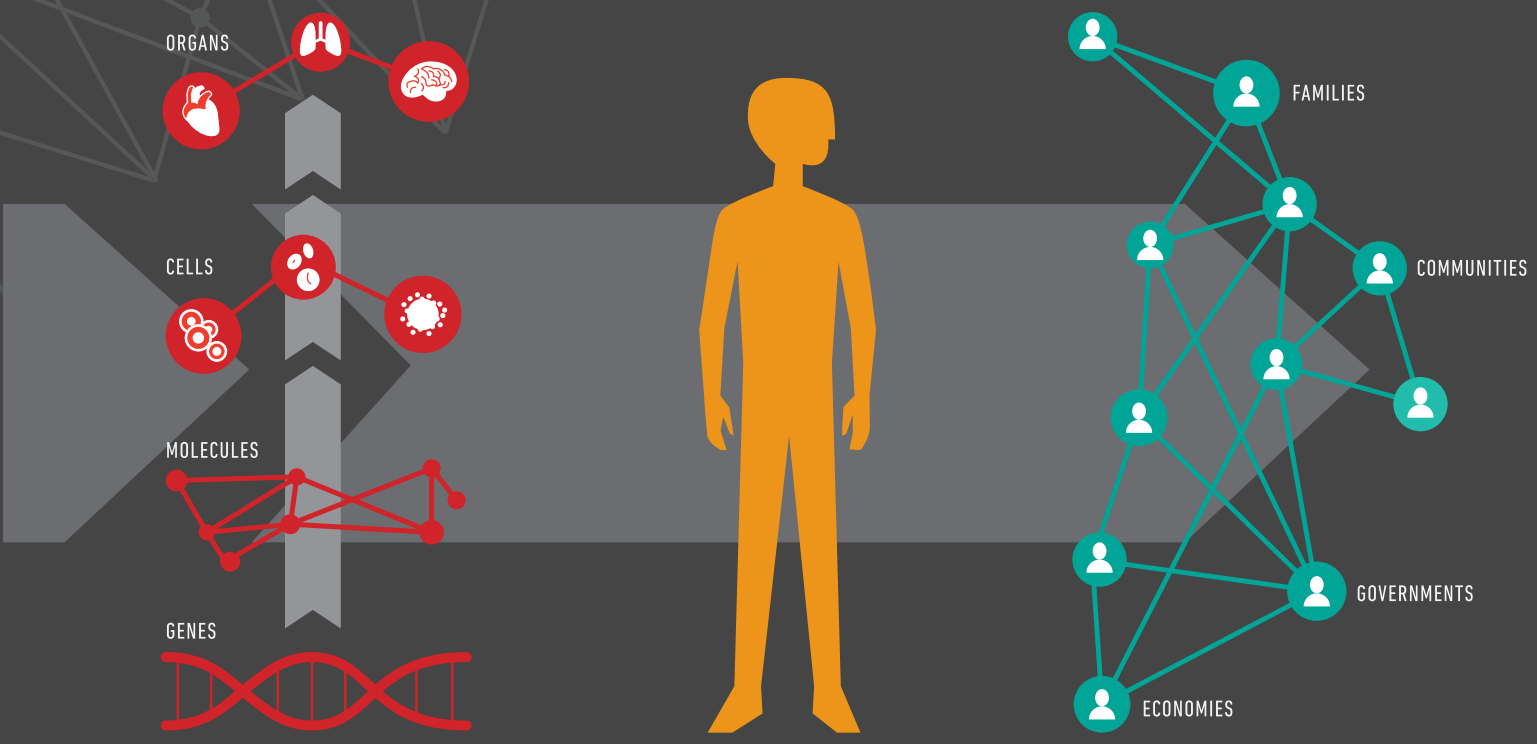
Center for Infectious Disease Research
PEOPLE. SCIENCE. HOPE.

# INFECTIOUS DISEASES DEVASTATE FAMILIES, COMMUNITIES & ECONOMIES

"THE SINGLE MOST IMPACTFUL THING WE CAN DO TO IMPROVE THE WORLD IS END THE BURDEN OF INFECTIOUS DISEASES."

JOHN AITCHISON, PH.D., PRESIDENT
CENTER FOR INFECTIOUS DISEASE RESEARCH



At the Center for Infectious Disease Research, we use systems biology approaches and cutting-edge technologies to accelerate the development of life-saving drugs, diagnostics and treatments for the world's most devastating infectious diseases.

# MALARIA HIV/AIDS TUBERCULOSIS LEISHMANIASIS CHAGAS DISEASE DENGUE EBOLA ZIKA

TOGETHER THESE DISEASES CLAIM OVER 15 MILLION LIVES EVERY YEAR.

## MICROBIOLOGY

We are pioneers in combining our deep expertise in microbial pathogens and the human immune system with the systems biology approach. Our biologists, virologists and immunologists work together with computer scientists, mathematicians, engineers and chemists, breaking down silos and addressing new questions in a novel discovery science approach.

