SO VERY GRATEFUL FOR THE OPPORTUNITY TO WORK WITH GLA. ALL THE PERSISTER WORK AND ALL THIS DEVELOPING THE METHOD FOR A RAPID DRUG SCREEN WAS SUPPORTED THROUGH GLA.”

— Ying Zhang, M.D., Ph.D.

Ying Zhang, M.D., Ph.D., Professor, Molecular Microbiology and Immunology, Johns Hopkins Bloomberg School of Public Health. Dr. Zhang’s Lyme disease research focuses on the study of persister bacteria. He is a GLA grantee.
"GLA PLAYS A CRITICAL ROLE IN LYME DISEASE RESEARCH. THEY'RE THINKING OUT OF THE BOX. THEY'RE LOOKING FOR INNOVATION, FOR CREATIVITY. THEY'RE FUNDING SCIENTISTS ASKING THE CRITICAL QUESTIONS — AND THIS IS THE ONLY WAY OF FINDING THE BIG PRIZE — THE CURE."

— Benjamin Luft, M.D.

Benjamin Luft, M.D., Director and Principal Investigator, Stony Brook University WTC Wellness Program. Dr. Luft is an internationally recognized expert in the treatment of Lyme disease and AIDS-related conditions. The use of Ceftriaxone for the treatment of neuroborreliosis is based upon Dr. Luft’s ground-breaking work. He is a GLA grantee.
DEAR FRIENDS:

We are pleased and excited to share with you Global Lyme Alliance’s inaugural Research Report. As these pages show, Global Lyme Alliance (GLA) has been shifting the paradigm for Lyme disease research ever since we funded our first research initiative in 1998. Through a combination of generous support from donors, a dedicated and professional internal team, and a focused mission—GLA continues to advance critically-needed Lyme and tick-borne disease research, accelerating progress toward reliable diagnostics, better treatments and ultimately a cure.

The biggest driver of our research agenda is patients. More people are suffering from Lyme and other tick-borne diseases today than at any other time. The harrowing truth is that 329,000 new cases of Lyme disease are diagnosed each year in the U.S. alone, according to the Centers for Disease Control and Prevention. Add to that the growing number of ticks and their expanding geographical range and the result is a pandemic.

GLA is at the forefront of discovery and innovation, making us a catalyst for change across the Lyme disease world. Despite all, GLA has learned about the complex nature of the Lyme bacterium, the dearth of federal funding makes it challenging to convert promising tests and therapies from the lab to the doctor’s office.

Our Scientific Advisory Board reviews all research grants to determine whether they can deliver significant, measurable advances that will be accepted by the medical community. GLA-funded grantees are discovering the underlying molecular biology of the Lyme bacterium; identifying new and better targets for treatment; and exploring drug combinations that successfully attack “persister” cells that evade conventional antibiotics, as well as antibiotic resistant Lyme bacteria.

GLA has been the only 501(c)(3) focused on research with either an M.D. or a Ph.D. at the helm of its science program. GLA’s research initiatives are currently led by our in-house Chief Scientific Officer and our Director of Research and Science. Their combined 30 years of experience in Lyme disease research, and track record of building bridges among scientists, clinicians, industry and government, makes GLA the preferred partner for researchers. These partnerships allow GLA to bridge the gap between its research discoveries and their translation into marketable products, a process ensuring that discoveries reach the public in a practical and useful form.

Together with our supporters, we will accelerate Lyme knowledge by funding great minds, innovative ideas, and results-driven efforts for the benefit all Lyme disease patients and their families.

Thank you,

Scott Santarella
CEO

Robert Kobre
Chairman of the Board

MAY 2018
Incidence of Co-infection

Tick-borne co-infections such as Babesiosis, Bartonella, Anaplasmosis, Ehrlichiosis are increasingly being reported. In one study, 40% of Lyme patients experienced concurrent Babesiosis, according to researchers at Columbia University, Tufts Medical Center, Stony Brook University and Yale School of Medicine.

For a list of co-infections, go to: GLA.org

Limited Government Support

Despite the pressing need, Lyme disease research is seriously underfunded at the government level. See chart on page 10 to learn how much Lyme disease received in 2016 from the National Institutes of Health (NIH) compared to some other diseases.

Persistence

Based on GLA-funded research, it’s estimated that 10-20% of acute Lyme disease cases are not cured by immediate antibiotic treatment. This statistic is now used by mainstream medicine and is the direct result of exclusive GLA-funded research at Johns Hopkins.

Injustice

Lyme patients today face an incredible injustice, both from the medical community, insurance companies and their peers. Until an accurate diagnostic test and standard of care is established and accepted by the medical community, this will continue.

Why We Are Fighting So Hard

Escalating Incidence

There are 329,000 new cases of Lyme each year in the U.S. alone. Combine this fact with the escalating number of reported cases worldwide and the result is a global pandemic.

Research indicates that the tick population has exploded in number and geography over the last 15 years, and a greater proportion of deer ticks are infected with Borrelia burgdorferi, the Lyme disease bacterium. Due to warmer winters, many ticks are active year-round instead of seasonally.

Why the Problem Is Worsening

Increased tick populations

Expanding geographic range for ticks

Many ticks are active year-round, due to warmer winters

More ticks are testing positive for Lyme bacteria

More Lyme Disease & Co-infections

Delayed Treatment

The longer a patient goes without treatment of their Lyme or tick-borne infection, the worse the symptoms may become. For some patients, symptoms become life threatening. An early, accurate diagnostic test and improved understanding of tick-borne infections will help patients get more timely and effective treatment.

Incidence Among Children

Children are most at risk. The highest incidence of Lyme disease occurs in children, ages 3–14. More than 200 children contract Lyme disease every day.

