National Institute of Allergy and Infectious Diseases

NASEM Committee for the Assessment of NIH Research on Autoimmune Diseases

Autoimmunity Research in the Division of Intramural Research

Thursday, March 4 1:30 to 5:30 p.m.

NIAID

National Institute of Allergy and Infectious Diseases

Karyl S. Barron, M.D.
Deputy Director
Division of Intramural Research

NIAID's Complex Mandate

- Support and promote basic science
- Enable and foster clinical research
- Provide outstanding patient care to support both
- Respond to emerging threats and diseases

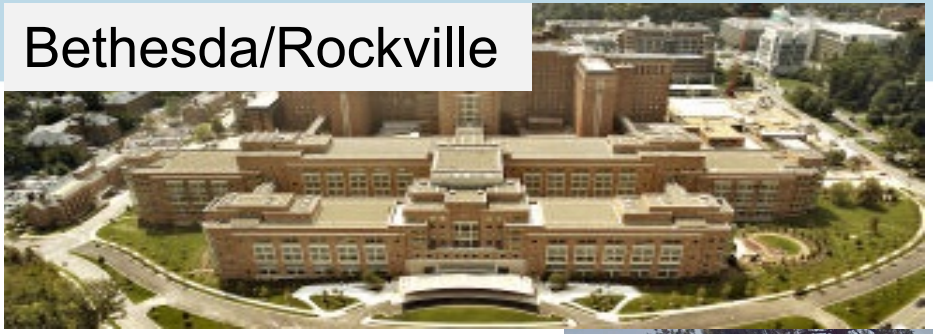
Intramural Program

- Relatively stable resources
- Long-term complex and high impact problems
- Rapid response to public health emergencies
- Retrospective review by BSC, unlike extramural grants

DIR Research: Facts and Figures

- 7.5% of NIAID budget
- 20 Labs/branches
- 133 Principal Investigators
- **44 Research projects related to autoimmunity**

Bethesda/Rockville



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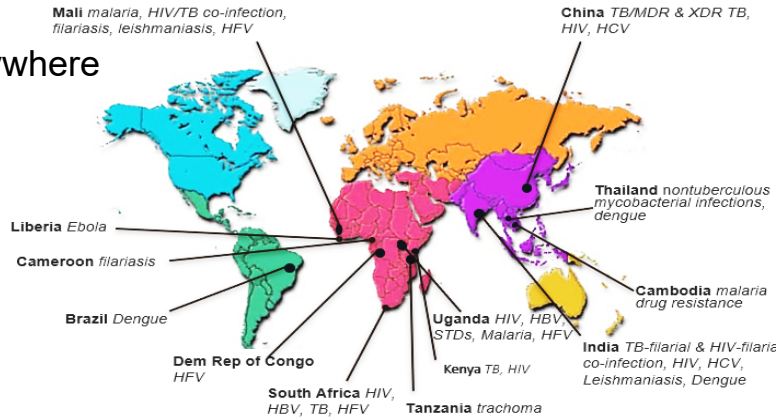


DIR's Research Programs in Autoimmunity Long-standing Investment

1973: Revolutionary treatment for anti-neutrophil cytoplasmic antibody (ANCA)-associated vasculitis (Fauci)

13/15 had total remission – prior to new treatment, 90% fatality w/in 2 years

1982: Discovery of IL-4 (Paul)

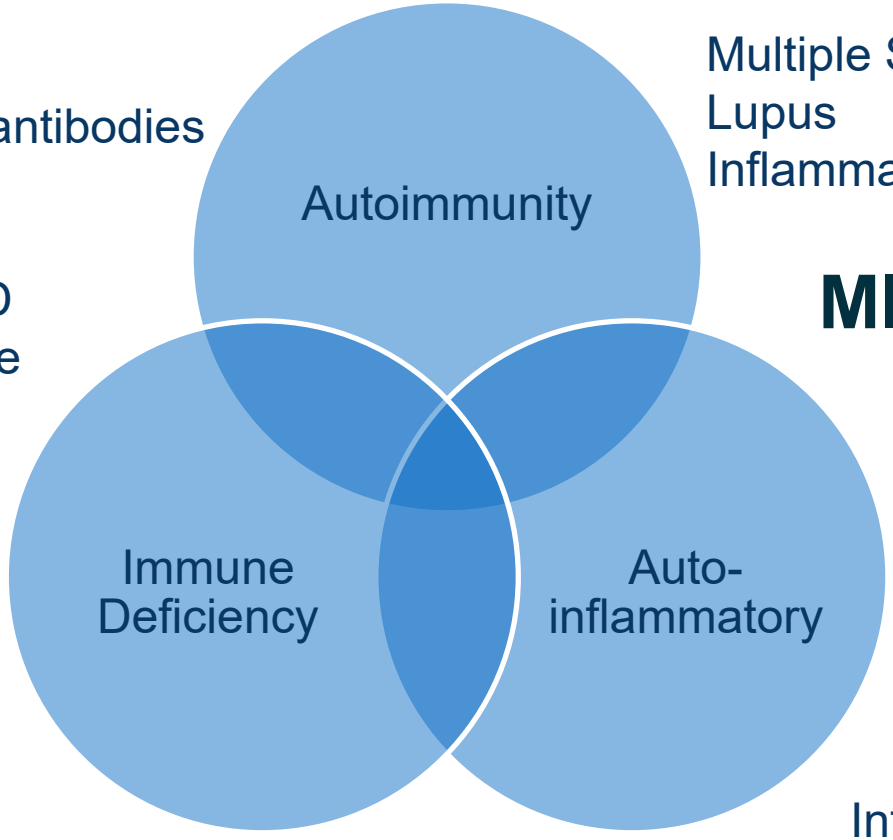
Master regulator of inflammation underpins all current models of immunity

