across forms;
- nationwide efforts to standardize the reporting of newborn screening; and
- many others to develop and encourage the adoption of Common Data Elements. (See "Standardizing Big Health Data for Patient Care and Clinical Research.")

LHC organized agreements between LOINC® and IEEE, and between LOINC and RadLex (RSNA) to unify their respective coding systems and distribute mappings. LHC also worked closely with the FDA, CDC, and ONC to encourage the use of clinical standards—developed and supported by NLM—in instrument labels and drug trial submissions.

LHC enhanced LOINC's coverage, utility, and globalization and added new lab tests, such as maternal cell-free DNA tests for fetal trisomy, and genetic stool tests to predict colon cancer risk.

LHC developed SNOMED CT mapping resources to support the use of SNOMED CT® for coding diagnoses with greater clinical specificity than enabled by the International Classification of Diseases (ICD) codes (which were primarily developed and used for statistical and administrative purposes). LHC published a new release of the SNOMED CT to ICD-10 map, and Partners Healthcare System deployed the map in its clinical systems.

To help implement SNOMED CT, LHC extended its SNOMED CT CORE Problem List Subset, which covers 80% of commonly used terms and 84% of usage in a new problem list vocabulary. Staff also analyzed coverage of rare disease names in standard terminologies.

The RxNav browser and its APIs—for navigating RxNorm and other NLM-developed medication information resources—received one billion queries in 2015. Staff worked with OHDSI and PCORnet to map NDCs (historical drug codes) to RxNorm, extended the coverage of phenotypes in SNOMED CT through post-coordination, and added a new feature to RxClass to compute the similarity between two classes.

To enable standards-based EHRs and mobile health apps, LHC developed NLM-Forms, a suite of software tools to help build input forms and to readily populate form fields with terms from open medical vocabularies. LHC published the code and documentation for this open source software on GitHub.

Natural language processing

LHC staff worked with the Library Operations Division to refine and enhance two ongoing projects using natural language processing:

- The Consumer Health Information Question Answering (CHIQA) system helps staff handle the large volume of incoming customer service questions by creating sets of question types, recognizing spatial relations in questions, translating expressions to UMLS terms, correcting misspellings, and finding relevant information using the focus and type of question.
- The Medical Text Indexer (MTI) generates recommended MeSH terms for journal articles, allowing indexing work to proceed more quickly and efficiently.

Staff developed MeSH on Demand, an easier way to find Medical Subject Headings (MeSH) based on text processing, to help teachers annotate curriculum and class notes and to help authors find keywords for papers. LHC also conducted research to help Native Americans and other people with health disparities better utilize Semantic MEDLINE, a free tool that uses natural language processing and graph analysis to guide users to relevant MEDLINE citations.

LHC's Indexing Initiative worked with the FDA to determine the best MetaMap settings to extract information about side effects from Structured Product Labels. Through the PubMed Early Alerts pilot project, staff provided FDA safety officers with timely information about specific adverse drug events. Based on that success, LHC expanded the service to eight other FDA teams. Staff also deployed the NLM Scrubber de-identification software for the NCI SEER (Surveillance, Epidemiology, and End Results) Program. This effort improved the value of these data for research while preserving patient privacy.

Mobile health and emergency response

In collaboration with the National Institute of Neurological Disorders and Stroke (NINDS) Human Motor Control Section, NLM developed a mobile app to help people with Parkinson's disease record their daily health status. The app helps patients track their symptoms, including dyskinesia, tremors, falls, speech, mood, and medications. Such information can provide doctors with a fuller picture of their patients' condition to tailor treatments, adjust medications, and improve overall patient care.

LHC's Lost Person Finder Project helps reunite families after disasters. PEOPLE LOCATOR® was activated in response to emergencies including earthquakes, typhoons, and a volcanic eruption. Staff demonstrated TriageTrak, a hospital use-case version of the PEOPLE LOCATOR software, at the National Association of City and County Health Organizations 2015 Preparedness Summit.

Digital preservation

In collaboration with NLM's History of Medicine Division, LHC enhanced public resources for digital

preservation and history of medicine via *Profiles in Science* and *Turning the Pages*.

LHC published five new illustrated interviews in the *Conversations with Medical Informatics Pioneers* oral history collection: Donald A.B. Lindberg, G. Octo Barnett, Nina Matheson, Homer R. Warner, Sr., and Don Detmer.

Training

Our Medical Informatics Training Program hosted nine postdoctoral fellows in 2015 (seven PhD, one MD, and one MD/PhD), as well as students from NLM-sponsored university training programs, medical school, college, and high school. Students represented 17 US states and 11 countries, including the Philippines, Brazil, Nepal, and Hungary. Each participant spends between a few months and several years working on a research project under a mentor's guidance.

National Center for Biotechnology Information

David Lipman, MD
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 generated by the genetic revolution.

To fulfill its mission, NCBI:

- creates automated systems for storing and analyzing molecular biology and 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 healthcare personnel; and
- coordinates efforts to gather and disseminate biotechnology information worldwide.

NCBI has developed a vast array of resources, ranging from genetic and 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 the PubMed and PubMed Central databases of life sciences journal literature. Each day these and other NCBI resources are used by about 4 million people, who download a total of 35 terabytes of data, the equivalent of 50,000 CDs.

Foodborne Pathogens Project

One in six Americans gets sick each year from consuming contaminated food or beverages, and approximately 3,000 people die of foodborne disease. To address this public health challenge, NCBI has joined forces with other public health agencies to use whole-genome sequencing (WGS) to identify the pathogens involved in outbreaks of foodborne illness.

Partner labs at CDC, FDA, and USDA sequence samples from human patients, food, and the environment, and send the raw sequencing data to NCBI, which assembles the sequences and compares them to sequences in its database to identify those with similar genomes. Results allow scientists and public health officials to link cases of foodborne illness, even if they occur on opposite coasts, and to link food ingredients and production facilities to those outbreaks. WGS provides much faster and more precise identification of related pathogens than earlier technologies. In FY2015, this project helped resolve numerous foodborne disease outbreaks, including *E. coli* at Chipotle Mexican Grill; *Salmonella* in cucumbers, pork, and frozen, stuffed chicken entrees; and *Listeria* in cheese, sprouts, and caramel apples.

PubMed Labs

Introduced in 2015, PubMed Labs is an initiative for developing experimental new projects with input from the user community. Projects in PubMed Labs include early versions of new resources, new features for existing resources, and novel content. The NCBI Insights blog announces the projects and provides instructions on how users can test the functions. Users are encouraged to provide feedback. Two PubMed Labs projects were introduced for testing in 2015: SmartBLAST and PubMed Also-Viewed.

Genomic Resources

NCBI took significant steps to improve its Genome Annotation Pipelines and the Reference Sequence (RefSeq) database. Staff revised the annotations on all 42,000-plus RefSeq prokaryotic genomes to make the annotations comparable across genomes and species. Staff also removed 7 million redundant proteins from the RefSeq database, retaining the best representative genomes for identical protein sequences. The clean-up has improved search accuracy and allows for better annotation going forward.

The Database of Genotypes and Phenotypes (dbGaP)

NCBI launched the dbGaP Data Browser, which enables users to explore variant calls, genotype calls, and supporting sequence read alignments for controlled-access datasets in a genomic context. dbGaP also added an advanced search feature focused on datasets residing within the controlled-access portion of the database. The new search feature enables users to determine more easily whether to pursue a request for approval to access a dataset. Finally, 2015 saw the release of NIH's position statement on the use of cloud computing services for the

analysis of dbGaP controlled-access data. Investigators now may request to move dbGaP data associated with a specific project to a cloud provider of their choice.

Medical Genetics

Precision medicine will depend upon clinical validity of gene-disease associations, transparency of genetic testing used for medical decision making, accurate interpretations about the impact of sequence variation on discrete phenotypes, and evidence to support the clinical utility of genetic information. NCBI has made a strong commitment to develop resources that will help support these needs. NCBI medical genetic resources include the Genetic Testing Registry (GTR), ClinVar, MedGen, GeneReviews, Medical Genetics Summaries, OMIM, GeneTests, and others.

PubChem

PubChem, NCBI's database of compounds, substances, and bioassays, added Laboratory Chemical Safety Summaries (LCSS) to compound records for commonly encountered lab chemicals. The LCSS provides hazard and safety information for a chemical, such as flammability, toxicity, exposure limits, exposure symptoms, first aid, handling, and clean up.

Research

NCBI's Computational Biology Branch (CBB) focuses on computational approaches to a broad range of fundamental problems in evolution, molecular biology, genomes, biomedical science, and bioinformatics. Among other projects this year, NCBI scientists identified three new CRISPR-Cas systems that have potential for genome editing. (See "Lofty Goal, Amazing Discoveries: NCBI's Work with CRISPR-Cas.")

Literature Information Resources

Among numerous other enhancements to PubMed and its companion resources, My NCBI, the customizable dashboard to NCBI databases, revised SciENcv (Science Experts Network Curriculum Vitae) to support two new biosketch formats: the NIH Biographical Sketch format —which became mandatory for NIH grant applications with due dates of May 2015 or later—and the National Science Foundation biosketch format. More than 37,500 biosketches were made in the new formats by the end of FY2015.

FY2015 saw a 13% increase in the number of articles available (3.6 million) in PubMed Central (PMC) and a 20% increase in the number of articles retrieved each day (2.4 million). In addition, several government agencies began making their funded research available through PMC. (See "PubMed Central and Public Access to Biomedical Information.")

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, answered emails, and managed social media sites. Staff delivered courses and workshops both on-site at NLM and at sponsoring institutions. Their weekly "NCBI Minute" delivered tips or enhancements via short, informational videos, and every few weeks, full-length webinars explored resources or topics in greater depth. All tutorials, webinars, and workshops were uploaded to NCBI's YouTube channel, which surpassed one million views this year. NCBI also hosted two "genomics hackathons" at NLM that 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's first grant awards were issued in 1965. The funds are expended as grants-in-aid to the extramural community in support of the library's mission. Review and award procedures conform to NIH policies.