Stigma

Many Lyme patients with persistent symptoms are dismissed by the medical community as hypochondriacs or malingerers, when in fact their symptoms are very real. Patients are also often criticized by friends and family because of the difficulty of diagnosis.
Global Lyme Alliance – Research Report 2018

Funding Challenge for Researchers

Many scientists hope to make a difference in the fight to protect people from Lyme and other debilitating tick-borne diseases, but they face an unpleasant reality. Federal funding for Lyme research is miniscule, which puts the onus into the hands of private donors willing to fund such vital work.

Without ongoing federal funding, the Lyme field risks losing qualified researchers, who either move on to better-funded causes or leave science altogether. This means we are perpetually at risk of losing the researcher who could discover the next big breakthrough.

Research laboratories need to apply for new funds regularly if they are to keep their labs open and running. The universities themselves depend on institutional support funds that are attached to research grants. In general, when labs receive reduced federal funding, research positions are eliminated. According to a recent NPR analysis of National Institutes of Health data, 3,400 scientists lost sustaining grants in fiscal year 2013. Thus, valuable investigations by trained scientists were curtailed.

Complicating matters, most NIH grants tend to be awarded to more established Lyme researchers. This in effect cuts out a number of highly qualified young researchers and postdoctoral candidates with fresh perspectives. GLA funds researchers based on the quality of their work and potential for meaningful results regardless of their legacy standing.

The dearth of federal grants, especially when seen in light of the growing threat of Lyme, makes research funding from Global Lyme Alliance more important than ever. Our support of essential research is crucial if pioneering scientists are to undertake necessary investigations. It is only through the generous support of our donors that we can continue to disburse critical research funds that contribute to the future of every family at risk for tick-borne diseases, and those now living with persistent or chronic Lyme.

Lyme funding awarded by the NIH goes to basic biology research, while relatively little goes to research which seeks to develop new diagnostic tests, therapies, or understand the best tick reduction and prevention strategies.

Where Does the NIH Funding Go

<table>
<thead>
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<th>NIH spending Lyme vs other diseases (2016)</th>
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<tr>
<td>$120,000,000</td>
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</tbody>
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| $107,000,000 |
| $47,000,000 |
| $28,000,000 |
| $44,000,000 |

Lyme Disease
West Nile Virus
Hepatitis C
Hepatitis B

Annual new cases of Lyme in U.S. vs. other diseases (CDC)

| 400,000 |
| 300,000 |
| 200,000 |
| 100,000 |

| 329,000 |
| 2,038 |
| 104,000 |
| 47,100 |

Lyme Disease
West Nile Virus
Hepatitis C
Hepatitis B

We’re Helping to Fund Young Scientists!

GLA recently announced the first cohort of the “Deborah and Mark Blackman Postdoctoral Fellowship in Bacterial Persistence and Host Evasion.” The three-year fellowships support five recent Ph.D. graduates with specific interest in understanding whether persistence of the bacteria Borrelia burgdorferi, the Lyme disease pathogen, or host evasion mechanisms are responsible for the continued symptoms experienced by patients treated for Lyme disease. Each fellow will receive $75,000 annually. The funding will allow the young scientists to equip themselves to eventually become independent, principal researchers in their own labs. The first five Blackman Postdoctoral Fellows are: George Aranjuez, Ph.D., from the University of Central Florida; Ashley Groshong, Ph.D., University of Connecticut; Matthew Muramatsu, Ph.D., University of Texas-Southwestern; Bijaya Sharma, Ph.D., Tufts University, and Chrysoula Kitsou, Ph.D., University of Maryland.
GLA FUNDS RESEARCHERS IN THREE PRIMARY AREAS:

1 **DIAGNOSTICS:**

There is an urgent need to develop accurate, dependable diagnostic tests, for both Lyme disease, in all stages, and for detecting other tick species and tick-transmitted co-infections. GLA-supported research has been and will continue to be focused on the development of various technologies and methodologies that can lead to reliable diagnostic testing.

2 **TREATMENT / THERAPEUTICS:**

GLA-funded researchers are identifying new and effective treatments for both early and late-stage Lyme disease. They are also studying optimal treatments and therapies to help the body fight infection with reduced side effects. For example, GLA has funded studies to identify new antibiotics and combinations of antibiotics that may more effectively kill Lyme bacteria. These studies have shown that slow-growing persister forms of *Borrelia* may survive conventional antibiotics.

3 **BASIC SCIENCE:**

Basic science research focuses on questions about Lyme and tick-borne diseases at the fundamental molecular and cellular level, resulting in a better understanding of the bacteria or immune response. This research is not conducted on people. It is carried out in a laboratory with experiments involving cells, tissue or blood samples in vitro (such as test tubes) or in vivo (with animals). This vital work is important because scientific findings can be translated into diagnostic, preventive and therapeutic benefits for patients, or lead to entirely new concepts in applied medicine.