1995: Identified autoimmune lymphoproliferative syndrome (ALPS) as the first genetic disease of apoptosis (Lenardo)

2012: Linkage of anti-interferon autoantibodies with adult-onset immunodeficiency and opportunistic infections in Thailand (Holland)

DIR Autoimmunity Portfolio Overview

Anticytokine Autoantibodies
APECED
ALPS
Post Acute COVID syndrome



Multiple Sclerosis
Lupus
Inflammatory Bowel Disease

MIS-C

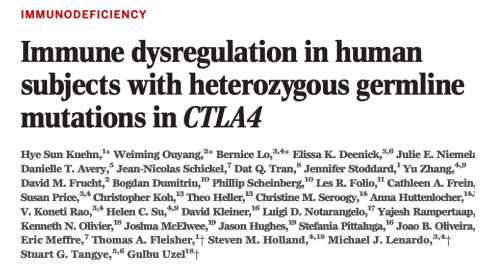
Interferonopathies

DIR Program Highlights

Clinical and Translational Research

Primary immunodeficiency w/ autoimmunity

- Immunodeficiency can co-present with hyperactive immune disorders (autoimmunity, lymphoproliferation, or atopy)
- NIAID Primary Immune Deficiency Clinic (PID)
- Blood and Immune Deficiency – Cellular Therapy Program (BID-CTP) (NIAID/NCI/NHLBI), established 2019


IMMUNODEFICIENCY

Immune dysregulation in human subjects with heterozygous germline mutations in *CTLA4*

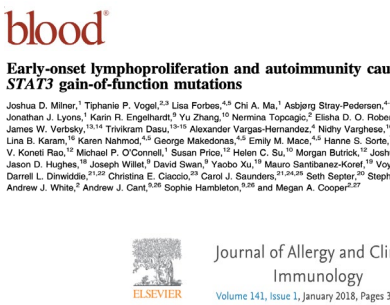
Hye Sun Kuehn,[1*] Weiming Ouyang,[2*] Bernice Lo,[3,4*] Elissa K. Deenick,[5,6] Julie E. Niemela, Danielle T. Avery,[5] Jean-Nicolas Schickel,[7] Dat Q. Tran,[8] Jennifer Stoddard,[1] Yu Zhang,[4,9] David M. Frucht,[2] Bogdan Dumitriu,[10] Phillip Scheinberg,[10] Les R. Folio,[11] Cathleen A. Frein, Susan Price,[3,4] Christopher Koh,[12] Theo Heller,[13] Christine M. Seroogy,[14] Anna Huttenlocher,[14,] V. Koneti Rao,[3,4] Helen C. Su,[4,9] David Kleiner,[16] Luigi D. Notarangelo,[17] Yajesh Rampertaap, Kenneth N. Olivier,[18] Joshua McElwee,[19] Jason Hughes,[19] Stefania Pittaluga,[16] Joao B. Oliveira, Eric Meffre,[7] Thomas A. Fleisher,[1†] Steven M. Holland,[4,18] Michael J. Lenardo,[3,4†] Stuart G. Tangye,[5,6] Gulbu Uzel[18†]


The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

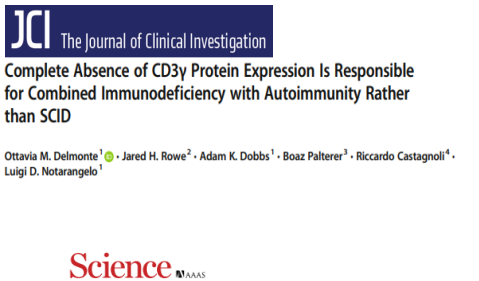
CD55 Deficiency, Early-Onset Protein-Losing Enteropathy, and Thrombosis