## BIG DATA

Vast amounts of data are produced when researchers examine the consequences of infection, immunization and treatment on the thousands of molecules that comprise pathogens and hosts – and the interactions between them. We track and analyze these data using customized software and advanced computation to reveal critical insights from these massive data sets. These insights guide therapeutics.

## GENOMICS

The 'omics technologies – genomics, transcriptomics, proteomics, etc., and the associated bioinformatics – are essential for generating meaningful biomedical insights that lead to new diagnostics, drugs and therapies.

## COMPUTATION

We combine computational, statistical and bioinformatics approaches to create computer models of the immune and disease processes under study. Mathematics and computational simulations predict complex behaviors such as vaccine protection, drug susceptibility or progression to disease, and aid in designing approaches to prevent disease.

## VACCINES

We are leveraging discoveries about the interactions between invading pathogens and the human immune system to develop safe and effective vaccines. Our approach combines our expertise in adaptive and innate immunity with our deep knowledge of pathogens.

## DRUGS

We conduct the discovery research required to identify new compounds and drug targets that are needed to treat the diseases we study. Operating at the earliest stages of the drug development pipeline, many techniques we develop can be applied to various pathogens, thus generating promising solutions for multiple diseases to save more lives.

## DIAGNOSTICS

Advanced analytical technologies and mathematical analyses are being used to develop desperately needed new diagnostic tools, allowing for earlier treatment, reducing risks of drug resistance, and preventing needless suffering.

CID RESEARCH FACULTY: ALAN ADEREM, PH.D. • JOHN AITCHISON, PH.D. • CHRISTOPH GRUNDNER, PH.D. • STEFAN KAPPE, PH.D.

# NEW APPROACHES FOR TOMORROW'S SOLUTIONS

IN A UNIQUELY COLLABORATIVE ENVIRONMENT, THE CENTER FOR INFECTIOUS DISEASE RESEARCH APPLIES SYSTEMS BIOLOGY AND THE MOST ADVANCED SCIENTIFIC TOOLS TO CONFRONT THE CHALLENGES OF INFECTIOUS DISEASE.

## RESEARCH THAT LEADS TO DRUG TARGETS AND NEW THERAPIES

Before new drugs can enter clinical trials, extensive investigation into host-pathogen interactions is necessary to identify weaknesses in the pathogen's system of attack. CID Research excels at investigating these leads, identifying numerous drug candidates and targets in tuberculosis, Zika, malaria and other pathogens. One example is the work of the **Smith Lab**, focused on unraveling the mysteries of cerebral malaria, a disease that for years presented researchers with many challenges preventing substantial therapeutic advances. They discovered how malaria parasites bind to brain blood vessels and cause swelling, the leading cause of malaria deaths. With partners from around the world, the Smith Lab identified a receptor on brain endothelial cells that is now a promising target for drug intervention.

## TECHNOLOGY DEVELOPMENT FOR SYSTEMS BIOLOGY

The huge challenges facing global health need to be addressed by the best research approaches. CID Research is driving new advances in high-throughput technologies and computational biology to reveal systems-level insights into the biology of infectious diseases. In a recent example of customizing new techniques, the **Aitchison Lab** developed ODELAY, an automated and scalable tool to measure cell growth in highly precise ways – even in multiple dimensions. This extremely powerful and sensitive tool handles the huge data sets that are produced by tracking the growth of thousands of individual cells without sacrificing resolution or using averages. This precision in controlling variables at the genetic level opens new avenues for probing original pathogen-based or immunological problems in the high-stakes fight against antimicrobial resistance.

## PREDICTIVE APPROACHES FOR DIAGNOSING DISEASE

Although one-third of the world's population tests positive for latent TB, there's no method to predict when a person infected with latent TB will develop an active infection – until now. A new diagnostic test developed by the **Zak and Aderem Labs**, along with partners at the South African Tuberculosis Vaccine Initiative, can predict whether someone is likely to develop active TB more than a year before the disease manifests. Their work to decipher the molecular networks controlling the immune system provides an exciting new window of opportunity for early detection and more effective treatment.

## GENOMICS FOR SMARTER VACCINES

CID Research is pioneering new techniques for smart vaccines. This includes using advanced genetic methods to identify genes that are critical to pathogen survival and precisely removing them to generate safe and effective attenuated, whole pathogen vaccines. This is how the **Kappe Lab** produced the revolutionary Genetically Attenuated Parasite (GAP) malaria vaccine candidate, which has already been tested for safety in clinical trials. The Kappe Lab also innovated preclinical studies by using "chimeric" mice in which mouse liver cells are replaced with human liver cells then infused with human red blood cells. This allows safety testing of newly created GAP vaccines – before performing clinical trials. As the GAP3KO vaccine candidate readies for efficacy trials in early 2018, scientists in the Kappe Lab are further improving their vaccine approach, utilizing more recent 'omics such as RNA sequencing and CRISPR genome editing to identify superior GAPs and create them in a fraction of the time.