**LYME IS A COMPLEX DISEASE WITH MANY BACTERIAL STRAINS AND CO-INFECTIONS. THE COMPLEXITY OF THE DISEASE COMBINED WITH LACK OF FEDERAL FUNDING MAKES GLOBAL LYME ALLIANCE’S ROLE IN TICK-BORNE DISEASE RESEARCH ESSENTIAL. GLA IS COMMITTED TO UNCOVERING THE KEYS THAT WILL OPEN THE DOOR FOR ACTIONABLE, SCIENCE-BASED ANSWERS THAT WILL IMPACT PATIENTS. GLA’S OBJECTIVE IS TO DEVELOP MORE EFFECTIVE MEANS OF DIAGNOSING AND TREATING THE DISEASE.**

Funding by Type

2008 — 2017

Based on total dollar amount of funding

**WHEN OUR SON WAS SO SICK WITH LYME MORE THAN 10 YEARS AGO, I VOWED TO BECOME AN ACTIVIST TO HELP FIND A CURE SO THAT OTHER INDIVIDUALS AND FAMILIES WOULD NOT SUFFER AS WE DID. I AM PROUD TO SUPPORT GLOBAL LYME ALLIANCE. IT IS THE RIGHT ORGANIZATION TO FUND THE EDUCATION AND RESEARCH NECESSARY TO COMBAT TICK-BORNE DISEASES.”**

— Karen Peetz

Karen Peetz is the former President of The Bank of New York Mellon Corporation (BNY Mellon). She is a member of GLA’s Board of Directors.
OUR GRANTING PROCESS

GLOBAL LYME ALLIANCE AWARDS RESEARCH GRANTS FOLLOWING A RIGOROUS PEER-REVIEW PROCESS USING GUIDELINES ESTABLISHED BY THE NATIONAL INSTITUTES OF HEALTH (NIH). EACH GRANTEE MUST MEET THE SAME SCIENTIFIC STANDARDS THAT THE NIH APPLIES TO ITS OWN RESEARCH GRANT REVIEW PROCESS.

This thorough process ensures that GLA funds only the most outstanding research projects with the best prospects of advancing knowledge and delivering actionable results.

The grants process starts with a request for proposals (RFP) issued by GLA in the spring of every year. The RFP guidelines are established by GLA’s Chief Scientific Officer and Director of Research and Science. The Chairman, CEO, CSO, and key members of the Board of Directors also augment the RFP process by identifying themes to proactively pursue based upon cutting-edge science. All applications received undergo a thorough review by members of our Scientific Advisory Board (SAB), comprised of some of the most distinguished researchers and clinical innovators in multidisciplinary fields of Lyme and tick-borne disease. Grants are awarded to projects judged to have exceptional prospects of delivering measurable advances, and that will best fulfill our mission of improving diagnostic testing, uncovering more effective treatment protocols. The Financial Review Sub-Committee of the SAB, composed of business leaders with extensive strategic, operational and senior management experience, works to bridge the gap between the research community and the marketplace with the goal of transitioning successful research programs into accessible treatments that are readily available to patients. The Sub-Committee also ensures that the aggregate research projects meet with GLA’s budget and appropriate benchmarks are set for the phasing of research funding.

To underscore our research commitment, GLA sets itself apart from other Lyme organizations by having a Board Chair who is immersed in Lyme disease and sits on the SAB, along with a full-time, in-house, fully credentialed Chief Scientific Officer and a Director of Research and Science. GLA’s CEO also has extensive disease and research experience.

With a business-minded Board of Directors who demand accountability, we proactively manage our grants, with payments structured on a multiple installment basis that required detailed reporting and accountability at each stage.

The review process—including all deliberations, scores and proposal critiques—remains confidential. Grants for projects selected through the process are then made to academic institutions on behalf of individual investigators.

GLA ADDRESSES A CRITICAL NEED FOR BASIC RESEARCH INTO THE DIAGNOSIS, PROGRESSION AND TREATMENT OF LYME DISEASE. WITH SUBMISSION REQUIREMENTS AS RIGOROUS AS THE NIH, APPLICATIONS ARE EVALUATED BY A FIRST CLASS SCIENTIFIC ADVISORY BOARD. AWARD WINNERS ARE THEN MONITORED FOR COMPLIANCE BY AN EXPERT IN-HOUSE SCIENTIFIC TEAM.”

— Mark Blackman

Long-time supporters of GLA research, Mark Blackman and his wife, Deborah, are parents of a child who has not been “easy to cure.”
In addition, GLA hosts the only annual symposium for Lyme and tick-borne disease researchers, including GLA SAB members and grant recipients, whose purpose is to foster brainstorming of new diagnostic and therapeutic measures, communication of ideas and collaboration. The Financial Review Sub-Committee of the SAB is composed of business leaders with extensive strategic, operational and senior management experience, and provides financial oversight.

**GLA’S SCIENTIFIC ADVISORY BOARD (SAB) IS COMPRISED OF WORLD-RENOUNED LYME AND TICK-BORNE DISEASE RESEARCHERS, SCIENTISTS AND CLINICAL INNOVATORS IN THE FIELD. FOR MORE THAN A DECADE, THE SAB HAS PROVIDED STRATEGIC GUIDANCE AND DIRECTION FOR OUR RESEARCH AND SCIENTIFIC PROGRAMS JUDGED TO HAVE THE BEST PROSPECTS OF DELIVERING MEASURABLE RESULTS AND THE GREATEST IMPACT.**

**Catherine A. Brissette, Ph.D., Associate Professor of Biomedical Sciences, University of North Dakota School of Medicine and Health Sciences, Grand Forks, ND. Dr. Brissette’s research focuses on bacterial-host interactions, with a particular interest in pathogenic spirochetes.**

**Charles Chiu, M.D., Ph.D., Associate Professor of Laboratory Medicine and Medicine, University of California, San Francisco, and Director of the UCSF-Abbott Viral Diagnostics and Discovery Center. Dr. Chiu is an expert in advanced genomic technologies, pathogen discovery and clinical assay validation.**

**Allison K. DeLong, M.S., Biostatistician at the Center for Statistical Studies, Brown University, Providence, RI. With a M.S. degree in applied mathematics and statistics, she is certified as a professional statistician by the American Statistical Association. Her interests include the quantification of Lyme disease incidence among populations.**

**Richard Goldstein, D.V.M., Executive Director and Chief Medical Officer of Diagnostics, Zoetis, Inc. in New Jersey. Dr. Goldstein is internationally recognized for his expertise in infectious diseases in dogs and cats, especially those common to both animals and humans, most notably Lyme disease and leptospirosis.**