Ahmet Ozen, M.D., William A. Comrie, Ph.D., Rico C. Ardy, M.Res., Cecilia Domínguez Conde, M.Sc., Buket Dalgic, M.D., Ömer F. Beser, M.D., Aaron R. Morawski, M.S., Elif Karakoc-Aydiner, M.D., Engin Tutar, M.D., Safa Baris, M.D., Figen Ozcay, M.D., Nina K. Serwas, Ph.D., Yu Zhang, Ph.D., Helen F. Matthews, B.S.N., Stefania Pittaluga, M.D., Ph.D., Les R. Folio, D.O., M.P.H., Aysel Unlusoy Aksu, M.D., Joshua J. McElwee, Ph.D., Ana Krolo, M.Sc., Ayca Kiykim, M.D., Zeren Baris, M.D., Meltem Gulsan, M.D., Ismail Ogulur, Ph.D., Scott B. Snapper, M.D., Ph.D., Roderick H.J. Houwen, M.D., Ph.D., Helen L. Leavis, M.D., Ph.D., Deniz Ertem, M.D., Renate Kain, M.D., Sinan Sari, M.D., Tülay Erkan, M.D., Helen C. Su, M.D., Ph.D., Kaan Boztug, M.D., and Michael J. Lenardo, M.D.


blood

Early-onset lymphoproliferation and autoimmunity caused by germline *STAT3* gain-of-function mutations

Joshua D. Milner,[1] Tiphanie P. Vogel,[2,3] Lisa Forbes,[4,5] Chi A. Ma,[1] Asbjørg Stray-Pedersen,[4-7] Julie E. Niemela,[8] Jonathan J. Lyons,[1] Karin R. Engelhardt,[9] Yu Zhang,[10] Nermina Topcagic,[2] Elisha D. O. Roberson,[3,11] Helen Matthews,[12] James W. Verbsky,[13,14] Trivikram Dasu,[13-15] Alexander Vargas-Hernandez,[4] Nidhy Varghese,[16] Kenneth L. McClain,[16] Lina B. Karam,[16] Karen Nahmod,[4,5] George Makedonas,[4,5] Emily M. Mace,[4,5] Hanne S. Sorte,[7] Gari Perminow,[17] V. Koneti Rao,[12] Michael P. O'Connell,[1] Susan Price,[12] Helen C. Su,[10] Morgan Butrick,[12] Joshua McElwee,[18] Jason D. Hughes,[18] Joseph Willet,[9] David Swan,[9] Yaobo Xu,[19] Mauro Santibanez-Koref,[19] Voytek Slowik,[20] Darrell L. Dinwiddie,[21,22] Christina E. Ciaccio,[23] Carol J. Saunders,[21,24,25] Seth Septer,[26] Stephen F. Kingsmore,[21,24,25] Andrew J. White,[2] Andrew J. Cant,[4,25] Sophie Hambleton,[9,25] and Megan A. Cooper[4,27]


Science AAAS

IMMUNODEFICIENCIES

HEM1 deficiency disrupts mTORC2 and F-actin control in inherited immunodysregulatory disease

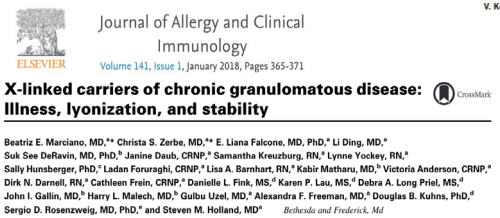
Sarah A. Cook[1†], William A. Comrie[1,2†], M. Cecilia Poli[3-4,5], Morgan Similuk[6], Andrew J. Oler[7], Aiman J. Faruqi[1], Douglas B. Kuhns[8], Sheng Yang[9], Alexander Vargas-Hernández[3,4], Alexandre F. Carisey[3,4], Benjamin Fournier[10,11], D. Eric Anderson[12], Susan Price[13], Margery Smelkinson[3,4], Wadih Abou Chahla[10], Lisa R. Forbes[3,4], Emily M. Mace[10], Tram N. Cao[3,4], Zeynep H. Coban-Akdemir[17,18], Shalini N. Jhangiani[18,19], Donna M. Muzny[18,19], Richard A. Gibbs[17,18,19], James R. Lupski[17,18,19], Jordan S. Orange[20], Geoffrey D. E. Cuvelier[21], Meza Al Hassani[21], Nawal Al Kaabi[21], Zain Al Yafei[21], Soma Jyonouchi[22,23], Nikita Raje[24,25], Jason W. Caldwell[26], Yanping Huang[27,28], Janis K. Burkhardt[27], Sylvain Latour[10,11], Baoyu Chen[9], Gehad ElGhazali[21], V. Koneti Rao[13], Ivan K. Chinn[3,4], Michael J. Lenardo[1†]


Science

AUTOIMMUNE DISEASE

Patients with LRBA deficiency show CTLA4 loss and immune dysregulation responsive to abatacept therapy

Bernice Lo,[1,2*] Kejian Zhang,[3*] Wei Lu,[1,2] Lixin Zheng,[1,2] Qian Zhang,[2,4] Chrysi Kanellopoulou,[1,2] Yu Zhang,[2,4] Zhiduo Liu,[2] Jill M. Fritz,[1,2] Rebecca Marsh,[6] Ammar Husami,[2] Diane Kissell,[2] Shannon Nortman,[2] Vijaya Chaturvedi,[6] Hilary Haines,[7] Lisa R. Young,[8] Jun Mo,[9] Alexandra H. Filipovich,[6] Jack J. Bleesing,[6] Peter Mustillo,[10] Michael Stephens,[11] Cesar M. Rueda,[12] Claire A. Chougnet,[12] Kasper Hoebe,[12] Joshua McElwee,[13] Jason D. Hughes,[13] Elif Karakoc-Aydiner,[14] Helen F. Matthews,[1,2] Susan Price,[1,2] Helen C. Su,[2,4] V. Koneti Rao,[1,2] Michael J. Lenardo,[1,2†] Michael B. Jordan[6,12†‡]