EP awards several categories of grants, all of which pertain to biomedical informatics and the management and dissemination of biomedical knowledge. Applications are received through parent NIH funding opportunity announcements (FOAs) or through special FOAs issued by EP. Each year, NLM makes new and/or continuing awards in five grant categories: Research Projects, Resources, Career Development, Research Career Training, and Small Business Research and Development.

Grants Summary

EP's FY2015 base budget for grant awards was $42,291,453, nearly $2 million below the FY2012 level. EP issued 136 grant awards in FY2015 for a total budget of $42,288,280.

As has been the case in recent years, the fiscal year began under a continuing resolution. NIH Institutes and Centers cannot make new awards or launch new initiatives until an appropriations bill or other annual funding bill has been passed.

Success Rates

Success rates are computed by dividing the number of awards in a given fiscal year by the number of applications reviewed that year.

Success rates were down in several programs in FY2015 compared to earlier years as a result of flat funding, as most grants are multiyear grants. Nevertheless, NLM's combined success rate for its research grant programs was 19.8% in FY2015, compared to 18.3% for NIH as a whole.

Table 1: Success Rates of Core NLM Grant Programs, FY2012-2015

	Activity Code	FY2012	FY2013	FY2014	FY2015
Research[1]	R01	14%	16%	22%	**24%**
	R21	11%	3%	16%	**10%**
Career[2]	K99	26%	25%	25%	**30%**
	K01	N/A	N/A	60%	**17%**
Resource[3]	G13	8%	7%	13%	**13%**

[1] Research grants, funded with appropriated funds, support basic and applied informatics projects.
[2] K22 Career Development award program was suspended in FY2015.
[3] Resource grants use appropriated funds to support dissemination and management of health-related information.

FY2015 Highlights

NLM became the administrative home for a new Big Data to Knowledge (BD2K) T32 training grant and several BD2K open educational resource grants on data management, curation, and annotation of biomedical big data.

NLM issued its first Ruth L. Kirschstein National Research Service Award (NRSA) pre-doctoral Fellowship (F31).

NLM made 11 new informationist administrative supplement awards to active grants at nine different institutions.

NLM is now administering a three-year NIH Director's New Innovator Award (DP2).

NLM co-funded with the National Heart, Lung, and Blood Institute (NHLBI) an NIH Early Innovator Award.

NLM hosted its annual Informatics Training Conference June 23-24, 2015. Approximately 264 people attended.

Planning began for re-competition of NLM's Informatics Training Programs. A funding announcement will be issued in FY2016. The new five-year awards will begin July 1, 2017.

Program staff organized a series of Informatics Lectures by NLM grantees:

- Dr. Peter Szolovits: "How to Learn in The Learning Healthcare System" (November 5, 2014)
- Dr. John Pestian: "Phenotypical Cohort Retrieval Using the Multi-Institutional Pediatric Epilepsy Decision Support" (March 18, 2015)
- Dr. Atul Butte: "Data-Driven Precision Medicine" (June 3, 2015)

Grant Programs

NLM participates in two types of multi-institute grant programs: general and topical. General programs are fundamental components of NLM's overall grant program. NLM participates selectively in topic-focused multi-institute funding announcements.

Table 2: NLM's Core Active Grant Programs

Announcement	Title	Expiration
PAR-13-300	NLM Express Research Grants in Biomedical Informatics (R01)	September 8, 2016
PA-13-302	Research Project Grant (NIH Parent R01)	September 8, 2016
PA-13-303	NIH Exploratory/Developmental Research Grant Program (Parent R21)	September 8, 2016
PA-13-347	NLM Informatics Conference Grants (R13)	September 8, 2016
PA-13-313	Academic Research Enhancement Award (AREA) (Parent R15)	September 8, 2016
PA-15-249	NLM Administrative Supplements for Informationist Services in NIH-funded Research Projects (Administrative Supplement)	July 18, 2015
PAR-14-339	NLM Grants for Scholarly Works in Biomedicine and Health (G13)	February 23, 2016
PAR-13-284	NLM Career Development Award in Biomedical Informatics (K01)	September 8, 2016
PA 15-083	NIH Pathway to Independence Award (K99/R00)	January 8, 2017

Table 3: Multi-Institute Active Announcements in which NLM Participates

Announcement	Title	Expiration
PA-15-321	Research Grant Supplement to Promote Reentry in 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
PAR-13-130/132	Understanding and Promoting Health Literacy Research Grants (R01) (R21)	May 8, 2016
PA-13-292/288	Behavioral and Social Science Research on Understanding and Reducing Health Disparities (R01) (R21)	September 8, 2016
RFA-RM-13-006	NIH Pioneer Award Program (DP1)	October 15, 2015
RFA-RM-13-007	NIH Director's New Innovator Award Program (DP2)	October 17, 2015
RFA-HG-14-007	Mentored Career Development Award in Biomedical Big Data Science for Clinicians and Doctorally Prepared Scientist (K01)	April 2, 2015
RFA-HG-14-008	Courses for Skills Development in Biomedical Big Data Science (R25)	April 2, 2016
RFA-HG-14-006	Revisions to Add Biomedical Big Data Training to Active NLM Institutional Training Grants in Biomedical Informatics (T15)	July 26, 2016
RFA-HG-14-004	Predoctoral Training in Biomedical Big Data Science (T32)	July 28, 2015
PAR-14-071/072	Small Business Innovations Research Grants (SBIR R43/R44) (STTR R41/R42)	May 8, 2015
PA-12-196	Innovative Health Information Technology for Broad Adoption by Healthcare Systems and Consumers (SBIR)(R44)	January 8, 2015
PA-14-154/157	Early Stage Development of Technologies in Biomedical Computing, Informatics, and Big Data Science (R43/R44) (R41/R42)	May 8, 2017
PA-14-147/148/150	Ruth L. Kirschstein NRSA Individual Predoctoral Fellowships (F30/F31)	January 8, 2017

Table 4: FY2015 Operating Budget Request by NIH Activity Code

Activity Code	No. of Awards	Amount
DP1: Pioneer Award	1	$389,388
G08: Information Resource Grants to Reduce Health Disparities	6	$540,609
G13: Scholarly Works in Biomedicine and Health	9	$482,998
K99: Pathway to Independence	5	$407,804
K22: NLM Independent Career Development Award for Biomedical Informatics	6	$852,113
K01: Career Development Award in Biomedical Informatics	4	$586,663
R00: Pathway to Independence	10	$1,969,440
R01: Research Project Grants	56	$22,054,200
R13: Conference Grants	4	$78,209
R15: Academic Research Enhancement Award (AREA)	1	$312,651
R21: Exploratory/Developmental Grants	9	$1,671,985
R25: Education Projects	3	$181,942
R41: Small Business Technology Transfer (STTR)	1	$99,115
R43: Small Business Innovation Research (SBIR)	5	$714,270
T15: University Biomedical Informatics Research Training Programs	14	$11,838,417
F31: NRSA Individual Predoctoral Fellowships	1	$36,613
Y03: Interagency Agreement	1	$75,000
TOTAL	**136**	**$42,291,453**

Table 5: NLM Grant Portfolio: New and Continuing Awards by NIH Grant Mechanism

	New FY2015	New FY2014	Continuing FY2015
Research Grants			
R01	16	15	40
R21	3	6	6
R13	1	2	3
R15	1	1	0
R56	1	1	1
DP1	0	1	1
DP2	1	0	0
Resource Grants			
G08	4	0	2
G13	6	5	4
Administrative Supplement	11	11	11
Training Grants			
T15	0	0	14
K99/R00	3	4	9
K01	1	3	3
K22	0	0	6
R25	0	0	3
SBIR/STTR			
R41	1	0	0
R43	4	1	0
R44	0	0	0
Total	**53**	**49**	**103**

Figure 1: NLM FY2015 Awards by Investment Area

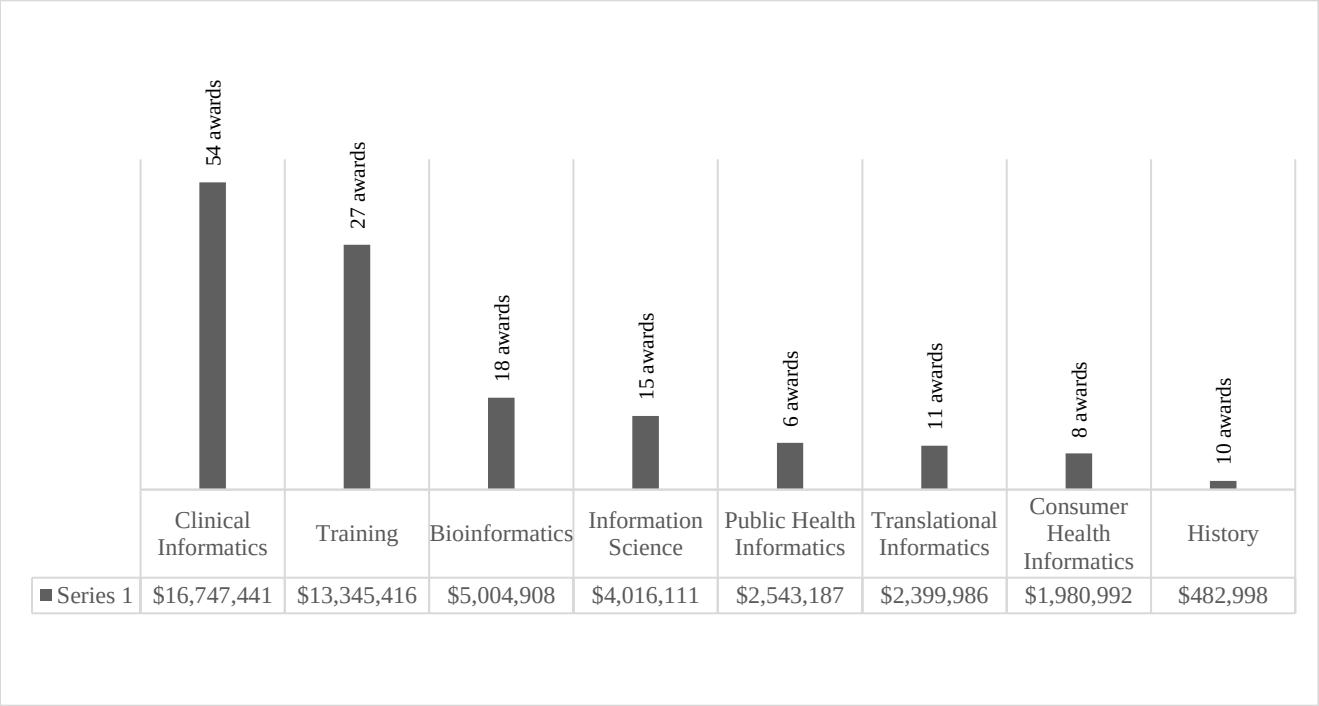


Table 6: FY2015 Operating Budget Request by NIH Mechanism Groupings

Activity Code	No. of Awards	Amount
Research Project Grants (R01, R21, R00, R15, R56)	76	$26,008,276
SBIR/STTR (R41, R42, R43, R44)	6	$813,385
Other Research - Research Careers (K99, K22, K01, DP1, DP2)	16	$2,236,004
Other Research – Other (G08, G13, R13, R25)	22	$1,283,758
Training – Institutional (T15 and T32)	14	$11,838,417
Research and Development Contracts (Y03)	1	$75,000
Fellowship (F31)	1	$36,613
TOTAL	**136**	**$42,291,453**