**Andreas Kogelnik, M.D., Ph.D., Founder and Director, of the Open Mind Institute in Mountain View, CA. And a practicing physician. His interests are in the bioinformatics and genomic revolution in medicine.**

**Robert Kobre, C.P.A., M.B.A., Vice Chairman, Investment Banking at Credit Suisse. Kobre has analyzed and helped construct over 200 business plans and financial forecasts. He specializes in IPOs, leveraged loans, high yield bonds and M&A. With over 20 years of financial and health care industry experience, he has advised GLA over the past six years on research objective protocols and grant-making strategy.**

**Scott Santarella, GLA’s CEO, brings more than 25 years experience as a senior executive with a proven track record in strategic planning, innovative marketing, and fundraising. He has run businesses with annual revenues ranging from $5 million to $35 million.**

**Brian Scanlan is the President of Mount Hope Capital, a family firm based in Greenwich, CT. Scanlan was also the founder of Caminus Corporation (formerly ZaiNet Software, Inc), a NASDAQ-listed energy software company based in New York.**
"WE MUST SPEAK UP FOR ALL THOSE WHO CAN NOT BE HEARD. WE WILL NO LONGER ALLOW THIS DISEASE TO TERRORIZE OUR LIFE. WE MUST BREAK THE SILENCE. WE MUST RESTORE HOPE FOR THOSE WHO HAVE GIVEN UP."

— Yolanda Hadid

Actress, television star and passionate Lyme advocate.
GLOBAL LYME ALLIANCE HAS PIONEERED MANY KEY ADVANCEMENTS IN LYME AND TICK-BORNE DISEASE RESEARCH, AND IS CHARTING THE PATH FOR THE NEXT BIG FINDINGS.

GLA, IN COLLABORATION WITH OUR FUNDED SCIENTISTS, IS THE ORGANIZATION RESPONSIBLE FOR MANY EVIDENCE-BASED FIRSTS ABOUT LYME DISEASE, INCLUDING:

- Identified that 10-20% of Lyme patients do not react to early antibiotic therapy – now widely accepted
- Definitively proved that Lyme patients with neurological issues are in fact ill, and have a unique set of proteins in their spinal fluid that healthy and chronic fatigue syndrome patients do not have
- Came up with the idea that the Lyme bacteria could go dormant when exposed to antibiotics and then start growing once antibiotics were stopped – and then proved this to be the case in vitro at two major medical institutions
- Mapped the genome of strains of Borrelia burgdorferi
- Came up with two drug cocktails to potentially stop growing of persister Lyme cells
- Showed Lyme is the only bacteria that does not require iron but rather manganese
- Developed a test kit for chronic Lyme
- Developed the most accurate Lyme blood test (not yet commercially available)
- Hosted a scientific, researcher only, symposium to facilitate sharing of ideas and funding at Banbury Medical Conference (and in Greenwich, CT)
- Coordinated and funded the Banbury paper, of leading Lyme in authorities from academic and the federal government, questioning the utility of the current 2-tier system diagnostic testing and encouraging better techniques.
- Hired an M.D. as Chief Scientific Officer, a Ph.D. as Director of Research and Science, and a Ph.D. with 25 years’ Lyme research experience as full-time Chief Scientific Officer
- Created a world class Scientific Advisory Board
- Established and implemented an NIH-based, peer reviewed system to evaluate grants
- Found Borrelia burgdorferi in the tissue of a human being post antibiotic treatment
- Found that Borrelia burgdorferi invades the lymph nodes of Lyme patients
- Discovered that Lyme camps out in the meninges of the brain
- The first organization to fund research for an amplified-PCR diagnostic blood test
- Created the first research Centers at any university dedicated to Lyme disease – at Columbia University.
GLOBAL LYME ALLIANCE HAS GAINED NATIONAL PROMINENCE FOR ITS COMMITMENT TO CHANGING THE COURSE OF TICK-BORNE DISEASE BY FUNDING INNOVATIVE, GROUND-BREAKING, EVIDENCE-BASED RESEARCH. OUR RESEARCH PROGRAM IS ONGOING AND IS RESPONSIBLE FOR MAJOR ACCOMPLISHMENTS.

SOME GLA RESEARCH ACCOMPLISHMENTS INCLUDE:

- The GLA thesis of persister cells in Lyme disease, as proven in vitro
- First to show Lyme disease behavior in the brain
- Developed a diagnostic test for chronic Lyme infection
- Developed a diagnostic test more sensitive and accurate than any currently available
- Two independent GLA-funded researchers showed the survival of persisting Lyme bacteria antibiotic treatment, which suggests the existence of chronic Lyme disease
- Mapped the genome of the bacterium that causes Lyme
- Showed ongoing and evolving antibody response to Borrelia bacteria in patients with persisting Lyme disease symptoms
- Uncovered the unique metal properties of Lyme bacteria
- 100% of GLA-funded research projects have been published in peer-reviewed scientific journals such as Emerging Microbes & Infections, Journal of Immunology, PLoS ONE, Frontiers in Microbiology, and Clinical Infectious Diseases

Our researchers are on the threshold of devising new diagnostic tests and GLA has partnered with Ionica Sciences and Cornell to accelerate the development of a very promising new, advanced science Lyme disease diagnostic. In addition, our investigators are uncovering the molecular biology of the Lyme bacterium; exploring how the disease can survive antibiotic therapy; identifying new and better targets for treatment, and analyzing how and why a large percentage of individuals continue to experience persistent, debilitating symptoms after their initial treatment.