Journal of Allergy and Clinical Immunology

Volume 141, Issue 1, January 2018, Pages 365-371

X-linked carriers of chronic granulomatous disease: Illness, lyonization, and stability

Beatriz E. Marciano, MD,[a*] Christa S. Zerbe, MD,[a*] E. Liana Falcone, MD, PhD,[a] Li Ding, MD,[a] Suk See DeRavin, MD, PhD,[a] Janine Daub, CRNP,[a] Samantha Kreuzburg, RN,[a] Lynne Yockey, RN,[a] Sally Hunsberger, PhD,[c] Ladan Fouraghi, CRNP,[a] Lisa A. Barnhart, RN,[a] Kabir Matharu, MD,[b] Victoria Anderson, CRNP,[a] Dirk N. Darnell, RN,[a] Cathleen Frein, CRNP,[a] Danielle L. Fink, MS,[d] Karen P. Lau, MS,[d] Debra A. Long Priel, MS,[d] John I. Gallin, MD,[b] Harry L. Malech, MD,[b] Gulbu Uzel, MD,[a] Alexandra F. Freeman, MD,[a] Douglas B. Kuhns, PhD,[d] Sergio D. Rosenzweig, MD, PhD,[a] and Steven M. Holland, MD[a]

Bethesda and Frederick, Md

NIAID

Inflammatory Bowel Disease

Broad spectrum of basic and clinical studies on the immune system governing the mucosal surface

Patient Recruitment

An Open-Label, Phase I/II Pilot Study to Assess the Safety and Tolerability of Vorinostat for the Treatment of Moderate-to-Severe Crohn's Disease

Do you have uncontrolled Crohn's disease?

JCI The Journal of Clinical Investigation

Loss-of-function CARD8 mutation causes NLRP3 inflammasome activation and Crohn's disease

Liming Mao,[1] Atsushi Kitani,[1] Morgan Similuk,[2] Andrew J. Oler,[3] Lindsey Albenberg,[4] Judith Kelsen,[4] Atiye Aktay,[5] Martha Quezado,[6] Michael Yao,[1,7] Kim Montgomery-Recht,[8] Ivan J. Fuss,[1] and Warren Strober[1]

JCI The Journal of Clinical Investigation

Bruton tyrosine kinase deficiency augments NLRP3 inflammasome activation and causes IL-1β–mediated colitis

Liming Mao, … , Adrian Wiestner, Warren Strober

J Clin Invest. 2020;130(4):1793-1807. https://doi.org/10.1172/JCI128322.

Journal of Clinical Immunology (2019) 39:653–667
https://doi.org/10.1007/s10875-019-00659-8

ORIGINAL ARTICLE

Check for updates

Chronic Granulomatous Disease-Associated IBD Resolves and Does Not Adversely Impact Survival Following Allogeneic HCT

Rebecca A. Marsh[1] · Jennifer W. Leiding[2] · Brent R. Logan[3] · Linda M. Griffith[4] · Danielle E. Arnold[5] · Elie Haddad[6] · E. Liana Falcone[7] · Ziyan Yin[3] · Kadam Patel[3] · Erin Arbuckle[8] · Jack J. Bleesing[1] · Kathleen E. Sullivan[5] · Jennifer Heimall[5] · Lauri M. Burroughs[9] · Suzanne Skoda-Smith[10] · Shanmuganathan Chandrakasan[11] · Lolie C. Yu[12] · Benjamin R. Oshrine[13] · Geoffrey D. E. Cuvelier[14] · Monica S. Thakar[15] · Karin Chen[16] · Pierre Teira[17] · Shalini Shenoy[18] · Rachel Phelan[19] · Lisa R. Forbes[20] · Deepak Chellapandian[21] · Blachy J. Dávila Saldaña[22] · Ami J. Shah[23] · Katja G. Weinacht[24] · Avni Joshi[25] · Farid Boulad[26] · Troy C. Quigg[27] · Christopher C. Dvorak[28] · Debi Grossman[29] · Troy Torgerson[30] · Pamela Graham[29] · Vinod Prasad[31] · Alan Knutsen[32] · Hey Chong[33] · Holly Miller[34] · M. Teresa de la Morena[35] · Kenneth DeSantes[36] · Morton J. Cowan[28] · Luigi D. Notarangelo[37] · Donald B. Kohn[38] · Elizabeth Stenger[39] · Sung-Yun Pai[40] · John M. Routes[41] · Jennifer M. Puck[28] · Neena Kapoor[42] · Michael A. Pulsipher[42] · Harry L. Malech[29] · Suhag Parikh[43] · Elizabeth M. Kang[29] · submitted on behalf of the Primary Immune Deficiency Treatment Consortium