Grant Funding

Table 7: Pan-NIH Projects and Interagency Collaborations

Award	NLM Cost	Awardee
Informationist Services Supplement (R01, P01)	$614,670	18 supplemental awards to NIH-funded Research Projects
NIH Director's Early Independence Awards (DP5)	$423,750	University of Pittsburgh: Impact of Racially Targeted Food and Beverage Ads on Adolescent Behavior
NIH Director's New Innovator Award (DP2)	$462,000[1]	New York University: A Novel Intervention to make Heuristics as source of Power for Physicians
Small Business Innovation Research	$37,965[2]	GENAPSYS, Inc.: Development of Digital Pneumatic Microfluidic Systems for NGS Sample Preparation

[1]$2,310,000 over 5 years
[2]Co-fund share of $659,846 Phase II award

Table 8: Interagency Agreements and Funding

Awardee	Amount	Source
Dr. John Brownstein (NLM Grantee)	$20,000	Office for the Assistant Secretary for Preparedness and Response, DHHS
Protein Sequence Databank, Rutgers University	$100,000	NLM

Shared Funding for Research

In FY2015, NLM co-funded the following research efforts:

- a Small Business Technology Transfer award administered by the National Institute of Mental Health; and
- the NHLBI National Center for Biomedical Computing (NCBC) at the University of California, San Diego (known as iDASH: Integrating Data for Analysis, Anonymization and Sharing).

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. EP provides both institutional training support and individual career transition support.

Five-year institutional training grants support predoctoral, postdoctoral, and short-term informatics research trainees at 14 university-based programs across the country.

In FY2015, NLM supported 116 predoctoral and 85 postdoctoral fellowship slots. In addition, two predoctoral and seven postdoctoral trainees in dental informatics were supported by the National Institute of Dental and Craniofacial Research. Nine of NLM's training programs also received support for a total of 31 Short-term Trainee Positions (STTP) to help enhance diversity in the field of biomedical informatics. Of the NLM informatics research trainees, 39% are women and 31% are from underrepresented or disadvantaged backgrounds.

Big Data to Knowledge (BD2K) Grants

Table 9: Big Data to Knowledge Grants

Award	NLM Cost	Awardee
Open Educational Resources for Sharing, Annotating, and Curating Biomedical Big Data (R25)	$269,856	Five institutes of higher education
Predoctoral Training in Biomedical Big Data Science (T32)	$170,429	Northwestern University at Chicago: three trainees

Grant Review Activities

Table 10: Grant Review

Total applications reviewed	**262**		
Breakdown by Review Panel	107	41%	NLM Biomedical Library and Informatics Review Committee (BLIRC)
	105	40%	NLM Special Emphasis Panels
	50	19%	NIH Center for Scientific Review
Breakdown by Grant Mechanism (NLM-reviewed applications only)	75	35%	R01: Research Grant
	3	1%	R13: Research Grant
	32	15%	R21: Research Grant
	17	8%	K01, K22, K99: Career Development
	47	22%	G08: Resource Grants
	36	17%	G13: Scholarly Works
	2	1%	F31: Predoctoral Fellowship

NLM New Grants Awarded in FY2015

Research Projects (R01)

Altman, Russ B.
Text Mining for High-Fidelity Curation and Discovery of Gene-Drug-Phenotype Relationships
2 R01 LM005652-19A1
Stanford University

Benos, Panagiotis V.
Integrative Graphical Models for Large Multi-Modal Biomedical Data
1 R01 LM012087-01
University of Pittsburgh

Brownstein, John S.
An Approach for Estimating Foodborne Illnesses and Assessing Risk Factors
1 R01 LM011965-01A1
Children's Hospital Corporation

Gui, Jiang (New Investigator)
Bioinformatics Strategies to Relate Age of onset with Gene-Gene Interaction
1 R01 LM012012-01A1
Dartmouth College

Hunter, Lawrence E.
Bio Text NLP
2 R01 LM009254-09
University of Colorado, Denver

Kirkendall, Eric S.
Improving Intensive Care Medication Safety through EHR-based Algorithms
1 R01 LM012230-01
Cincinnati Children’s Hospital Medical Center

Leroy, Gondy
Evidence-based Strategy and Tool to Simplify Text for Patients and Consumers
1 R01 LM011975-01A1
University of Arizona

Lu, Xinghua
Deciphering Cellular Signaling System by Deep Mining a Comprehensive Genomic Compendium
1 R01 LM012011-01
University of Pittsburgh

Neapolitan, Richard E.
Multidimensional Computer Adaptive Testing for Patient Reported Outcomes
1 R01 LM011962-01A1
Northwestern University at Chicago

Savova, Guergana K.
Temporal Relation Discovery for Clinical Text
2 R01 LM010090-05
Children's Hospital Corporation

Schillinger, Dean
The Next Frontier in Diabetes Communication: Promoting Health Literacy in the Era of Secure Messaging
1 R01 LM012355-01A1
University of California, San Francisco

Scotch, Matthew (New Investigator)
Merging Viral Genetics with Climate and Population Data for Zoonotic Surveillance
1 R01 LM012080-01
Arizona State University

Shapiro, Jason S. (New Investigator)
Terminology Services to Reduce Avoidable CT Imaging
1 R01 LM012196-01
Icahn School of Medicine at Mount Sinai

Simon, Gyorgy (New Investigator)
Extracting Typical and Atypical Disease Progression Patterns from Multi-Site EHR
1 R01 LM011972-01A1
Mayo Clinic

Viswewaran, Shyam
Development and Evaluation of a Learning Electronic Medical Record System
1 R01 LM012095-01A1
University of Pittsburgh

Wallace, Byron C.
Semi-Automating Data Extraction for Systematic Reviews
1 R01 LM012086-01A1
University of Texas

Exploratory/Developmental Research (R21)

Chu, Haitao
Statistical Methods and Software for Multivariate Meta analysis
1 R21 LM012197-01
University of Minnesota

Dixon, Brian E.
Advancing Methods to Measure and Improve the Quality of Large Scale Health Data
1 R21 LM012219-01
Indiana University-Purdue University at Indianapolis

Myneni, Sahiti
Content-Based Social Network Analysis Methods for Data-Driven Health Promotion
1 R21 LM012271-01
University of Texas Health Science Center, Houston

NLM Informatics Conference (R13)

Kakadiaris, Ioannis A.
International Workshop on Large-scale Biomedical Semantic Indexing and Question Answering (BioASQ)
1 R13 LM012214-01
University of Houston

Academic Research Enhancement Award (R15)

Rodriguez, Manuel
THS: Using Twitter and Big Data Analytics to Track and Predict Health Conditions
1 R15 LM012275-01
University of Puerto Rico, Mayaguez

NIH Director's Pioneer Award (DP1)

Wu, Sean M.
Enabling Technologies for Human-Machine Hybrid Tissues
1 DP1 LM012179-01
Stanford University

NIH Director's New Innovator Award Program (DP2)

Mohan, Deepika
A Novel Intervention to make Heuristics a Source of Power for Physicians
1 DP2 LM012339-01
University of Pittsburgh

Applied Informatics Resource (G08)

Kaur, Judith S.
Stories of our Men: American Indian/Alaska Native Colorectal Health
1 G08 LM012120-01
Mayo Clinic Rochester

Lyles, Courtney R.
Overcoming Health Disparities by Engaging Patients with the Personal Health Record, MYSFHEALTH
1 G08 LM012166-01
University of California, San Francisco

Martin, Elaine R.
Bridges to Health Information for Individuals with Serious Mental Illness
1 G08 LM012154-01
University of Massachusetts Medical School, Worcester

Shin, Sonya S.
Reducing Cancer Health Disparities in Navajo Nation
1 G08 LM012143-01
Brigham and Women's Hospital

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

Herzberg, David
The Other Drug War: A History of Prescription Drug Abuse in America
1 G13 LM012050-01
State University of New York at Buffalo

Imada, Adria L.
Capturing Leprosy: The Medical Gaze in Americas Pacific Empire
1 G13 LM011898-01A1
University of California-Irvine

Jones, David S.
On the Origins of Therapies: Innovation, Imagination, and the Evolution of Coronary Artery Surgery, 1910-1970
1 G13 LM012053-01
Harvard Medical School

Starks, Tricia
Cigarettes and Soviets: The Culture of Tobacco Use in Modern Russia
1 G13 LM011893-01A1
University of Arkansas

Taylor, Rosemary C.R.
Risks Unforeseen: Policy-making, Science and the Politics of Contaminated Blood
1 G13 LM011888-01A1
Tufts University, Medford

Tuchman, Arleen M.
Diabetes Types: Cultural History of a Chronic Disease
1 G13 LM012252-01
Vanderbilt University

NIH Pathway to Independence Award (K99)

Chen, You
Learning Patterns of Collaboration to Optimize the Management of Care Providers
1 K99 LM011933-01A1
Vanderbilt University

Hribar, Michelle
Modeling and Optimization of Clinical Processes Using EHR Data
1 K99 LM012238-01
Oregon Health & Science University

Li, Ding Cheng
Construction of Relation Detection Framework Empowered by Topic Modeling
1 K99 LM012021-01
Mayo Clinic Rochester

NLM Career Development Award in Biomedical Informatics (K01)

Eng, Kevin H.
Informatic Methods for Differential Signaling and Immune Co-Regulatory Expression
1 K01 LM012100-01
Roswell Park Cancer Institute

Small Business Innovations Research (SBIR) and Small Business Technology Transfer (STTR) Awards (R41, R42, R43, R44)

Crangle, Colleen E.
A Tool for Research on Emotion in Naturally Occurring Speech
1 R41 LM012177-01
Converspeech, LLC

Makarov, Sergey
Visible Human Project Full Body Finite-Element Phantom and Workflow
1 R43 LM012352-01A1
Neva Electromagenics, LLC

Minton, Steven
Automatically Creating and Updating Meta-Studies of Randomized Controlled Trials
1 R43 LM012210-01
InferLink Corporation

Riskin, Daniel J.
Subgroup Analytics and Advanced Semantic Technologies to Enable Personalized Medicine
1 R43 LM012168-01A1
VMT, Inc.