GLOBAL LYME ALLIANCE HAS GAINED NATIONAL PROMINENCE FOR ITS COMMITMENT TO CHANGING THE COURSE OF TICK-BORNE DISEASE BY FUNDING INNOVATIVE, GROUND-BREAKING, EVIDENCE-BASED RESEARCH. OUR RESEARCH PROGRAM IS ONGOING AND IS RESPONSIBLE FOR MAJOR ACCOMPLISHMENTS.
Globally, Lyme disease (Borrelia burgdorferi). The first report of Lyme disease was published in 1975 by a medical team at the Landstuhl Regional Medical Center in Germany, describing a group of patients with unusual symptoms that were later attributed to Lyme disease. The disease was named after a tiny town in Connecticut, USA, where it was first recognized as a distinct entity. Lyme disease is caused by the bacterium Borrelia burgdorferi, which is transmitted to humans through the bite of infected black-legged ticks. When left untreated, Lyme disease can progress through three stages: early localized disease, early disseminated disease, and late tissue-damaging disease. The late stages of Lyme disease can lead to severe, chronic conditions affecting the heart, nervous system, and joints.

The Global Lyme Alliance (GLA) is a leading nonprofit organization dedicated to accelerating the development of new and improved treatments for Lyme and other tick-borne diseases. The GLA’s mission is to dramatically improve patient care and accelerate the development of new therapies by bringing together leaders in academia, government, philanthropy, and industry to foster innovation and collaboration. The GLA has made significant contributions to the field of Lyme disease research, including funding for disease diagnosis, treatment, and prevention.

In 2018, GLA awards $3 million in research grants.

In 2019, GLA presents the first global diagnostic challenge, partnering with Cornell University to accelerate the development of a highly sensitive, accurate Lyme disease diagnostic test.

In 2019, GLA awards $3 million in research grants.

In 2020, GLA announces the launch of the Global Lyme Alliance’s Lyme and Tick-Borne Disease Research Program.

In 2021, GLA presents the first global diagnostic challenge, partnering with Cornell University to accelerate the development of a highly sensitive, accurate Lyme disease diagnostic test.

In 2022, GLA awards $3 million in research grants.

In 2023, GLA announces the launch of the Global Lyme Alliance’s Lyme and Tick-Borne Disease Research Program.

In 2024, GLA presents the first global diagnostic challenge, partnering with Cornell University to accelerate the development of a highly sensitive, accurate Lyme disease diagnostic test.

In 2025, GLA awards $3 million in research grants.

In 2026, GLA announces the launch of the Global Lyme Alliance’s Lyme and Tick-Borne Disease Research Program.

In 2027, GLA presents the first global diagnostic challenge, partnering with Cornell University to accelerate the development of a highly sensitive, accurate Lyme disease diagnostic test.

In 2028, GLA awards $3 million in research grants.

In 2029, GLA announces the launch of the Global Lyme Alliance’s Lyme and Tick-Borne Disease Research Program.

In 2030, GLA presents the first global diagnostic challenge, partnering with Cornell University to accelerate the development of a highly sensitive, accurate Lyme disease diagnostic test.

In 2031, GLA awards $3 million in research grants.

In 2032, GLA announces the launch of the Global Lyme Alliance’s Lyme and Tick-Borne Disease Research Program.

In 2033, GLA presents the first global diagnostic challenge, partnering with Cornell University to accelerate the development of a highly sensitive, accurate Lyme disease diagnostic test.

In 2034, GLA awards $3 million in research grants.

In 2035, GLA announces the launch of the Global Lyme Alliance’s Lyme and Tick-Borne Disease Research Program.

In 2036, GLA presents the first global diagnostic challenge, partnering with Cornell University to accelerate the development of a highly sensitive, accurate Lyme disease diagnostic test.

In 2037, GLA awards $3 million in research grants.

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In 2040, GLA awards $3 million in research grants.

In 2041, GLA announces the launch of the Global Lyme Alliance’s Lyme and Tick-Borne Disease Research Program.

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In 2048, GLA presents the first global diagnostic challenge, partnering with Cornell University to accelerate the development of a highly sensitive, accurate Lyme disease diagnostic test.

In 2049, GLA awards $3 million in research grants.
Borrelia burgdorferi, the bacteria that cause Lyme disease. Dr. Luft found that some Lyme patients have a unique pattern of antibodies that patients who were successfully treated. It will determine whether these antibodies are also present in other patients who are treated with antibiotics to develop a more comprehensive therapy.

**STUDY (2017):** "Tick chip: identify pathogen cause of STARI"

Edouard Vannier, Ph.D., Virginia Commonwealth University

Dr. Vannier’s work will address gene expression changes in patients at various stages of Lyme disease. The study will identify specific genes whose polymorphisms may determine whether an individual will go on to develop chronic Lyme disease or be cured by antibiotics. These mechanisms may also influence the efficacy of antibiotic therapy. These new tools in the treatment of Lyme disease will allow for earlier diagnosis and more effective treatment of Lyme disease.

**STUDY (2018):** "High activity of selective essential oils against B. burgdorferi"

Richard Marconi, Ph.D., University of North Carolina at Chapel Hill

Dr. Marconi’s work will target the bacteria responsible for Lyme disease. This study will identify specific genes whose polymorphisms may determine whether an individual will go on to develop chronic Lyme disease or be cured by antibiotics. These mechanisms may also influence the efficacy of antibiotic therapy. These new tools in the treatment of Lyme disease will allow for earlier diagnosis and more effective treatment of Lyme disease.

**STUDY (2017):** "High tech Bb antibody and antigen detection"

Klemen Strle, Ph.D., University of Ljubljana

Lyme diagnostic test to detect B. burgdorferi antigens and antibodies. Dr. Johnson is focusing on a technique that could be used to identify patients with Lyme disease who need specific treatments to control their disease. This technique may help to improve antibiotic treatments, particularly in patients who are not responding to traditional treatments.

