

ELSEVIER
SAUNDERS

EDWARD D. HARRIS, JR.
RALPH C. BUDD
GARY S. FIRESTEIN
MARK C. GENOVESE
JOHN S. SERGENT
SHAUN RUDDY
CLEMENT B. SLEDGE

KELLEY'S TEXTBOOK OF
RHEUMATOLOGY



Volume **II**

SEVENTH EDITION

Kelley's

T E X T B O O K O F

Rheumatology

EDITORS

Edward D. Harris, Jr., MD
 George DeForest Barnett Professor
 of Medicine, Emeritus
 Stanford University School of
 Medicine
 Academic Secretary to Stanford
 University
 Stanford, California

Ralph C. Budd, MD
 Professor of Medicine
 Chief of Clinical Services
 Division of Immunology and
 Rheumatology
 University of Vermont College of
 Medicine
 Burlington, Vermont

Mark C. Genovese, MD
 Associate Professor of Medicine
 Chief of Clinical Services
 Division of Immunology and
 Rheumatology
 Stanford University
 Stanford, California



Gary S. Firestein, MD
 Professor of Medicine
 Chief, Division of Rheumatology,
 Allergy and Immunology
 University of California, San Diego
 School of Medicine
 La Jolla, California

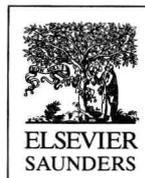
John S. Sargent, MD
 Professor of Medicine and
 Senior Associate Dean for
 Clinical Affairs
 Vanderbilt University School of
 Medicine
 Chief Medical Officer
 Vanderbilt University Medical
 Center
 Nashville, Tennessee

Clement B. Sledge, MD

John B. and Buckminster Brown
 Professor Emeritus of
 Orthopedic Surgery
 Harvard Medical School
 Chairman Emeritus, Department
 of Orthopedic Surgery
 Brigham and Women's Hospital
 Boston, Massachusetts

**ELECTRONIC
EDITOR****Shaun Ruddy, MD**

Elam C. Toone Professor Emeritus
 of Internal Medicine,
 Microbiology and Immunology
 Chairman Emeritus, Division of
 Rheumatology, Allergy, and
 Immunology
 Department of Internal Medicine
 Virginia Commonwealth University
 School of Medicine
 Richmond, Virginia



**ELSEVIER
SAUNDERS**

The Curtis Center
170 S Independence Mall W 300 E
Philadelphia, Pennsylvania 19106

Kelley's Textbook of Rheumatology, Seventh
Edition

ISBN: 0-7216-0141-3

Copyright © 2005, Elsevier. All rights reserved.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Permissions may be sought directly from Elsevier's Health Sciences Rights Department in Philadelphia, PA, USA: phone: (+1) 215 238 7869, fax: (+1) 215 238 2239, e-mail: healthpermissions@elsevier.com. You may also complete your request on-line via the Elsevier Science homepage (<http://www.elsevier.com>), by selecting 'Customer Support' and then 'Obtaining Permissions'.

Notice

Surgery is an ever-changing field. Standard safety precautions must be followed, but as new research and clinical experience broaden our knowledge, changes in treatment and drug therapy may become necessary or appropriate. Readers are advised to check the most current product information provided by the manufacturer of each drug to be administered to verify the recommended dose, the method and duration of administration, and contraindications. It is the responsibility of the licensed prescriber, relying on experience and knowledge of the patient, to determine dosages and the best treatment for each individual patient. Neither the publisher nor the author assumes any liability for any injury and/or damage to persons or property arising from this publication.

Previous editions copyrighted 1981, 1985, 1989, 1993, 1997, 2001

International Standard Book Number: 0-7216-0141-3

Library of Congress Cataloging-in-Publication Data

Kelley's textbook of rheumatology / edited by Edward D. Harris, Jr. ...[et al.].--7th ed.
p.; cm.

Includes bibliographical references and index.

ISBN 0-7216-0141-3

I. Rheumatism. 2. Arthritis. I. Title: Textbook of rheumatology. II. Harris, Edward D., 1937-III. Kelley, William N., 1939-

[DNLM: 1. Rheumatic Diseases. 2. Arthritis. WE 544 K29 2005]

RC927.T49 2005

616.7'23—dc22

2004052586

Printed in the United States

Last digit is the print number: 9 8 7 6 5 4 3 2

Kelley's

T E X T B O O K O F

Rheumatology

The editors are proud to dedicate this seventh edition of Textbook of Rheumatology to our mentors, colleagues in research and the clinics, and family and loved ones. Our mentors showed us the way, giving us focus and a sense of what questions were truly important to answer. Our colleagues amplified our work, gave us course correction, and through their own hard efforts and successes, invigorated our own efforts. To our wives and loved ones (including those dear children and grandkids) we owe deep and abundant thanks for nurture and sustenance in good times and, especially, on those days when all seems bleak. We all agree that we would choose the paths we have taken once again, so long as those mentioned above would be there to join us.