Velez, Carmelo E.
Hybrid Ontology and Machine Learning based Methods using EMR Data for Effective Clinical Decision Support (CDS); A Sepsis Case Study using ICU Data
1 R43 LM012291-01
Computer Technology Associates, Inc.

NIH High Priority, Short-Term Project Award (R56)

Wright, Melanie C.
Right Place, Right Time: Information Design to Support Decisions in Acute Care
1 R56 LM011925-01A1
Saint Alphonsus Regional Medical Center

NIH Big Date to Knowledge (BD2K) Grants

Haddad, Bassem R.
Demystifying Biomedical Big Data: A User's Guide
1 R25 LM012285-01
Georgetown University

Martin, Elaine R.
Development of a Best Practices in Research Data Management Massive Open Online Course (MOOC)
1 R25 LM012284-01
University of Massachusetts Medical School

Lawson, Catherine L.
Enabling Data Science in Biology
1 R25 LM012286-01
Rutgers, The State University of New Jersey

Seymour, Anne
Training and Tools for Informationists to Facilitate Sharing of Next Generation Sequencing Data
1 R25 LM012288-01
Johns Hopkins University

Starren, Justin
Predoctoral Training Program in Biomedical Data-Driven Discovery (BD3)
1 T32 LM012203-01
Northwestern University at Chicago

Surkis, Alisa
Preparing Medical Librarians to Understand and Teach Research Data Management
1 R25 LM012283-01
New York University School of Medicine

Fellowships

Beard, Rachel
Integrating Bioinformatics and Clustering Analysis for Disease Surveillance
1 F31 LM012176-01A1
Arizona State University

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.

OCCS provides NLM's computer networking backbone, connects to external networks, manages the DHS and HHS-approved "unrestricted Trusted Internet Gateway" point-of-presence, handles the interconnections to divisional networks within the NLM, and operates both the NLM Computer Center onsite in Bethesda and the offsite co-location facility in Sterling, Virginia. OCCS helps coordinate, integrate, and standardize the vast array of computer services available throughout all the organizations comprising NLM. Staff create, maintain, and enhance applications and websites for controlled medical terminology systems, consumer and public health, and outreach programs. We also engineer systems that provide many different types of medical data for public consumption. These applications and websites are designed to be secure, user-friendly, and easily accessible by all.

Consumer and Public Health

OCCS partnered with Library Operations and the Lister Hill National Center for Biomedical Communications (LHNCBC) to semi-automate indexing work using the Data Creation and Maintenance System (DCMS) and the Medical Text Indexing (MTI) application. MTI, which was developed in-house by the LHNCBC, automates first-line indexing, with human indexers validating and augmenting the automated work within the DCMS. This automation significantly reduces the human effort involved with indexing, saving labor costs. Using MTI for first-line indexing of 75,000 citations is expected to provide an annual recurring savings of $265,000.

OCCS re-engineered DOCLINE, NLM's automated interlibrary loan request routing and referral system, to automatically reroute requests based on the hours of operation of participating libraries. This improvement, which addressed a known problem, helps ensure timely service to customers and saves staff time.

MedlinePlus staff worked with OCCS to institute a better user experience for site visitors, regardless of their devices, by implementing a single responsive website that replaced the separate MedlinePlus and MedlinePlus Mobile sites. Responsive pages automatically change their layout to fit the user's screen. While improving the user experience, this change also allowed NLM to decommission the MedlinePlus Mobile application, saving time and maintenance costs. Since the launch of the MedlinePlus responsive website, customer satisfaction scores for mobile users have increased, jumping from 80 to 85 for MedlinePlus English and from 86 to 89 for the Spanish site. Total visits have gone up 19%, visits by users on mobile devices has increased by 6.9%, and return users are up 7.2%.

The library made several improvements to NLM Digital Collections, a free online collection of biomedical books and videos. OCCS re-engineered the back-end process to take input from multiple document scanners and provided increased options for output formats. Staff also increased the number of descriptive metadata fields from 13 to 59, delivering better search results and easier site navigation. Digitized assets increased by 23%, from 12,690 to 15,628. Growing the collection of materials not previously available digitally, staff added: 38 films; 2,898 books; 221,454 pages; 24 volumes in 6 sets; 8 leaves in 1 serial; and 42,738 citations. Staff deployed a third copy of the repository's master content in an off-site, off-line location for preservation purposes.

Medical Terminology

OCCS worked extensively on an authoring and collaboration environment associated with the Value Set Authority Center (VSAC), which is a repository for storing, searching, and retrieving purpose-specific subsets of standard terminologies known as value sets. This collaboration environment, which will launch in FY2016, will allow stakeholders to work together to create, revise, and evaluate value sets. Eligible hospitals and providers use these value sets of medical codes in their clinical quality measures to document Meaningful Use, Stage 2 in conjunction with the requirements issued by the Centers for Medicare and Medicaid Services (CMS) and the Office of the National Coordinator for Health Information Technology (ONC).

OCCS helped develop and launch the Common Data Elements Repository. (See "Standardizing Big Health Data for Patient Care and Clinical Research.")

OCCS staff helped NLM publish a new RF2 format of SNOMED CT, a comprehensive clinical terminology designated for use in US federal government systems for the electronic exchange of clinical health information. With this release, NLM made it easier for US organizations to transition from the RF1 format, which is being deprecated worldwide, to RF2, and to keep up with the continually changing landscape of clinical terminology.

NLM IT Infrastructure

OCCS organized and hosted the HHS IPv6 Symposium to promote the adoption of the next-generation Internet protocol (IPv6). The symposium focused on helping government personnel overcome the challenges of the current Internet protocol (IPv4) and efficiently transition to IPv6, in compliance with the OMB mandate. (The IPv6 protocol exponentially expands the number of devices that can connect to the Internet.)

Ivor D'Souza, NLM's Chief Information Officer (CIO), partnered with industry and other federal agencies to build the event's agenda and recruit speakers. Over 650 employees and contractors from across the federal government attended, and Dr. Vinton Cerf, a founding father of the Internet, delivered the keynote.

In FY2015 alone, NIH had transitioned 442 websites to IPv6, a 108% increase in only 10 months. In the previous four years, all of NIH managed to transition only 212 websites.

OCCS implemented a "Science-DMZ," a secure, isolated "de-militarized zone" on the NLM computer network that delivers high-speed digital content to colleges and universities across the country. This implementation was the first such deployment at HHS and serves as a model for others to adopt. NLM uses the low-cost, high-performance "research Internet2" connection to deliver most of its digital content to academia.

Staff increased the capacity of NLM's Internet2 connection at the Sterling Data Center—NLM's off-site data center—from 2.5 to 100 Gigabits per second. As a result, the Sterling Data Center can carry more traffic, which will allow NLM to perform at full bandwidth capacity in the event of a disaster affecting the on-site data center.

OCCS staff put in place an Intrusion Detection System/Intrusion Protection System that provides automated blocking against many IT security exploits.

Administration

Todd D. Danielson
Associate Director

Table 1: Financial Resources and Allocations, FY2015

	(Dollars in Thousands)
Extramural Program	$57,544
Intramural Programs	265,670
Library Operations	(88,291)
Computer and Communications Systems	(36,030)
Lister Hill National Center for Biomedical Communications	(38,321)
National Center for Biotechnology Information	(83,449)
Specialized Information Services	(19,579)
Research Management and Support	14,110
Total Appropriation	337,324
Plus: Reimbursements	68,130
Total Resources	**$405,454**

Table 2: FY2015 Full-Time Equivalents (Actual)

Office of the Director	7
Office of Health Information Programs Development	5
Office of Communication and Public Liaison	10
Office of Administration	58
Office of Computer and Communications Systems	45
Extramural Programs	22
Lister Hill National Center for Biomedical Communications	63
National Center for Biotechnology Information	295
Specialized Information Services	41
Library Operations	257
Total FTEs	**803**

NOTE 1: In FY2014, six FTE and funding of $4.1 million for ClinicalTrials.gov was organizationally located in the Lister Hill National Center for Biomedical Communications (LHC). Beginning in FY2015, the staff and funding for ClinicalTrials.gov was transferred to the National Center for Biotechnology Information (NCBI). Additional funding totaling $1.6 million for ClinicalTrials.gov was received from the NIH Institutes and Centers in FY2015.

NOTE 2: In March 2015, the NIH Office of the Director notified NLM that it was under a partial hiring freeze, pending the recruitment of the new NLM Director to give the new Director some hiring flexibility. The NLM Acting Director submitted requests for permission to proceed with selected hiring actions to the NIH Deputy Director for Science, Outreach, and Policy. Permission was granted in some cases but not others.