**STUDY (2018):** "A longitudinal systems-level dissection of the immune response to B. burgdorferi infection during pregnancy"

Lise Nigrovic, M.D., Harvard Medical School

Genetics, particularly the differences in genetic responses to Borrelia burgdorferi, the bacteria that cause Lyme disease, may determine whether a patient responds or continues to suffer symptoms. Dr. Nigrovic will continue her work of identifying genetic differences in patients at different stages of Lyme disease.

**STUDY (2017):** "Defining protective antibody-mediated immunity to Borrelia burgdorferi in the mouse model of Lyme disease. His work will identify new targets for antimicrobial therapy. This new approach may provide an effective and safe therapy for Borrelia burgdorferi infections in humans.

**STUDY (2018):** "Bb fatty acid metabolism, do statins kill Bb?"

Northeastern University

Dr. Zhang will continue his work of identifying and defining how the borrelia bacteria are able to evade the immune system and persist in the body. His research will target the bacteria’s fatty acid metabolism, which is critical for its survival and persistence. The study will identify new targets for antimicrobial therapy. These new tools in the treatment of Lyme disease will allow for earlier diagnosis and more effective treatment of Lyme disease.

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Dr. Zhang will continue his work of identifying and defining how the borrelia bacteria are able to evade the immune system and persist in the body. His research will target the bacteria’s fatty acid metabolism, which is critical for its survival and persistence. The study will identify new targets for antimicrobial therapy. These new tools in the treatment of Lyme disease will allow for earlier diagnosis and more effective treatment of Lyme disease.
WHERE GLA SCIENTISTS ARE FROM

GLA PARTNERS WITH THE MOST TALENTED LYME AND TICK-BORNE DISEASE RESEARCHERS AT TOP INSTITUTIONS ACROSS THE COUNTRY.

CALIFORNIA
Open Medical Institute, Stanford
Stanford University, Stanford
University of California-Davis
University of California-Irvine
University of California-San Francisco

CONNECTICUT
University of Connecticut, Storrs
University of New Haven
Yale University, New Haven

COLORADO
University of Colorado, Colorado Springs

FLORIDA
University of Central Florida, Orlando

ILLINOIS
University of Chicago

LOUISIANA
Tulane National Primate Research Center, New Orleans

MARYLAND
Johns Hopkins University, Baltimore
Johns Hopkins University Bloomberg School of Public Health, Baltimore
University of Maryland, College Park

MASSACHUSETTS
Harvard Medical School, Cambridge
Northeastern University, Boston
Tufts University, Medford

MISSOURI
University of Missouri, St. Louis

NEW JERSEY
Rutgers New Jersey Medical School, Newark
University of Medicine and Dentistry of New Jersey, Newark

NEW YORK
Cary Institute, Millbrook
Columbia University, New York
Cornell University, Ithaca
Ionica Sciences, Ithaca
State University of New York-Stony Brook

NORTH CAROLINA
Duke University, Durham

NORTH DAKOTA
University of North Dakota, Grand Forks

PENNSYLVANIA
University of Pennsylvania, Philadelphia

RHODE ISLAND
Brown University, Providence

TEXAS
Texas A&M University, College Station
University of Texas-San Antonio
University of Texas-Southwestern, Dallas

VIRGINIA
Virginia Commonwealth University, Richmond

WASHINGTON
Institute for Systems Biology, Seattle
WHAT WE FUND: A LOOK BACK AT FIVE YEARS OF FUNDING

2015 — 2016
- Armin Alaedini, Ph.D. “Immunologic Mechanisms and Biomarkers of Post-Treatment Lyme Disease Syndrome.”
- Nicole Baumgarth, D.V.M., Ph.D. “Host Response to Borrelia burgdorferi (Bb) Infection.”
- Alla Landa, Ph.D. “Uncovering Neural and Immune Mechanisms Underlying Chronic Pain and Central Sensitization in Post-Treatment Lyme Syndrome.”
- Christopher Janson, M.D. “Generation and Characterization of Brain Lymphatic Co-culture System.”
- Kim Lewis, Ph.D. “Treatment of Lyme Disease.”
- Benjamin Luft, M.D. “Multiprotein Recombinant Assay for the Diagnosis of Lyme Disease.”
- Karen Newell-Rogers, Ph.D. “Effects of TLR-2 Activation or Bb Infection on Blood Brain Barrier, Immune Trafficking and Neuropathology.”
- Eva Sapi, Ph.D. “Characterization of Borrelia and Other Pathogenic Species in Autopsy Tissues of an Antibiotic-refractory Lyme Disease Case.”
- Ying Zhang, M.D., Ph.D. “Optimal Drug Combinations Targeting Bb Persisters for Improved Treatment of Lyme Disease.”

2014 — 2015
- Armin Alaedini, Ph.D. “Novel Antibody Biomarkers of Post-Treatment Lyme Disease Syndrome.”
- John Aucott, M.D. “Anti-Borrelia Antibodies in a Cohort of Well-Characterized Patients with PTLDS/CLD.”
- Nicole Baumgarth, D.V.M., Ph.D. “Host Defense Against Bb Infection.”
- Charles Chiu, M.D., Ph.D. “Pathogen Characterization and Discovery by Deep Sequencing of Two Major Vectors Associated with Lyme Disease and Other Tick-Borne Infections.”
- Kim Lewis, Ph.D. “Formation of Persisters in Bb and their Elimination”
- Steven Schutzer, M.D. with Claire Fraser, Ph.D. “CNS-Associated Borrelia and Other Microbes in LD Patients with Persistent Neurocognitive and Fatigue Features.”