Ted Harris: Many thanks to my mentor, Steve Krane, and for the support of the Harris boys and Eileen...and for the happy smiles of the grandkids—Andrew, Eliza, Maeve, and Liam.

Ralph C. Budd: Sincere thanks to the kind mentoring from Edward D. Harris, Jr., H. Robson MacDonald, and C. Garrison Fathman, as well as to the support of my wife, Lenore, and my children, Graham and Laura.

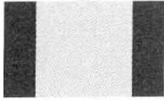
Gary S. Firestein: Thanks to Linda and our children, David and Cathy, for their patience and support, as well as to Nathan Zvaifler for his guidance for over two decades.

Mark C. Genovese: To my wife Nancy and our daughters, Alexandra, Danielle, and Lauren, for their patience and support, and to Ted Harris for his guidance and mentorship.

Shaun Ruddy: To my wife, Millie; our children, Christi and Candace; and our grandchildren, Kevin, Matthew and Katharine.

John S. Sergent: To Carole and our children, Ellen and Katie, and to our grandchildren, Kathryn, Henry, and Emmaline.

Clement Sledge: To my wife, Georgia; our children, Mego, John, Matthew, and Claire; and our grandchildren, Matthew, Kaitlyn, Kevin, and Brian Tracy; Alexa and Jake Sledge; and Mollie, Reid, and Elsa Smith.



Contributors

Anthony J. Abene, M.D., M.B.A.

Fellow
Sports, Orthopaedics and Rehabilitation
Redwood City, California
Hip and Knee Pain

Steven B. Abramson, M.D.

Professor of Medicine and Pathology
New York University School of Medicine
Division of Rheumatology
New York, New York
Neutrophils and Eosinophils; Pathogenesis of Osteoarthritis

Leena Ala-Kokko

Professor, Department of Medicine
Center for Gene Therapy
Tulane University Health Sciences Center
New Orleans, Louisiana
Collagen and Elastin

Roy D. Altman, M.D.

Professor of Medicine
Division of Rheumatology
David Geffen School of Medicine at the
University of California at Los Angeles
Los Angeles, California
Hypertrophic Osteoarthropathy

William P. Arend, M.D.

Scoville Professor of Rheumatology Medicine
University of Colorado School of Medicine
Denver, Colorado
Antigen-Presenting Cells

Erin L. Arnold, M.D.

Rheumatologist
Center for Arthritis and Osteoporosis
Illinois Bone and Joint Institute, LTD
Morton Grove, Illinois
Arthroscopy

William J. Arnold, M.D., F.A.C.P., F.A.C.R.

Rheumatologist
Center for Arthritis and Osteoporosis
Illinois Bone and Joint Institute, LTD
Morton Grove, Illinois
Arthroscopy

Leyla Alparslan, M.D.

Associate Professor
Department of Radiology
Florence Nightingale Hospital
Kadir Has University School of Medicine
Istanbul, Turkey
Imaging

John P. Atkinson, M.D.

Samuel B. Grant Professor of Medicine
Professor of Molecular Microbiology
Department of Medicine/Rheumatology Division
Washington University School of Medicine
Physician
Internal Medicine
Barnes-Jewish Hospital
St. Louis, Missouri
Complement System

Stanley P. Ballou, M.D.

Associate Professor of Medicine
Case Western Reserve University
Director of Rheumatology
Metro Health Medical Center
Cleveland, Ohio
Laboratory Evaluation of Inflammation

N. Nichole Barry, M.D.

Sports Medicine
Stanford University
Palo Alto, California
Hip and Knee Pain

Robert M. Bennett, M.D., FRCP, FACP

Professor of Medicine
Oregon Health and Science University
and Portland, Oregon
*Mixed Connective Tissue Disease and Other Overlap
Syndromes*

Johannes W.J. Bijlsma, M.D., Ph.D.