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Autoimmune Lymphoproliferative Syndrome (ALPS)

- **Lymphoproliferation**
  - Lymph nodes, liver, spleen
- **Autoimmune sequelae**
  - Hemolytic anemia
  - Thrombocytopenia
- 25 year long ongoing study of ALPS patients


blood

Natural history of autoimmune lymphoproliferative syndrome associated with *FAS* gene mutations

Susan Price,[1] Pamela A. Shaw,[2] Amy Seitz,[3] Gyan Joshi,[4] Joie Davis,[1] Julie E. Niemela,[5] Katie Perkins,[6] Ronald L. Hornung,[6] Les Folio,[7] Philip S. Rosenberg,[8] Jennifer M. Puck,[9] Amy P. Hsu,[3] Bernice Lo,[1] Stefania Pittaluga,[10] Elaine S. Jaffe,[10] Thomas A. Fleisher,[5] V. Koneti Rao,[1] and Michael J. Lenardo[1]


frontiers in Immunology

Paradoxical CD4 Lymphopenia in Autoimmune Lymphoproliferative Syndrome (ALPS)

Andrea Lisco[1], Chun-Shu Wong[1], Susan Price[2], Peiying Ye[1], Julie Niemela[3], Megan Anderson[1], Elizabeth Richards[1], Maura Manion[1], Harry Mystakelis[1], Morgan Similuk[4], Bernice Lo[5], Jennifer Stoddard[3], Sergio Rosenzweig[3], Christophe Vanpouille[6], Adam Rupert[7], Irina Maric[8], Ainhoa Perez-Diez[1], David Parenti[9], Peter D. Burbelo[10], V. Koneti Rao[2] and Irini Sereti[1]*

Autoimmune polyendocrinopathy-candidiasis-ectodermal dystrophy (APECED)

- Monogenic disorder caused by *AIRE* mutations resulting in:
  - chronic yeast infections
  - **autoimmunity** to organs (endocrine system, lungs, etc.)
- Largest single center cohort of patients in the world

SCIENCE TRANSLATIONAL MEDICINE | RESEARCH ARTICLE

AUTOIMMUNITY

Lymphocyte-driven regional immunopathology in pneumonitis caused by impaired central immune tolerance

Elise M. N. Ferré[1], Timothy J. Break[1]*, Peter D. Burbelo[2]*, Michael Allgäuer[3,4], David E. Kleiner[3], Dakai Jin[5], Ziyue Xu[5], Les R. Folio[5], Daniel J. Mollura[5], Muthulekha Swamydas[1], Wenjuan Gu[6], Sally Hunsberger[6], Chyi-Chia R. Lee[3], Anamaria Bondici[1], Kevin W. Hoffman[7], Jean K. Lim[7], Kerry Dobbs[8], Julie E. Niemela[9], Thomas A. Fleisher[9], Amy P. Hsu[10], Laquita N. Snow[1], Dirk N. Darnell[1], Samar Ojaimi[11,12], Megan A. Cooper[13], Martin Bozzola[14], Gary I. Kleiner[15], Juan C. Martinez[16], Robin R. Deterding[17], Douglas B. Kuhns[18], Theo Heller[19], Karen K. Winer[20], Arun Rajan[21], Steven M. Holland[10], Luigi D. Notarangelo[8], Kevin P. Fennelly[22], Kenneth N. Olivier[22], Michail S. Lionakis[1†]

Science AAAS

Aberrant type 1 immunity drives susceptibility to mucosal fungal infections

Timothy J. Break*, Vasileios Oikonomou*, Nicolas Dutzan, Jigar V. Desai, Marc Swidergall, Tilo Freiwald, Daniel Chauss, Oliver J. Harrison, Julie Alejo, Drake W. Williams, Stefania Pittaluga, Chyi-Chia R. Lee, Nicolas Bouladoux, Muthulekha Swamydas, Kevin W. Hoffman, Teresa Greenwell-Wild, Vincent M. Bruno, Lindsey B. Rosen, Wint Lwin, Andy Renteria, Sergio M. Pontejo, John P. Shannon, Ian A. Myles, Peter Olbrich, Elise M. N. Ferré, Monica Schmitt, Daniel Martin, Genomics and Computational Biology Core, Daniel L. Barber, Norma V. Solis, Luigi D. Notarangelo, David V. Serreze, Mitsuru Matsumoto, Heather D. Hickman, Philip M. Murphy, Mark S. Anderson, Jean K. Lim, Steven M. Holland, Scott G. Filler, Behdad Afzali, Yasmine Belkaid, Niki M. Moutsopoulos, Michail S. Lionakis†

Autoinflammatory Diseases

- Clinical and translational studies in children with autoinflammatory diseases
  - NOMID/CAPS
  - DIRA
  - CANDLE
  - SAVI
  - NLRC4-MAS
  - Still's-like diseases
  - Undifferentiated

- Identifying novel diseases and treatments

JAK1/2 inhibition with baricitinib in the treatment of autoinflammatory interferonopathies

Gina A. Montealegre Sanchez, … , William L. Macias, Raphaela Goldbach-Mansky

J Clin Invest. 2018;128(7):3041-3052. https://doi.org/10.1172/JCI98814.