New Appointments

Name & Date	Appointment Description
Valerie Whipple *November 2014*	Deputy Director, Office of Acquisitions and Consolidated Operations *Office of Administration*
Thor Sigfusson *January 2015*	General Engineer *Office of Administration*

NLM Associate Fellows, 2015-2016

Becky Balditch Nelson
MLS, University of Maryland
MS, St. Cloud State University
BS, University of Wisconsin-Superior

Kim-Loan Nguyen
MLS, University of Maryland
MS, Washington University
BA, University of Notre Dame

Tyler Nix
MSLS, University of Kentucky
BA, University of Arkansas

Table 3: Director's Education Fund

Institutions	Enrollees
American University	2
Boston University	1
Colorado State University	3
FAES at NIH	1
George Washington University	3
Kent State	1
Mount Saint Mary's University	1
Strayer University	2
Syracuse University	2
University of Maryland	25
Total Staff Enrolled	**31**
Total Courses	**41**

Awards: NLM and NIH

Award / Recipient	Accomplishment
The Regents Award for Scholarship or Technical Achievement **Dr. W. John Wilbur**	For his outstanding pioneering work in applying natural language processing and text mining methodologies for improving the retrieval of biomedical information
Frank B. Rogers Award **Mary Kate Dugan**	In recognition of her substantial contributions to resolving NLM's critical collection space needs to house its valuable collection of journals, books, and audiovisuals.
NLM Director's Honor Award **Dwight H. Mowery**	In recognition of his outstanding leadership in grants management policy implementation and his commitment to improving the efficiency and effectiveness of NIH grant award processes in a way that benefits all Institutes and Centers.
NLM Director's Honor Award **Dimpal Patel**	For exceptional leadership and contributions to maturing the enterprise compute and storage platforms in OCCS, resulting in a robust and modern infrastructure, scaling to meet the demands of NLM's mission.
Phillip C. Coleman Award **Michael J. Gill**	For his conscientious and consistent coaching and mentoring efforts resulting in a student internship program benefitting both students and NLM research staff.
Phillip C. Coleman Award **Laura A. Hartman**	For her enthusiastic and dedicated mentorship of young women entering the field of librarianship, particularly in the field of cataloging and rare book curation.
EEO Special Achievement Award **Laura L. Wong**	In recognition of her excellence in leadership as an active member of the NIH Asian and Pacific Islander Organization (APAO) raising awareness and promoting career development activities amongst her colleagues.
NIH Merit Award **Dr. Dennis A. Benson**	For sustained outstanding contributions to program development, policy formulation, and operational management of the National Center for Biotechnology Information and of NLM as a whole.
NIH Merit Award **Victor H. Cid**	For development of unique tools to aid in disaster management of all types of hazards.
NIH Merit Award **Darlene M. Dodson**	For exceptional leadership and coordination of financial management operations in support of NLM's mission.
NIH Merit Award **Paul V. Kiehl**	For exceptional oversight of NLM space and facilities.
NIH Merit Award **Linda Q. Lord**	For exceptional administration of NLM ethics and employee recognition programs.

Award / Recipient	Accomplishment
NIH Merit Award **Shiuan Haur H. Lu**	For exemplary leadership and oversight of the IT resources and services of the Lister Hill Center.
NIH Merit Award **Wei Ma**	For exceptional leadership of the rapid development of the NLM-FDA Global Unique Device Identification Database Website.
NIH Merit Award **Beth Weston**	For leading data-driven innovations that have streamlined and enhanced the acquisition and management of the NLM serials collection.
NIH Director's Award **Dr. Jeffrey S. Reznick**	In recognition of his exceptional leadership and scholarly oversight of the collections and programs of NLM's History of Medicine Division.
NIH Director's Award **Dr. Thomas C. Rindflesch**	For exemplary performance while demonstrating significant leadership, skill, and ability in serving as a mentor.
NIH Director's Award **Team Dedicated to Developing the NIH Plan for Data Sharing** **Dr. Michael F. Huerta** **Jerry R. Sheehan**	In recognition of exceptional dedication and commitment to developing the NIH Plan for Data Sharing.
Harvey J. Bullock Jr. Award **Elena Leon**	In appreciation for your inspiring leadership, teamwork, dedication, and exemplary contributions furthering the National Institutes of Health equity, diversity, and inclusion efforts.

Awards: Outside Organizations

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

Award / Recipient	Accomplishment
Fellow of the Society Award *from the Society for Risk Analysis* **Dr. Pertti J. Hakkinen**	In recognition of outstanding contributions to the profession of Risk Analysis.
Best Paper Award *from MEDINFO 2015* **Dr. Olivier Bodenreider** **Dr. James T. Case** **Dr. Ferdinand Dhombres** **Dr. Rainer Winnenburg**	For the paper on "Extending the coverage of phenotypes in SNOMED CT through post-coordination."
2015 ALHHS Best Article Award *from Archivists and Librarians in the History of the Health Sciences* **Dr. Jeffrey S. Reznick**	In recognition of the article entitled "Embracing the Future as Stewards of the Past: Charting a Course Forward for Historical Medical Libraries and Archives."
Secretary's Pick Award *from* HHS*innovates* **NIH 3D Print Exchange Group** **Dr. Terry S. Yoo**	The National Institutes of Health's 3D Print Exchange is an online portal to open-source data and tools for discovering, creating, and sharing 3D-printable models related to biomedical science. Our goal is to empower researchers, physicians, and the public with high-quality, informative models that inspire new discoveries that transform science and health care.
FDA Commissioner's Special Citation Award *from the Food and Drug Administration* FDA's Pharmacology Class Work Group **Dr. Evan E. Bolton** **Dr. John T. Kilbourne** **Dr. Stuart J. Nelson**	For creating processes resulting in authoritative Pharmacologic Class indexing that is being used nationwide to enhance prescribing practices and reduce unfavorable patient outcomes.

APPENDICES

Appendix 1: Regional Medical Libraries

MIDDLE ATLANTIC REGION
Middle Atlantic Region
University of Pittsburgh
Health Sciences Library System
200 Scaife Hall, 3550 Terrace Street
Pittsburgh, Pennsylvania 15261
Phone: (412) 648-2065 / Fax: (412) 624-1515
States served: DE, NJ, NY, PA

SOUTHEASTERN/ATLANTIC REGION
University of Maryland at Baltimore
Health Science and Human Services Library
601 Lombard Street
Baltimore, MD 21201
Phone: (410) 706-2855 / Fax (410) 706-0099
States served: AL, FL, GA, MD, MS, NC,
SC, TN, VA, WV, DC, VI, PR

GREATER MIDWEST REGION
University of Illinois at Chicago
Library of the Health Sciences (M/C 763)
1750 West Polk Street
Chicago, IL 60612
Phone: (312) 996-2464 / Fax (312) 996-2226
States served: IA, IL, IN, KY, MI, MN,
ND, OH, SD, WI

MIDCONTINENTAL REGION
University of Utah
Spencer S. Eccles Health Sciences Library
10 North 1900 East
Salt Lake City, Utah 84112-5890
Phone: (801) 587-3412 Fax: (801) 581-3632
States served: CO, KS, MO, NE, UT, WY

SOUTH CENTRAL REGION
Houston Academy of Medicine-Texas Medical Center
Library 1133 John Freeman Blvd.
Houston, TX 77030
Phone: (713) 799-7880 / Fax: (713) 790-7030
States served: AR, LA, NM, OK, TX

PACIFIC NORTHWEST REGION
University of Washington
Health Sciences Libraries and
Information Center
Box 357155
Seattle, WA 98195-7155
Phone: (206) 543-8262 / Fax: (206) 543-2469
States served: AK, ID, MT, OR, WA

PACIFIC SOUTHWEST REGION
University of California, Los Angeles
Louise M. Darling Biomedical Library
12-077 Center for the Health Sciences
Los Angeles, CA 90025
Phone: (310) 825-1200 / Fax: (310) 825-5389
States served: AZ, CA, HI, NV and
US Territories in the Pacific Basin

NEW ENGLAND REGION
University of Massachusetts Medical School
55 Lake Avenue North Rm S4-241
Worchester, MA 01655
Phone: (508) 856-5979 / Fax: (508) 856-5977
States served: CT, MA, ME, NH, RI, VT

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

MacKay, Trudy, PhD
Distinguished University Professor of Genetics
Department of Genetics
North Carolina State University
Raleigh, NC 87695

Appointed Members

Dishman, James Eric, MS
Intel Fellow and General Manager
Health Science Division
Intel Corporation
Hillsboro, OR 97124

Fleming, David A., MD, MA, FACP
Professor and Chairman
Department of Internal Medicine
Director, MU Center for Health Ethics
University of Missouri School of Medicine
Columbia, MO 65212

Greenes, Robert A., MD, PhD
Professor and Ira A. Fulton Chair in Biomedical Informatics
College of Health Solutions
Arizona State University
Phoenix, AZ 85004

Lewis, Henry, PharMD
Provost
American University of Health Sciences
Signal Hill, CA 90775

Martin, Sandra, MSLS
Director
Shiffman Medical Library
Wayne State University
Detroit, MI 48201

Roskies, Ralph Z., PhD
Professor of Physics, University of Pittsburgh
Scientific Director, Pittsburgh Supercomputing Center
Pittsburgh, PA 15213

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
Tucson, AZ 85724

Yokote, Gail A., MS
Associate University Librarian for Collection Services
Peter J. Shields Library
University of California, Davis
Davis, CA 95616

Ex Officio Members

Billington, James H, DPhil
Librarian of Congress
Library of Congress
Washington, DC 20540

Clancy, Carolyn M, MD
Acting Under Secretary for Health, Quality, Safety, and Value
Veterans Health Administration
Washington, DC 20420

Collins, James, PhD
Assistant Director, Biological Sciences
National Science Foundation
Arlington, VA 22230

Horoho, Patricia D, BSC, MSN
The Surgeon General/Commander
US Army Medical Command
Falls Church, VA 22041

Liu, Simon Y, PhD
Director
National Agriculture Library
U.S. Department of Agriculture
Beltsville, MD 20705

Murthy, Vivek H., VADM, MD, MBA
Surgeon General
Office of the Surgeon General
Office of the Assistant Secretary for Health
Washington, DC 20201

Nathan, Matthew L, BS
Surgeon General of the Navy
Chief, Bureau of Medicine and Surgery
Department of the Navy
Washington, DC 20372