Professor and Head
Department of Rheumatology and Clinical
Immunology
University Medical Center Utrecht
Utrecht, The Netherlands
Glucocorticoid Therapy

Joseph J. Biundo, Jr., M.D.
Emeritus Professor of Medicine
Louisiana State University Health Science Center
New Orleans, Louisiana
Medical Director of Rehabilitation
Kenner Regional Medical Center
Kenner, Louisiana
Rehabilitation of Patients with Rheumatic Diseases

Juergen Braun, M.D., Ph.D.
Medical Director
Professor of Rheumatology
Rheumazentrum Ruhrgebiet
Herne, Germany
Ankylosing Spondylitis

Michael B. Brenner, M.D.
Theodore B. Bayles Professor of Medicine
Harvard Medical School
Chief, Division of Rheumatology, Immunology and
Allergy
Brigham and Women's Hospital
Boston, Massachusetts
Synoviocytes

Doreen B. Brettler, M.D.
Professor of Medicine
University of Massachusetts Medical School
Director
New England Hemophilia Center/Staff Hematologist
Hematology/Oncology
University of Massachusetts Memorial Healthcare
Worcester, Massachusetts
Hemophilic Arthropathy

Lenore M. Buckley, M.D., M.P.H.
Professor of Internal Medicine and Pediatrics
Virginia Commonwealth University School of
Medicine
Attending Physician
Internal Medicine and Pediatrics
Medical College of Virginia Hospitals
Richmond, Virginia
Development, Execution, and Analysis of Clinical Trials

Ralph C. Budd, M.D.
Professor of Medicine
Director, Immunobiology Program
The University of Vermont College of Medicine
Burlington, Vermont
T Lymphocytes

Nathalie D. Burg, M.D.
Postdoctoral Fellow
Coller Lab
Rockefeller University
Clinical Instructor
Department of Medicine
New York University School of Medicine
New York, New York
Neutrophils and Eosinophils

Jennifer Burkham, M.D., Ph.D.
Department of Rheumatology
University of California, San Francisco
San Francisco, California
Fibromyalgia: A Chronic Pain Syndrome

Leonard H. Calabrese, B.S., D.O.
Department of Rheumatic and Immunologic Disease
Head, Section of Clinical Immunology
R.J. Fasenmyer Chair of Clinical Immunology
Cleveland Clinic Foundation
Cleveland, Ohio
Antineutrophil Cytoplasmic Antibody-Associated Vasculitis

Dennis A. Carson, M.D.
Professor of Medicine
University of California San Diego
La Jolla, California
Rheumatoid Factor

Steve Carsons, M.D.
Professor of Medicine
SUNY Health Science Center at Stony Brook
Stony Brook, New York
Chief, Division of Rheumatology, Allergy and
Immunology
Winthrop University Hospital
Meneola, New York
Sjögren's Syndrome

James T. Cassidy, M.D.
Professor and Chief of Pediatric Rheumatology
Department of Child Health
University of Missouri Health Sciences
Columbia, Missouri
*Juvenile Rheumatoid Arthritis; Systemic Lupus
Erythematosus, Juvenile Dermatomyositis, Scleroderma,
and Vasculitis*

Eliza F. Chakravarty, M.D.
Assistant Professor
Division of Immunology and Rheumatology
Stanford University School of Medicine
Palo Alto, California
Musculoskeletal Syndromes in Malignancy

Doyt L. Conn, M.D.
Professor of Medicine
Director Division of Rheumatology
Department of Medicine
Emory University School of Medicine
Grady Health System
The Emory Clinic
Atlanta, Georgia
*Alternative Care for Arthritis and Related Musculoskeletal
Diseases; Cutaneous Small-Vessel Vasculitis*

Paul P. Cook, M.D.

Associate Professor of Medicine
 Division of Infectious Diseases
 Department of Infectious Diseases
 Department of Internal Medicine
 Brody School of Medicine at East Carolina University
 Greenville, North Carolina
Arthritis Caused by Bacteria or Their Components

Joseph E. Craft, M.D.M.D.

Professor of Medicine and Immunobiology
 Chief, Section of Rheumatology
 Department of Medicine
 Yale School of Medicine
 Attending and Chief of Rheumatology
 Yale-New Haven Hospital
 New Haven, Connecticut
Antinuclear Antibodies

Leslie J. Crofford, M.D.

Associate Professor
 Internal Medicine, Division of Rheumatology
 University of Michigan
 Ann Arbor, Michigan
Nonsteroidal Anti-Inflammatory Drugs

Jody A. Dantzig, Ph.D.

Senior Research Investigator
 Physiology/Pennsylvania Muscle Institute
 School of Medicine
 University of Pennsylvania
 Philadelphia, Pennsylvania
Muscle: Anatomy, Physiology, and Biochemistry

Devin K. Datta, M.D.

Brevard Orthopaedic Clinic
 Melbourne, Florida
Low Back Pain

Jeroen DeGroot, Ph.D.