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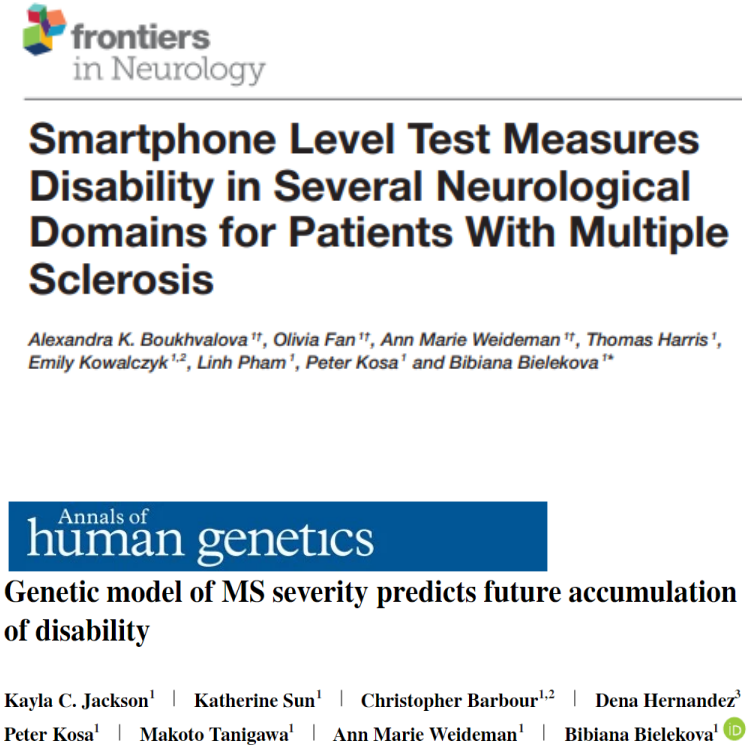
Multiple Sclerosis (MS)

Data-driven machine learning approaches in the diagnosis and treatment of MS

Targeting Residual Activity By Precision, Biomarker-Guided Combination Therapies of MS (TRAP-MS) trial (NCT03109288)


frontiers in Neurology

Smartphone Level Test Measures Disability in Several Neurological Domains for Patients With Multiple Sclerosis

Alexandra K. Boukhvalova [†‡], Olivia Fan [†‡], Ann Marie Weideman [†‡], Thomas Harris [‡], Emily Kowalczyk [‡,2], Linh Pham [‡], Peter Kosa [‡] and Bibiana Bielekova [†]*

Annals of human genetics

Genetic model of MS severity predicts future accumulation of disability

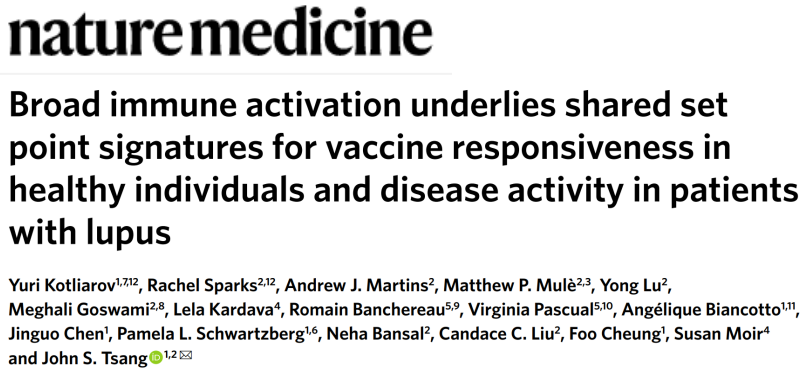
Kayla C. Jackson[1] | Katherine Sun[1] | Christopher Barbour[1,2] | Dena Hernandez[3] | Peter Kosa[1] | Makoto Tanigawa[1] | Ann Marie Weideman[1] | Bibiana Bielekova[1]

NIH National Institute of Allergy and Infectious Diseases

NIAID

Lupus

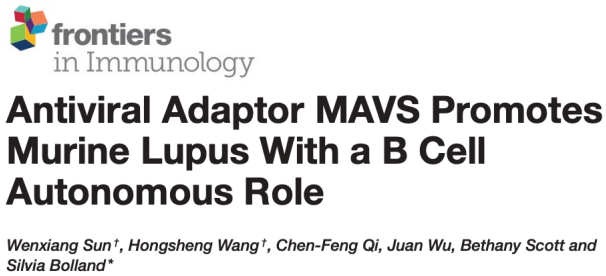
- Using newest advances to generate individualized predictions of disease risk and intervention efficacy
- Model for SLE in mice
  - Manipulates model to understand cellular mechanisms that induce pathology,
  - Identify new genes as therapeutic targets



nature medicine

Broad immune activation underlies shared set point signatures for vaccine responsiveness in healthy individuals and disease activity in patients with lupus