Rice, Charles L, MD
President
Uniformed Services University of the Health Sciences
Bethesda, MD 20814

Travis, Tom, Major General, USAF, MC
Surgeon General
United States Air Force
Washington, DC 22209

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

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

Chairperson

Berner, Eta S., EdD
Professor, Health Informatics
Department of Health Services Administration
School of Health Professions
School of Medicine
University of Alabama at Birmingham
Birmingham, AL 35294

Members

Cummins, Mollie R., PhD
Associate Professor
Schools of Nursing and Medicine
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Salt Lake City, UT 84112

Embi, Peter J., MD
Associate Professor with Tenure
Division of Rheumatology and Immunology
Director, Division of Clinical and Translational Informatics
Department of Biomedical Informatics
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Columbus, OH 43210

Hicks, LeRoi S., MD
Vice-Chair of Medicine
Department of Medicine
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Newark, DE 19718

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Columbia University Medical Center
Columbia University
New York, NY 10032

Rucker, Donald W., MD
Chief Operating Officer, IDEA Studio
Associate Dean for Innovation
Professor of Clinical Emergency Medicine and Biomedical Informatics
The Ohio State University
Columbus, OH 43210

Xu, Hua, PhD
Associate Professor
School of Biomedical Informatics
The University of Texas Health Science Center
7000 Fannin Street, Suite 870
Houston, TX 77030

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
Associate Professor
Department of Microbiology
University of Florida
Gainesville, FL 32611

Members

Boehnke, Michael L., PhD
Professor
Department of Biostatistics
School of Public Health
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Ann Arbor, MI 48109

Edwards, Scott V., PhD
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Guy, R. Kiplin, PhD
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Professor
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University of Chicago
Chicago, IL 60637

Zhang, Jianzhi, PhD
Marshall W. Nirenberg Collegiate Professor
Department of Ecology and Evolutionary Biology
University of Michigan
Ann Arbor, MI 48109

Appendix 5: 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

Tannery, Nancy H., MLS
Senior Associate Director
Health Sciences Library System
University of Pittsburgh
Pittsburgh, PA 15261

Members

Balasubramaniam, Sanjeeve, MD
Medical Officer
Office of Hematology Oncology Products
Center for Drug Evaluation and Research
Food and Drug Administration
Silver Spring, MD 20993

Cheung, Dorothy S., MD
Assistant Medical Officer
Immunology, Tissue Growth and Repair
Early Clinical Development
Genentech, Inc.
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Conte, Marisa L., BA
Research and Data Informationist
Taubman Health Science Library
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Delclos, George L., MD, PhD
Professor
Division of Epidemiology, Human Genetics and Environmental Sciences, School of Public Health
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Godoy-Vitorino, Filipa, PhD
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College of Sciences and Technology
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Joe, Jennie R., PhD, MPH, MA
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Family and Community Medicine
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Section of Primary Care
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Nguyen, Thu Annelise, PhD
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Nwomeh, Benedict C., MD
Attending Surgeon, Professor
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Dean's Office
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Rayo, Jaya, MD
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American College of Physicians
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Yoshimura, Masami, DSc
Associate Professor
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School of Veterinary Sciences
School of Veterinary Medicine
Louisiana State University
Baton Rouge, LA 70803

Appendix 6: 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.

Chairperson

Haricombe, Lorraine J., PhD
Vice Provost and Director
University of Texas at Austin
Perry-Castaneda Library
Austin, TX 78713

Members

Bedard, Martha A., MSLS, MA
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Butter, Karen A., MLN
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Cantu, Adelita G., RN, PhD
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Family & Community Health Systems
The University of Texas Health Sciences Center
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Cooper, Nigel G.F., PhD
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Department of Anatomical Sciences and Neurobiology
University of Louisville
Louisville, KY 40292

Dewey, Barbara, MA
Dean
University Libraries and Scholarly Communications
Pennsylvania State University
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Eisen, Jonathan A., PhD
Departments of Medical Microbiology and Immunology
UC Davis Genome Center
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Jongeneel, C. Victor, PhD
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NCSA, Department of Bioengineering
University of Illinois at Urbana-Champaign
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Lively, Mark O., PhD
Professor Emeritus of Biochemistry
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Department of Biochemistry
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McCrary, Jr., Victor, PhD
Vice President for Research and Economic Development
Morgan State University
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Molecular Genetics Program
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Albany, NY 12201

Starratt, Jay, MA
Dean of Libraries
Washington State University
Pullman, WA 99164

Stodden, Victoria, PhD
Associate Professor
Graduate School of Library and Information Science
University of Illinois at Urbana-Champaign
Champaign, IL 61820

Terry, Sharon F., MA
President and CEO
Genetic Alliance
Washington, DC 20008

Appendix 7: Organizational Acronyms and Initialisms

Acronym	Meaning of Acronym
AAHSL	Association of Academic Health Sciences Libraries
AABB	Non-profit association formerly known as American Association of Blood Banks
AAPA	American Academy of Physicians Assistants
ABC	Advanced Biomedical Tele-Collaboration Test Bed)
ACIOP	Acquired Immune Deficiency Syndrome Community Information Outreach Project
ACLA	American Clinical Laboratory Association
ACORN	Automatically Creating OLDMEDLINE Records for NLM
ACP	American College of Physicians
ACSI	American Customer Satisfaction Index
AFIP	Armed Forces Institute of Pathology
AG	Access Grid
AHIC	American Health Information Community
AHILA	Association for Health Information and Libraries in Africa
AHRQ	Agency for Healthcare Research and Quality
AIDS*info*	Acquired Immune Deficiency Syndrome *info* (database)
AIH	American Indian Health (Web portal)
AJPP	African Journal Partnership Project
ALTBIB	Alternatives to Animal Testing
AME	Automated Metadata Extraction
AMIA	American Medical Informatics Association
AMPA	American Medical Publishers Association
AMPATH	Academic Model Providing Access to Healthcare
AMWA	American Medical Women's Association
APAO	Asian and Pacific Islander American Organization
APDB	Audiovisual Program Development Branch
API	Applied Programming Interface
APIRE	American Psychiatric Institute for Research and Education
APP	Application
ARRA	American Recovery and Reinvestment Act
ASCCP	American Society for Cervical Pathology and Colposcopy
ASHG	American Society of Human Genetics
ASPR	Assistant Secretary for Preparedness and Response, HHS Office of the
BAC	Bacterial Artificial Chromosome
BarSTool	Barcode Submission Tool
BD2K	Big Data to Knowledge
BGMUT	Blood Group Antigen Gene Mutation Database
BHEPP	Bethesda Hospitals' Emergency Preparedness Partnership
BISTI	Biomedical Information Science and Technology Initiative
BITA	Biomedical Image Transmission via Advanced Networks
BLAST	Basic Local Alignment Search Tool
BLIRC	Biomedical Library and Informatics Review Committee
BMERS	Emergency Radio Email System
BMT	Boundary Marking Tool
BN	Brand Name
BOR	Board of Regents
BSAT	BMT Study Administration Tool
BoSC	Board of Scientific Counselors
BSD	Bibliographic Services Division
BSN	Bioinformatics Support Network
CAM	Complementary and Alternative Medicine
C&A	Certification & Accreditation (audit)
CANDHI	Central American Network for Disaster and Health Information
CARe	Candidate Gene Association Resource project
CAS	Collection Access Section
Cas	CRISPR associated genes
CBB	Computational Biology Branch
CBIR	Content-Based Image Retrieval
CBRN	chemical, biological, radiological and nuclear (incidents)
CCB	Configuration Control Board
CCDS	Consensus Coding Sequence (database)
CCHIT	Commission for Healthcare Information Technology
CCR	Central Contractor Registration
CCRIS	Chemical Carcinogenesis Research Information System
CDART	Conserved Domain Architecture Retrieval Tool
CDC	Centers for Disease Control and Prevention
CDD	Conserved Domain Database
cDNA	Complementary DNA
CEB	Communications Engineering Branch
CEL	Affymetrix Cell intensity (file)
CgSB	Cognitive Science Branch
CHEBI	Chemical Entities of Biological Interest
ChEMBL	Computational Chemical Biology Group database