2013 — 2014
- Kim Lewis, Ph.D. “Persistor Cells and Antibiotic Tolerance in Bb.”
- Ying Zhang, M.D., Ph.D. “Targeting Dormant Bb Persisters for Improved Treatment of Chronic and Persistent Lyme.”

2012 — 2013
- Armin Alaedini, Ph.D. “Novel Antibody Biomarkers of Post-Treatment Lyme Disease Syndrome.”
- Valeria Culotta, Ph.D. “The Role of Manganese and Iron in Growth Control of Bb.”
- Benjamin Luft, M.D. “New Diagnostics for Lyme Disease.”
- Steven Schutzer, M.D. “Proteomic Investigation of Lyme Disease.”

2011 — 2012
- Karen Newell-Rogers, Ph.D. “Correlation Between Immune Response Genes, B cell Activation, and Susceptibility to Chronic Lyme Disease.”
- Karen Newell-Rogers, Ph.D. “A New Model of Intervention for Lyme Disease by Targeting Chronic Inflammation and Selective Aspects of Immune Activation.”
- Karen Newell-Rogers, Ph.D. “Lyme Disease: Preventing and/or Controlling Chronic Hyperimmune Activation with Targeted Peptide Therapy.”
- Steven Schutzer, M.D. “Diagnostic Biomarkers for Persisting Brain and Nervous System Symptoms in Lyme Disease.”
- Robert, E. Thach, Ph.D. “Vertebrate Reservoirs for Tick-Borne Diseases in the Central United States.”
- Ying Zhang, M.D. “Identified Borrelia burgdorferi L-form specific Proteins (ie: Persisters) for Development of New Diagnostics, Vaccines and Also Drugs Targeting L-Form Borrelia.”
“IT'S AN HONOR TO BE A PART OF THIS AMAZING ALLIANCE THAT IS FIGHTING TIRELESSLY TO GIVE US A VOICE AND HELP FIND A CURE, SO THAT OTHERS WON'T EVER HAVE TO SUFFER THIS WAY AGAIN.”

— Marisol Thomas

Marisol Thomas, philanthropist and animal rights activist, is the wife of GRAMMY Award-winning singer/songwriter Rob Thomas.
FROM SEED FUNDING TO NIH SUPPORT

GLOBAL LYME ALLIANCE’S COMMITMENT TO FUND INNOVATIVE AND PROMISING LYME DISEASE RESEARCH IS UNRIVALED. A VITAL COMPONENT OF GLA’S RESEARCH INITIATIVE INCLUDES EARLY-STAGE FUNDING, TO ASSIST RESEARCHERS AT A CRITICAL STAGE IN THEIR CAREERS AND THEIR RESEARCH. GLA’S EARLY-STAGE FUNDING HAS HAD A SIGNIFICANT IMPACT ON THE LYME LANDSCAPE.

Here are profiles of four individuals who advanced from GLA seed funding to significant support from the NIH and other research institutions.

**Armin Alaedini, Ph.D. Columbia University Medical Center**

Why do Lyme disease symptoms linger in some individuals, but not others? With a 2009 GLA grant, Dr. Armin Alaedini, then at Weill Medical College of Cornell University, analyzed blood and spinal fluid of patients whose symptoms persisted after antibiotic treatment. Dr. Alaedini and his colleagues demonstrated that the infection can trigger an ongoing abnormally activated immune response in some patients, suggesting some immunologic distinction between patients who responded favorably to treatment and those who did not.

As a result of this GLA-funded work, in 2011 Dr. Alaedini was awarded a one-year $360,000 grant from NIH/ National Institute of Allergy and Infectious Diseases, followed by a two-year grant of more than $373,000. He has since demonstrated that individuals who experience chronic Lyme disease have specific antibodies to parts of the *B. burgdorferi* surface protein, VlsE. His work continues to help us better understand immunologic mechanisms and biomarkers of post-treatment Lyme patients.

**John Aucott, M.D. Johns Hopkins University**

Dr. Aucott is Principal Investigator of the landmark SLICE project, the first prospective controlled study in the U.S. to examine the impact of Lyme disease on patients’ immune systems and their long-term health. It seeks to understand why some patients suffer from Post Treatment Lyme Disease Syndrome (PTLDS), while others do not. The study has helped to advance research, including biomarker discovery, for improved diagnostics and optimal therapies.

When he was honored by GLA at our Greenwich Gala in 2015, Dr. Aucott spoke about the early days with his team and GLA: “We started eight years ago,” he said, “without any funding until GLA (then called Time for Lyme) took a chance on us.” In 2014, Dr. Aucott received a two-year grant from GLA to recruit larger numbers of patients with medically documented chronic Lyme. In 2016, he and colleague Mark Soloski, Ph.D., also a GLA grantee, received a five-year $6 million grant from a national foundation to support the continuation of the SLICE study.

**Valeria Culotta, Ph.D. Johns Hopkins Bloomberg School of Public Health**

In 2013, GLA awarded a grant to Valeria Culotta, Ph.D. to further study the role of manganese and iron in the cellular workings of the Lyme bacterium. Dr. Culotta’s research group, working in collaboration with Woods Hole Oceanographic Institute, had discovered that *B. burgdorferi* uses manganese instead of iron to survive. Iron, which is crucial to the survival of all other bacteria in *vivo*, is in fact toxic to *B. burgdorferi*.

With her findings, Dr. Culotta was well-positioned to apply for additional funding from the NIH. The results obtained from her GLA-supported study led to a two-year $162,000 NIH grant to focus on “metal trafficking” in living organisms, or how bacteria and individual cells obtain and use metals in their biological processes.