Yuri Kotliarov[1,7,12], Rachel Sparks[2,12], Andrew J. Martins[2], Matthew P. Mulè[2,3], Yong Lu[2], Meghali Goswami[2,8], Lela Kardava[4], Romain Banchereau[5,9], Virginia Pascual[5,10], Angélique Biancotto[1,11], Jinguo Chen[1], Pamela L. Schwartzberg[1,6], Neha Bansal[2], Candace C. Liu[2], Foo Cheung[1], Susan Moir[4] and John S. Tsang[1,2]



frontiers in Immunology

Antiviral Adaptor MAVS Promotes Murine Lupus With a B Cell Autonomous Role

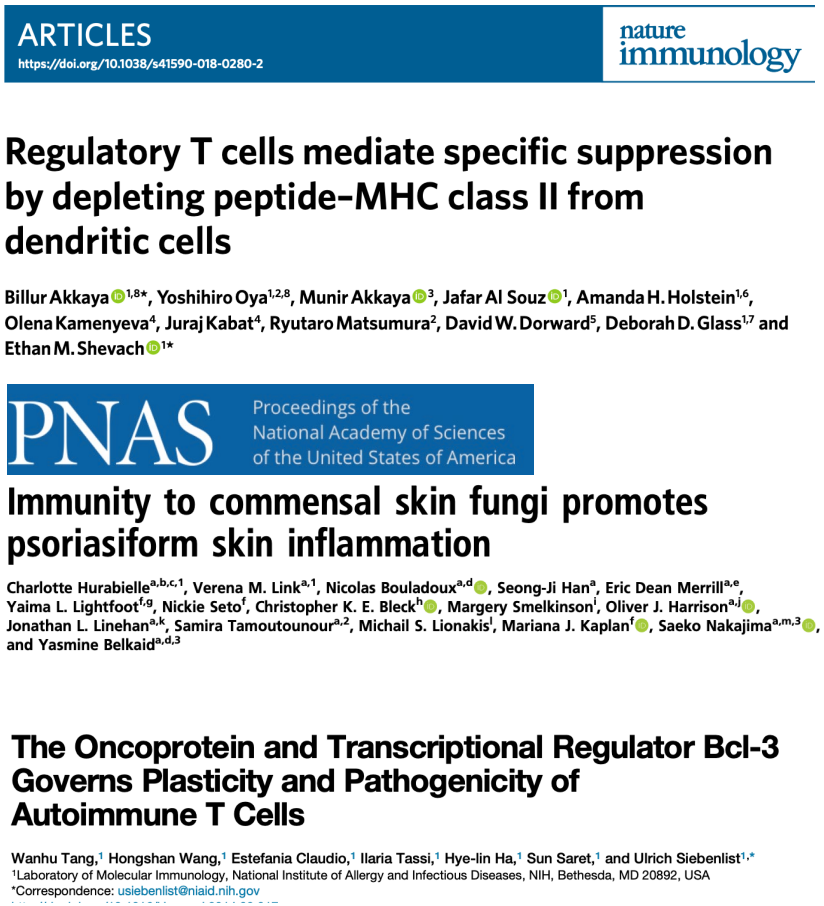
*Wenxiang Sun†, Hongsheng Wang†, Chen-Feng Qi, Juan Wu, Bethany Scott and Silvia Bolland**

NIH National Institute of Allergy and Infectious Diseases

NIAID

Fundamental Studies of Immunity

- NIAID DIR Centers provide support for research:
- Center for Human Immunology, Autoimmunity, and Inflammation (CHI)
- Center for Advanced Tissue Imaging (CAT-I)
- NIAID Microbiome Program



ARTICLES
https://doi.org/10.1038/s41590-018-0280-2
nature immunology

Regulatory T cells mediate specific suppression by depleting peptide–MHC class II from dendritic cells

Billur Akkaya[1,8*], Yoshihiro Oya[1,2,8], Munir Akkaya[3], Jafar Al Souz[1], Amanda H. Holstein[1,6], Olena Kamenyeva[4], Juraj Kabat[4], Ryutaro Matsumura[2], David W. Dorward[5], Deborah D. Glass[1,7] and Ethan M. Shevach[1*]

PNAS Proceedings of the National Academy of Sciences of the United States of America

Immunity to commensal skin fungi promotes psoriasiform skin inflammation

Charlotte Hurabielle[a,b,c,1], Verena M. Link[a,1], Nicolas Bouladoux[a,d], Seong-Ji Han[a], Eric Dean Merrill[a,e], Yaima L. Lightfoot[f,g], Nickie Seto[f], Christopher K. E. Bleck[h], Margery Smelkinson[i], Oliver J. Harrison[a,j], Jonathan L. Linehan[a,k], Samira Tamoutounour[a,2], Michail S. Lionakis[l], Mariana J. Kaplan[f], Saeko Nakajima[a,m,3], and Yasmine Belkaid[a,d,3]