Acronym	Meaning of Acronym
ChemIDplus	Chemical Identification File
CHEMM	Chemical Hazard Event Medical Management
CHRIS	Consumer Health Resource Information Service
CHIC	Chickasaw Health Information Center
CHIQA	Consumer Health Information Question Answering System
CIN	Cervical Intraepithelial Neoplasia
CIO	Chief Information Officer
CIT	Center for Information Technology
CLML	Current List of Medical Literature
CMAX	Collaborative Multi-Agency eXercise (BHEPP disaster drill)
CMS	Centers for Medicare and Medicaid Services
CMT	Convergent Medical Terminology
COOP	(NIH Pandemic Flu) Continuity of Operations Plan
CORE	Clinical Observations Recording and Encoding
CoreBio	Core Bioinformatics Facility
CounterACT	Countermeasures Against Chemical Threats
CPS	Commercial Peering Service
CPSC	Center for Public Service Communication
CPT	Current Procedural Terminology
CRAC	Computer Room Air Conditioner
CRAH	Computer Room Air Handler
CRD	Centre for Reviews and Dissemination (England)
CRI	Clinical Research Informatics
CRISP	Computer Retrieval of Information on Scientific Projects
CRISPR	Clustered regularly interspaced short palindromic repeats
CSB	Computer Science Branch
CSI	Commission on Systemic Interoperability
CSIRC	Computer Security Incident Response Center (HHS)
CSR	Center for Scientific Review
CT	Computer Tomography
CTD	Clinical Text De-identification
CTD	Comparative Toxicogenomics Database
CTS	Communications Technology Satellite
CTSA	Clinical Translational Science Award Centers
CUIs	Concept Unique Identifiers
CWDM	Coarse Wave Division Multiplexing
DAC	Data Access Committees
DAR	Data Access Request
DARE	Database of Reviews of Effects
DART/ETIC	Developmental and Reproductive Toxicology/Environmental Teratology Information
DBA	Data Base Administrator
dbEST	Database of Expressed Sequence Tags Center
dbGaP	Database of Genotypes and Phenotypes
dbMHC	Database for the Major Histocompatibility Complex
dbRBC	Database of Red Blood Cells
dbSNP	Database of Single Nucleotide Polymorphism
DCMS	Data Creation and Maintenance System
DDBJ	DNA Data Bank of Japan
DDD	Drug Delivery Devices
DDoS	Distributed Denial of Service (attack)
DCMS	Data Creation and Maintenance System
DEAS	Division of Extramural Administrative Support
DELTA-BLAST	Domain Enhanced Lookup Time Accelerated BLAST
DHHS	Department of Health and Human Services
DHS	Department of Homeland Security
DICOM	Digital Imaging and Communications in Medicine
DIMRC	Disaster Information Management Research Center
DIRLINE	Directory of Information Resources Online
DLXS	Digital Library Extension Service
DMSZ	Deutsche Sammlung von Mikroorganismen und Zellkulturen (German Collection of Microorganisms and Cell Cultures)
DMZ	De-militarized zone
DNA	Deoxyribonucleic Acid
DOT	Department of Transportation
DPR	Digital Preservation Research
DR2	National Institutes of Health Disaster Research Response Program
DRAGON	Dynamic Resource Allocation in GMPLS Optical Networks
DRESWG	Digital Repository Evaluation and Selection Working Group
DRIG	Digital Repository Implementation Group
DSLD	Dietary Supplement Label Database
DTD	Document Type Definition
DVTS	Digital Video Transport System
EAI	Emergency Access Initiative
EBI	European Bioinformatics Institute
EBP	Evidence-Based Practice
ECHO	European Community Humanitarian Office
Educollab	Educational Collaborators
EEO	Equal Employment Opportunity
EFTS	Electronic Funds Transfer Service
EHR	Electronic Health Record
EMBL	European Molecular Biology Laboratory
EMR	Electronic Medical Record
EMS	Emergency Medical Services
EnHIP	Environmental Health Information Partnership
EnHIOP	Environmental Health Information Outreach Program
EP	Extramural Programs
EPA	Environmental Protection Agency
eQTL	Expression Quantitative Trait Loci
eRA	Electronic Research Administration

Acronym	Meaning of Acronym
ERG	Emergency Response Guidebook
ESI	Early Stage Investigators
EST	Expressed Sequence Tag
ESTC	English Short Title Catalogue Project
ETIC	Environmental Teratology Information Center
eTK	Electronic Thorndike and Kibre
EUREKA	Exceptional, Unconventional Research Enabling Knowledge Acceleration
E-Utilities	Entrez Programming Utilities
eVK	Electronic Voights and Kurtz
FAES	Foundation for Advanced Education in the Sciences
FDA	Food and Drug Administration
FDCC	Federal Desktop Core Configuration
FHA	Federal Health Architecture
FIC	Fogarty International Center
FISMA	Federal Information Security Management Act
FMS	Facilities Management Section
FNLM	Friends of the National Library of Medicine
FOA	Funding Opportunity Announcements
FTE	Full Time Employee
FTP	File Transfer Protocol
FY	Fiscal Year
GAIN	Genetic Association Information Network
Gbps	Gigabits per Second
GCMS	Global Citation Management System
GDP	Genome Decoration Page
GDS	GEO DataSet
GEO	Gene Expression Omnibus (database)
GENSAT	Gene Expression Nervous System Atlas
geneRIF	Gene Reference Into Function
GENE-TOX	Genetic Toxicology
GHR	Genetics Home Reference
GIA	Gene Indexing Assistant
GIS	Geographic Information System
GO	Grand Opportunity (grant)
GO-ESP	Grand Opportunities-Exon Sequencing Project
GMAC	Grants Management Advisory Committee
GPS	Global Position System
GPU	Graphics Processing Unit
GRC	Genome Reference Consortium
GRMS	Global Records Management System
GSA	General Services Administration
GSS	Genome Survey Sequences
GTR	Genetic Testing Registry
GUI	Graphic User Interface
GWAS	Genome Wide Association Studies
H3Africa	Human Heredity and Health in Africa Initiative
HapMap	Haplotype Map
HAVnet	Haptic Audio Video Network for Education Technology
HBCU	Historically Black Colleges and Universities
HD	High Definition
HGVS	Human Genome Variation Society
HHS	Health and Human Services
HIPAA	Health Insurance Portability and Accounting Act
HITSP	Healthcare Information Technology Standards Panel
HIV/AIDS	Human Immunodeficiency Virus Infection and Acquired Immune Deficiency Syndrome
HLA	Human Leukocyte Antigen
HL7	Health Leven Seven, Inc.
HMD	History of Medicine Division
HSDB	Hazardous Substances Data Bank
HPCC	High Performance Computing and Communications
HPV	Human Papillomavirus
HRSA	Health Resources and Services Administration
HSRIC	HRS (Health Services Research) Information Central
HRSInfo	Health Services Research Information
HSRProj	Health Services Research Projects
HSRR	Health Services and Sciences Research Resources
HSTAT	Health Services and Technology Assessment Text
HTTP	Hypertext Transfer Protocol
HuGENet	Human Genome Epidemiology Network
I3	Image Indexing Initiative
IAIMS	Integrated Advanced Information Management Systems
IBIS	Inferred Biomolecular Interactions Server
ICC	Incident Command Center
ICCVAM	Interagency Coordinating Committee on The Validation of Alternative Methods
ICD	International Classification of Diseases
ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification
ICD-10-CM	International Classification of Diseases, Tenth Revision, Clinical Modification
ICMJE	International Committee of Medical Journal Editors
ICs	Institutes and Centers (of NIH)
ICT	Information and Communication Technologies
IDE	Integrated Development Environment
IDS	Intrusion Detection System
IE8	Internet Explorer 8
IEB	Information Engineering Branch
IEEE	Institute of Electrical and Electronics Engineers
IGS	Intergenic Spacer
IGSTK	Image Guided Surgery Toolkit
IHTSDO	International Health Terminology Standards Development Organization
IHM	Images from the History of Medicine
ILL	Interlibrary Loan
ILS	Integrated Library System

Acronym	Meaning of Acronym
IMPAC	Information Management Planning Analysis And Coordination
InCHIs	IUPAC International Identifiers
INDSC	International Nucleotide Sequence Database Collaboration (formerly DDBJ/EMBL/GenBank)
*info*SIDA	infoSíndrome de Inmunodeficiencia Adquirida (database)
iOS	iPhone Operating System (Apple)
IP	Interactive Publications
IPv6	Next Generation Internet, Version 6
IRB	Institutional Review Board
IRC	In-Row Coolers
IRIS	Integrated Risk Information System
IRMA	Image Retrieval for Medical Applications
ISO	International Organization for Standardization
ISTO	Image Storage and Transmission Optimization
IT	Information Technology
ITP	Informatics Training Program
ITER	International Toxicity Estimates for Risk
ITK	Insight Toolkit
ITP	Informatics Training Program
ITS	Internal Transcribed Space
ITSC	Information Technology Service Center
ITSMS	Information Technology Service Management System
IUPAC	International Union of Pure and Applied Chemistry
JDBC	Java Database Connectivity
JDI	Journal Descriptor Indexing
JDMS	Journal Descriptor Maintenance System
JRE	Java Runtime Environment
KEGG	Kyoto Encyclopedia of Genes and Genomes
KSS	Knowledge Source Server (data)
LactMed	Drugs and Lactation (database)
LAN	Local Area Network
LC	Library of Congress
LCSS	Laboratory Chemical Safety Summaries
LHI	Leading Health Indicators (HHS)
LHC	Lister Hill National Center for Biomedical Communications
LHNCBC	Lister Hill National Center for Biomedical Communications
LID	Laboratory for Informatics Development
LIPID MAPS	Lipid Metabolites and Pathways Strategy
LITE	Librarian Infobutton Tailoring Environment
LJI	List of Journals Indexed
LO	Library Operations
LOINC	Logical Observations Identifiers, Names, Codes
LPF	Lost Person Finder
LRG	Locus Reference Genomic
LRP	Long Range Plan (NLM)
LSD	Lysosomal Storage Disorders
LSI	List of Serials Indexed
LSTRC	Literature Selection Technical Review Committee
LVG	Lexical Variant Generator
LWS	Lifecycle Work Station
MARC	Machine- Readable Cataloging
MARG	Medical Article Records Groundtruth
MARS	Medical Article Records System
MAX	Mid Atlantic Exchange, U. of Maryland
MCI	Mass Casualty Incident
MDoT	MEDLINE Database on Tap
MDT	Multimedia Database Tool
MEDLARS	Medical Literature Analysis and Retrieval System
MEDLINE	MEDLARS Online
MegaBLAST	Basic Local Alignment Search Tool
MEME	Metathesaurus Editing and Maintenance Environment
MEO	Medical Education and Outreach
MEPI	Medical Education Partnership Initiative (Africa)
MeSH	Medical Subject Headings
MHC	Major Histocompatibility Complex
MHL	Medical Heritage Library
MID	Manuscript Identifiers
MICAD	Molecular Imaging and Contract Database
MIM	Mentoring In Medicine
MIM	Multilateral Initiative on Malaria
MIMCom	MIM Communications Working Group
MIN	Multiple Ingredient (term type), RxNorm
MIRS	Medical Information Retrieval System
MIT	Massachusetts Institute of Technology
MLA	Medical Library Association
MLAA	Medical Library Assistance Act
MLB	Medical Language Branch (database server)
MLP	Molecular Libraries Program (at NIH)
MMDB	Molecular Modeling DataBase
MMS	MEDLARS Management Section
MMTx	MetMap Technology Transfer
MOR	Medical Ontology Research
MOU	Memorandum of Understanding
mRNA	Messenger Ribonucleic Acid
MS	Mass Spectrometry
MTHSPL	Metathesaurus Structured Product Labels
MTI	Medical Text Indexer
MTIFL	Medical Text Indexer First Line
MTMS	MeSH Translation Management System
NAC	Network Access Control
NA-MIC	National Alliance of Medical Image Computing
NAML	Network of African Medical Libraries
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NCBC	National Center for Biomedical Computing
NCBI	National Center for Biotechnology Information