**Kim Lewis, Ph.D. Northeastern University**

In 2013, Kim Lewis, Ph.D., took aim at the *B. burgdorferi* bacterium, the chief cause of Lyme disease and PTLDS. In a landmark paper published two years later, he pointed to persisters—cells that evade a way for bacterial species to escape being destroyed by the immune system—as the cause of persistent Lyme. Persisters play dead and then reawaken once treatment is completed. “They start multiplying again,” Dr. Lewis said, “and you get this relapsing, chronic infection.”

Thanks to early support from GLA, including an initial 2013-14 grant, Dr. Lewis identified not only *B. burgdorferi* persisters but also a regimen for eradicating chronic bacterial infections. Last year, Dr. Lewis received nearly $3 million in new awards from a national foundation, GLA and an anonymous source. “The terrific thing about America is private philanthropy,” said Lewis, who grew up in Russia.
RESEARCHERS WE HAVE HONORED

John Aucott, M.D., 2015 Lauren F. Brooks Hope Award recipient
See Dr. Aucott’s bio page 38.

Brian A. Fallon, M.D., M.P.H. 2016 Lauren F. Brooks Hope Award recipient.
Dr. Fallon is director of the Lyme and Tick-Borne Diseases Research Center at Columbia University Medical Center, which was founded and endowed jointly by GLA and the Lyme Disease Association in 2007. He is one of the world’s leading researchers of tick-borne diseases. A Professor of Clinical Psychiatry at Columbia University Medical Center, he has served on expert panels for the NIH and has received over $9 million to support his research. His primary focus is on persistent cognitive impairment, fatigue and pain in patients with Post-Treatment Lyme Disease Syndrome (PTLDS) as well as the efficacy of repeated antibiotic therapy. Dr. Fallon’s most recent book, “Conquering Lyme Disease: Science Bridges the Great Divide” was published in December 2017.

Kim Lewis, Ph.D. and Ying Zhang, M.D., Ph.D. 2014 Lauren F. Brooks Hope Award recipients.
Two distinguished Lyme disease researchers both GLA grantees—Kim Lewis, Ph.D. of Northeastern University and Ying Zhang, M.D., Ph.D., of Johns Hopkins Bloomberg School of Public Health—were honored by GLA in 2014 for their work with persisters, cells that manage to survive antibiotic assault. Dr. Lewis, distinguished professor and director of Northeastern’s Antimicrobial Discovery Center, has since continued his work with B. burgdorferi persisters and has tested pulse-dosing antibiotics to target persistent infection. Dr. Zhang, professor of molecular microbiology and immunology at Johns Hopkins is testing compounds to find an optimal treatment regimen for patients with chronic Lyme disease.

Steven Schutzer, M.D. and Mark Eshoo, Ph.D. 2013 Lauren F. Brooks Hope Award recipients.
The importance of furthering research to ultimately find a cure for Lyme was emphasized in 2013 when GLA grantees Dr. Steven Schutzer of the University of Medicine and Dentistry of New Jersey and Mark Eshoo, Ph.D., director, New Technology Department, Abbott Laboratories received the Hope Award. Dr. Schutzer was honored for his ongoing work in the identification of distinct protein biomarkers. His work was cited for providing hope for furthering understanding the persistent symptoms of Lyme and, ultimately, for more effective diagnosis and treatment of the disease. Dr. Eshoo was recognized for working to improve the sensitivity of diagnostic tests and continues to make progress in the detection of Lyme disease during the initial stages of infection, when diagnosis and treatment are most effective. Together, utilizing state-of-the-art technology to identify Lyme and other tick-borne diseases in a speck of body fluid, Drs. Eshoo and Schutzer were honored for revolutionizing the field of diagnostics.
Despite a host of advances in twenty-first century medicine and technology, Lyme patients today continue to receive virtually the same treatment options they were offered decades ago. There is still a serious lack of Lyme awareness among the general public, not to mention unreliable diagnostics and limited treatment options—all of which is unacceptable.

That said, we at Global Lyme Alliance believe we are in a period of incipient change in Lyme diagnosis and treatment. Today, GLA-funded scientists and others in medical research are ever more confident of their growing understanding of the many forms and causes of Lyme and its co-infections. Researchers have made strides in understanding the genetics of the Lyme bacterium; new light has been shed on the role the immune system plays in the illness; and researchers are closer than ever to knowing why some individuals have a greater risk of persistent Lyme when treatment ends than others.

Healthcare technology is also changing the future of Lyme. A wide variety of technologies, as well as emerging scientific approaches, are advancing exponentially, all of which could have a profound impact on the lives of Lyme patients. We have entered a new era in medicine with a growing wave of progress in diseases employing immunotherapies, genetic testing and precision medicines. Moreover, GLA is establishing relationships and collaborating with other disease organizations as a means of translating their life-changing findings to benefit Lyme patients.

Our CEO, Scott Santarella, has more than 25 years of research experience and leadership in the oncology field. He has seen the advances that have come about in the cancer world as a result of interdisciplinary collaborations, and he envisions a similar interdisciplinary approach changing the face of Lyme research soon.

The good news is that the future looks brighter than ever for Lyme patients. But government research funding is trending downward. Therefore, the onus on GLA to advance scientific knowledge is greater than ever before. There is much work to be done—and we have the team to do it. We hope you’ll continue to support us in our efforts to accelerate research, identify new treatments and advance the opportunities for Lyme sufferers to live better lives.

Special thanks for the generous gifts from those who share our passion. With your support, we can do much more. Please make a tax-deductible donation to support Lyme research at GLA.org/donate or call 203.969.1333.

“GLA IS THE LEADER IN LYME RESEARCH THAT OTHER GROUPS FOLLOW AND SEEK TO EMULATE.”

— Robert Kobre
Chairman, Global Lyme Alliance