The Oncoprotein and Transcriptional Regulator Bcl-3 Governs Plasticity and Pathogenicity of Autoimmune T Cells

Wanhu Tang,[1] Hongshan Wang,[1] Estefania Claudio,[1] Ilaria Tassi,[1] Hye-lin Ha,[1] Sun Saret,[1] and Ulrich Siebenlist[1,*]
[1]Laboratory of Molecular Immunology, National Institute of Allergy and Infectious Diseases, NIH, Bethesda, MD 20892, USA
*Correspondence: usiebenlist@niaid.nih.gov

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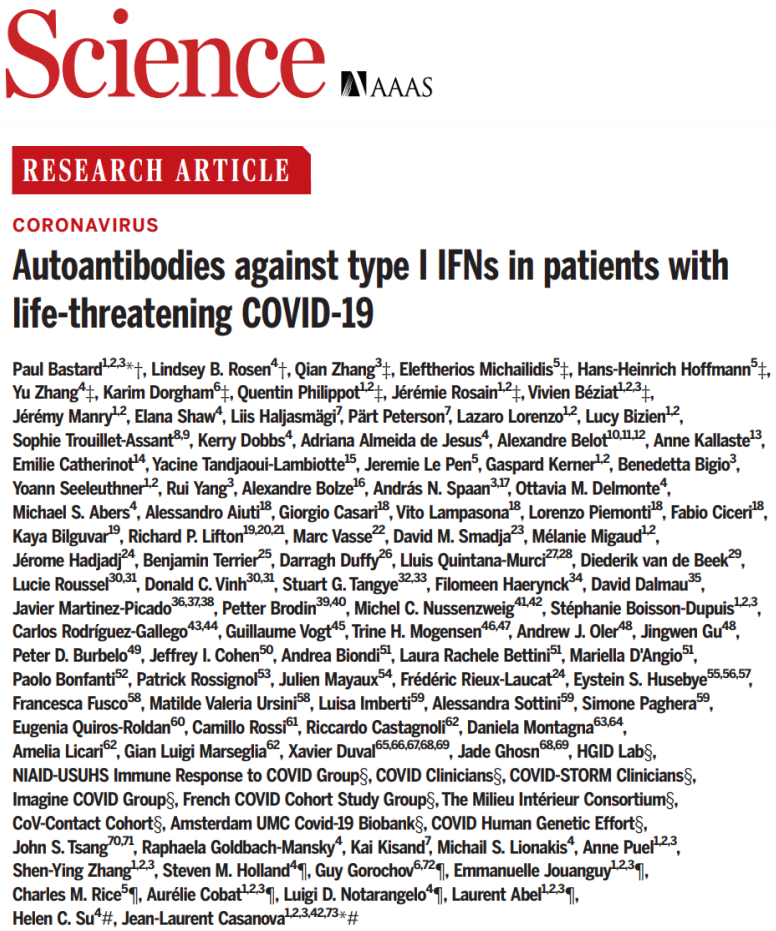
NIAID

DIR Program Highlights

COVID-19 Research

Anticytokine Autoantibodies in COVID-19

- ~1000 patients with life-threatening COVID-19 pneumonia
- >10% of severe COVID patients have autoantibodies to cytokines
- Predominantly in men



Science AAAS

RESEARCH ARTICLE

CORONAVIRUS

Autoantibodies against type I IFNs in patients with life-threatening COVID-19

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NIAID

Multisystem Inflammatory Syndrome in Children (MIS-C)

Trans-NIH effort

Ongoing clinical studies

- Longitudinal observational study of neutralizing antibodies, biomarkers, and transcriptional signatures in MIS-C
- Mechanisms of immune dysregulation that trigger MIS-C
- Characterization of mucosal oropharyngeal immune responses to SARS-CoV-2 in children
- Immunological characteristics of MIS-C patients from Italy, Chile, Israel, and US
- Assessment of autoantibody presence and function

Post-Acute COVID Syndrome

- Longitudinal study of COVID-19 sequelae and immunity in adults at NIH Clinical Center (NCT04411147)
- Longitudinal Study of COVID-19 sequelae and immunity in Italian patient cohorts
- Longitudinal COVID-19 studies in children
    - Will soon launch clinical study of 1000 children recovering from COVID-19 ranging from asymptomatic disease to MIS-C

Pre-existing Autoimmune Diseases

- SARS-CoV-2 nationwide serosurvey in people living with rare diseases who are part of the Rare Disease Clinical Research Network (NIAID, NCI, NCATS, NIBIB)
- Longitudinal study of COVID-19 sequelae and immunity in Italy would capture changes in disease state of patients with ITP and other diseases

DIR Autoimmunity Research Gaps:

Immediate need: COVID-19

- Vaccination efficacy in individuals with immune dysregulation
- Study of allergic responses to vaccination

Long-term needs:

- Recruitment and retention
- Augment pre-clinical research program
- Increased access to genetic, computational biology and machine learning approaches