Acronym	Meaning of Acronym
NCBI NOW	National Center for Biotechnology Information Next generation sequencing Online Workshop
NCCS	NIHI Consolidated Collocation Site
NCHS	National Center for Health Statistics
NCI	National Cancer Institute
NCI SEER	National Cancer Institute Surveillance, Epidemiology, and End Results Program
NCRR	National Center for Research Resources
NCVHS	National Committee on Vital and Health Statistics
NDC	National Data Codes
NDCs	National Data Codes
NDCO	National Network of Libraries of Medicine DOCLINE Coordination Office
NDF-RT	National Drug File – Reference Terminology
N*e*HC	National *e*-Health Collaborative
NEI	National Eye Institute
NEO	National Network of Libraries of Medicine Evaluation Office
NGI	Next Generation Internet
NHANES	National Health and Nutrition Examination Surveys
NHGRI	National Human Genome Research Institute
NHIN	National Health Information Network
NHLBI	National Heart. Lung, and Blood Institute
NIA	National Institute on Aging
NIAID	National Institute of Allergy and Infectious Diseases
NIBIB	National Institute of Biomedical Imaging and Bioengineering
NICHD	National Institute of Child Health and Human Development
NICHSR	National Information Center on Health Services Research and Health Care Technology
NIDCD	National Institute on Deafness and other Communication Disorders
NIDCR	National Institute of Dental and Cranio-facial Research
NIDDK	National Institute of Diabetes, Digestive, and Kidney Diseases
NIEHS	National Institute of Environmental Health Sciences
NIGMS	National Institute of General Medical Sciences
NIH	National Institutes of Health
NIHMS	NIH Manuscript Submission
NIH PI	NIH Pathways to Independence Award
NIMH	National Institute of Mental Health
NIMHD	National Institute on Minority Health and Health Disparities
NINDS	National Institute of Neurological Disorders and Stoke
NIOSH	National Institute for Occupational Safety and Health

Acronym	Meaning of Acronym
NIST	National Institute of Standards and Technology
NLM	National Library of Medicine
NLM LitArch	NLM Literature Archive
NLP	National Language Processing System
NN/LM	National Network of Libraries of Medicine
NNMC	National Naval Medical Center
NNO	National Network Office
NOAA	National Oceanic and Atmospheric Administration
NOSC	Network Operations and Security Center
NOVA	National Online Volumetric Archive
NPHCO	National Network of Libraries of Medicine Public Health Coordination Office
NPL	National Priorities List (as for Superfund)
NQF	National Quality Forum
NRCBL	National Reference Center for Bioethics Literature
NRSA	National Research Service Award
NSF	National Science Foundation
NTCC	National Online Training Center and Clearinghouse
NTO	National Network of Libraries of Medicine Training Office
NWSO	National Network of Libraries of Medicine Web Services Office
OA	Open Access
OACF	Onsite Alternate Computing Facility
OAM	Office of Administrative Management
OARF	Outreach Activity Reporting Form
OCCS	Office of Computers and Communications Systems
OCHD	Coordinating Committee on Outreach, Consumer Health and Health Disparities
OCIO	Office of the Chief Information Officer (NIH)
OCPL	Office of Communication and Public Liaison
OCR	Optical Character Recognition
OD	Office of the Director
ODIMRC	Office of the Disaster Information Management Research Center
OERC	Outreach Evaluation Resource Center
OHA	Office of Health Affairs (DHS)
ORF	Original Release Format
OHDSI	Observational Health Data Sciences and Informatics
OHIPD	Office of Health Information Programs Development
OMB	Office of Management and Budget
OMIA	Online Inheritance in Animals (database)
OMIM	Online Mendelian Inheritance in Man (database)
OMSSA	Open Mass Spectrometry Search Algorithm
ONC	Office of National Coordinator (for Health Information Technology)

Acronym	Meaning of Acronym
OPASI	Office of Portfolio Analysis and Strategic Initiatives
OPD	OLDMEDLINE Serials Application
OPD	Outreach Products Database
OSA	Optical Society of America
ORWH	Office of Research on Women's Health
OSIRIS	Open Source Independent Review and Interpretation System
PAHO	Pan American Health Organization
PAL	Potential Abstract Labels (tool)
PBM	Pharmacy Benefit Manager
PCA	Personal Computer Advisory Committee
PCORnet	National Patient-Centered Clinical Research Network
PCR	Polymerase Chain Reaction
PDA	Personal Digital Assistant
PDRS	Publisher Data Review System
PDB	Protein Data Bank
PDF	Portable Document Format
PDL	Personal Digital Library
PDM	Patient Data Management
PDQ	Physician Data Query
PFIF	Person Finder Interchange Format
PheGenI	Phenotype-Genotype Integrator
PHLIP	Public Health Law Information Project
PHII	Public Health Informatics Institute
PHP	Public Health Partners
PHR	Personal Health Record
PHS	Public Health Service
PI	Pathway to Independence award
PI	Principal Investigator
PII	Personally Identifiable Information
PICO	Patient/Population, Intervention, Comparison, and Outcome
PID	Pathway Interaction Database (NCI)
PIN	Precise Ingredient (term type), RxNorm
PIV	Personal Identify Verification
PL	Person Locator
PLAWAR*e*	Programmable Layered Architecture With Artistic Rendering
PMC	PubMed Central
PMCI	PubMed Central International
PMC ID	PubMed Central Identification (number)
PRS	Protocol Registration System
PSD	Public Services Division
PubMedHh	PubMed for Handhelds
PUE	Power Use Efficiency
PUG	PubChem Power User Gateway
QA	Quality Assurance
QCIM	Quarterly Cumulative Index Medicus
RAC	Real Application Clusters
RCDC	Research Condition and Disease Categorization
RCSB	Research Collaboratory for Structural Bioinformatics
RDMS	Rare Disease Maintenance System
RefSeq	Reference Sequence (database)
RefSNP	Reference SNP (database)
RELACIGER	Red Latinoamericana de Centros de Información en Gestión del Riesgo de Desastres (Latin American Network of Risk Management Centers)
REMM	Radiation Even Medical Management
RF2	Release Factor 2
RFA	Request for Applications
RFID	Radio Frequency Identification
RFP	Request for Proposals
RHIN	Refugee Health Information Network
RIDeM	Repository for Informed Decision Making
RML	Regional Medical Library
RNA	Ribonucleic Acid
RNAi	RNA Interference
RPS-BLAST	Reversed Position Specific BLAST
RQS	Request Submission and Tracking System
RRF	Rich Release Format
RSNA	Radiological Society of North America
RSS	Really Simple Syndication
RTECS	Registry of Toxic Effects of Chemical Substances
RTLS	Real Time Location System
RVDS	Remote Virtual Dialogue System
RWJF	Robert Wood Johnson Foundation
SAB	Source Abbreviations
SEPs	Special Emphasis Panels
SBIR	Small Business Innovation Research
SCID	Severe Combined Immunodeficiency
SciENcv	ScienceExperts Network Curriculum Vitae
SCR	(MeSH) Supplemental Chemical Records
SDK	Software Development Kit
SEF	Serials Extract File
SEIM	Security Event and Information Management System
SEO	Search Engine Optimization
SEP	Special Emphasis Panel
SEQ	Structured Evidence Queries
SIDA	Swedish International Development Agency
SIG	Special Interest Group
SII	Scalable Information Infrastructure
SIS	Specialized Information Services
SKR	Semantic Knowledge Representation
SMART	Scalable Medical Alert and Response Technology
SNOMED	Systematized Nomenclature of Medicine
SNOMEDCT	Systematized Nomenclature of Medicine Clinical Terms
SO	Signing Official
SOAP	Simple Object Oriented Protocol (also Simple Object Access Protocol)
SOC	Secretary's Operation Center (HHS)
SPER	System for the Preservation of Electronic Resources
SPIN	Shared Pathology Informatics Network
SPIRS	Spine Pathology Image Retrieval System
SPL	Structured Product Labels (FDA)
SPWG	Special Projects Workgroup (NIH)

Acronym	Meaning of Acronym
SRA	Short Read Archive
STB	Systems Technology Branch
STEM	Science, Technology, Engineering and Math
STR	Short Tandem Repeat
STTP	Short-Term Trainee Program
STTR	Small Business Technology Transfer Research
STS	Sequence Tagged Site
SVM	Support Vector Machine
TA	Title Abbreviation(s)
TBL	The bottom line
TDI	3D Informatics (Group)
TEHIP	Toxicology and Environmental Health Information Program
TERA	Toxicology Excellence for Risk Assessment
TIC	Trusted Internet Connection
TICAP	Trusted Internet Connection Access Partners
TIE	Telemedicine Information Exchange
TIFF	Tagged Image File Format
TILE	Text to Image Linking Engine
TIOP	Toxicology Information Outreach Project
TKMT	Traditional Korean Medical Terms
TOXLINE	Toxicology Information Online
TOXNET	Toxicology Data Network
TPA	Third Party Annotation (database)
TMS	Track Management System (NCBI)
TREF	Terminology Representation and Exchange Format
TRI	The Toxics Release Inventory
tRNA	Transfer Ribonucleic Acid
TSA	Transcriptome Shotgun Assembly
TSD	Technical Services Division
TT	Teaching Tool
TTP	Turning the Pages
UCUM	Unified Codes for Units of Measure
UID	Unique Identifier (PubMed)
UIMA	Unstructured Information Management Architecture
UKPMC	United Kingdom PubMed Central
UMLS	Unified Medical Language System
UMLSKS	UMLS Knowledge Source Server
UN	United Nations
UPS	Uninterrupted Power Supply
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
USHIK	United States Health Information Knowledgebase (team)
UTS	UMLS Terminology Services
VA	United States Department of Veterans Affairs
VSAC	Value Set Authority Center
WGS	Whole Genome Shotgun
WISER	Wireless Information System for Emergency Responders
YEP	Year End Processing

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Cover:

A slice from the Visible Human project representing the National Library of Medicine's early entry into providing valuable big data to the world. *Design by Donald Bliss, Lister Hill National Center for Biomedical Communications, 2015*.