# TRANSFORMING GLOBAL HEALTH

## 1976

CID Research is founded by Ken Stuart, Ph.D., to focus on deadly parasitic diseases. It becomes the nation's **FIRST INDEPENDENT RESEARCH INSTITUTE** solely focused on global infectious diseases.

## 1980

Founder Ken Stuart is invited to advise the World Health Organization about future research into tropical diseases, marking the rise of CID Research into international significance.

## LATE 1980s

The Stuart Lab **DISCOVERS RNA EDITING,** upsetting the central dogma of biology and revealing new opportunities for therapies and control of biological systems.

## 1989

**LAUNCHES HIV RESEARCH PROGRAM,** investing in immunity and smart vaccine research.

## 1999

**INTRODUCES MALARIA PARASITE RESEARCH** to Seattle, leading to funding from the Bill & Melinda Gates Foundation.

## 2004

Opens new specially designed state-of-the-art facility seeding Seattle's global health hub.

## 2005

**LEADS THE GENOME SEQUENCING** of parasites that cause leishmaniasis and trypanosomiasis, providing researchers world-wide with valuable genetic information for developing treatments.

## 2009

**TUBERCULOSIS RESEARCH** expands with the opening of a new biosafety level 3 lab, along with an extant BL2/3 lab dedicated to HIV research.

## 2010

The Human Challenge Center opens, **ONE OF ONLY FOUR IN THE WORLD** where malaria vaccines are directly tested in human volunteers. Now, malaria researchers can work on vaccine development from basic research to clinical trials.

## 2012

The Center **INTRODUCES SYSTEMS BIOLOGY** to infectious disease research under the new leadership of Alan Aderem, Ph.D. By integrating research across diseases and disciplines, the Center begins an interdisciplinary renaissance of scientific discovery.

## 2013

Discovers how malaria parasites bind to brain blood vessels during often-fatal cerebral malaria, a critical step needed to develop new treatments.

## 2014

HIV research leads to breakthroughs in understanding how broadly neutralizing antibodies against HIV are generated during HIV-infection – foundational knowledge for **HIV VACCINE DEVELOPMENT.**

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## 2015

The GAP3KO malaria **VACCINE CANDIDATE SUCCESSFULLY COMPLETES THE FIRST PHASE OF CLINICAL TRIALS,** moving closer to approval and adoption.

**TUBERCULOSIS GENE REGULATORY NETWORK** is revealed through systems biology, providing a key to understanding and battling drug resistance.

## 2017

Seattle Structural Genomics Center for Infectious Disease, housed within CID Research, **SOLVES ITS LANDMARK 1,000th PATHOGEN PROTEIN STRUCTURE,** deciphering structural details about disease agents and informing drug design.

Launches **SINGLE CELL SYSTEMS BIOLOGY INITIATIVE** to understand how small numbers of cells disproportionately influence disease, immune responses and drug efficacy, and to transform the future of infectious disease research.

Comprehensive understanding of innate immunity leads to the **ABILITY TO REPROGRAM THE IMMUNE SYSTEM** and defeat HIV/AIDS, cancers, neurodegenerative disorders and other non-communicable diseases.

## VISION FOR THE FUTURE

**HEALTH AND WELLNESS ACROSS THE WORLD IS REVOLUTIONIZED.**

**ANTIMICROBIAL RESISTANCE IS DEFEATED.**

**NEW EFFECTIVE DRUG COMBINATION REDUCES TB DEATHS** and the burdens of compliance that previously exacerbated drug resistance.

**MALARIA DEATHS FALL DRAMATICALLY WITH NEW DRUGS** for cerebral malaria and adoption of vaccine created using CRISPR.

## 2016

Systems biology leads to **DISCOVERY OF A BIOMARKER IN BLOOD** that predicts a patient's risk of converting from latent tuberculosis to active disease, enabling early treatment to prevent disease progression and drug resistance.

After years as Seattle Biomedical Research Institute, our name changes to the **Center for Infectious Disease Research**, better reflecting our **GLOBAL REACH AND MISSION.**

JOSEPH SMITH, PH.D. • DONALD SODORA, PH.D. • KEN STUART, PH.D. • KEVIN URDAHL, M.D., PH.D.

# FUNDING AND COLLABORATORS

PARTNERSHIPS WORLDWIDE WITH

## 6 FIELD SITES

IN ENDEMIC AREAS INCLUDING THAILAND, INDIA, MALAWI, MOZAMBIQUE, SOUTH AFRICA AND TANZANIA

## 15 BIOTECH & PHARMACEUTICAL COMPANIES

## 70 RESEARCH CENTERS & UNIVERSITIES

## $31 MILLION

IN PUBLIC AND PRIVATE ANNUAL FUNDING, WITH A STRONG SUCCESS RATE FOR NIH PROPOSALS

### PARTNERS IN GLOBAL HEALTH

Infectious diseases are part of a devastating cycle of poverty, instability and death. Reducing the burden of these diseases will result in healthier communities and a more stable world – making public and private funding of scientific research critical. Thank you to the foundations, corporations, government agencies and individuals who share our vision of a world free from the threat of infectious diseases.

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