Head
 Matrix Biology Research Group
 Division of Biomedical Research
 TNO Prevention and Health
 Netherlands Organization for Applied Scientific
 Research
 Leiden, the Netherlands
Biological Markers

Betty Diamond, M.D.

Professor of Microbiology and Immunology, Medicine
 Albert Einstein College of Medicine
 Bronx, New York
B Cells

Federico Díaz-González, M.D.

Staff of Rheumatology
 Rheumatology Service
 Hospital Universitario de Canarias
 La Laguna, Spain
Platelets and Rheumatic Diseases

Paul E. DiCesare, M.D.

Associate Professor of Orthopaedic Surgery and Cell
 Biology
 New York University School of Medicine
 Director, Musculoskeletal Research Center
 Chief, Adult Reconstructive Surgery
 Hospital for Joint Disease
 New York, New York
Pathogenesis of Osteoarthritis

Michael F. Dillingham, M.D.

Adjunct Clinical Professor
 Division of Orthopedic Surgery
 Stanford University School of Medicine
 Director and Team Physician
 Orthopedics
 Stanford University Medical Center
 San Francisco, California
Hip and Knee Pain

Maxime Dougados, M.D.

Professor of Rheumatology
 René (') Descartes University
 Chief and Professor
 Department of Rheumatology
 Hospital Cochin
 Paris, France
Clinical Features of Osteoarthritis

Joost P.H. Drenth, M.D., Ph.D.

Research Fellow
 Department of Medicine
 Division of Gastroenterology and Hepatology
 University Medical Center St. Radboud
 Nijmegen, The Netherlands
Familial Autoinflammatory Syndromes

George F. Duna, M.D., F.A.C.P.

Associate Professor of Medicine
 Baylor College of Medicine
 Chief of Rheumatology
 St. Luke's Episcopal Hospital
 Houston, Texas
Antineutrophil Cytoplasmic Antibody-Associated Vasculitis

Steven M. Edworthy, B.Sc., M.D., F.R.C.P.C.

Associate Professor of Medicine and Community
 Health Sciences
 Department of Medicine
 University of Calgary
 Associate Professor of Medicine
 Foothills Hospital
 Calgary, Alberta, Canada
Clinical Manifestations of Systemic Lupus Erythematosus

Keith B. Elkon, M.D.

Professor of Medicine
 Division of Rheumatology
 University of Washington
 Seattle, Washington
Apoptosis

Peng Thim Fan, M.D.

Clinical Professor of Medicine
David Geffen School of Medicine
University of California at Los Angeles
Los Angeles, California
*Reiter's Syndrome, Undifferentiated Spondyloarthropathy,
and Reactive Arthritis*

Barbara K. Finck, M.D.

Vice President
Clinical Development
Eos Biotechnology, Inc.
San Francisco, California
Development, Execution, and Analysis of Clinical Trials

Gary S. Firestein, M.D.

Professor of Medicine and Chief
Division of Rheumatology, Allergy and Immunology
University of California San Diego School of Medicine
Director
University of California San Diego Clinical
Investigation Institute
La Jolla, California
Etiology and Pathogenesis of Rheumatoid Arthritis

Karen A. Fortner, Ph.D.

Research Associate
Immunobiology Program, Department of Medicine
The University of Vermont College of Medicine
Burlington, Vermont
T Lymphocytes

Andrew G. Franks, Jr., M.D.

Clinical Professor of Dermatology
New York University School of Medicine
Attending Physician in Rheumatology
Hospital for Joint Diseases
New York University Medical Center
New York, New York

The Skin and Rheumatic Diseases

Sherine E. Gabriel, M.D., M.Sc.

Professor of Medicine Rheumatology and
Epidemiology
Mayo Clinic
Chair, Department of Health Sciences Research
Mayo Clinic College of Medicine
Rochester, Minnesota
Epidemiology of the Rheumatic Diseases

Rachel A. Garton, M.D.

Chief Resident in Dermatology
Department of Dermatology
Wake Forest School of Medicine
Winston-Salem, North Carolina
Behcet's Disease

Mark C. Genovese, M.D.

Associate Professor of Medicine
Chief of Clinical Services
Division of Immunology and Rheumatology
Stanford University
Palo Alto, California
*Treatment of Rheumatoid Arthritis; Musculoskeletal
Syndromes in Malignancy*

Danielle M. Gerlag, M.D.

Assistant Professor of Medicine
Division of Clinical Immunology and Rheumatology
Academic Medical Center
University of Amsterdam
Amsterdam, The Netherlands
*Synovial Fluid Analyses, Synovial Biopsy, and Synovial
Pathology*

Jayashri V. Ghatge, M.D.

Department of Dermatology
Wake Forest University School of Medicine
Winston-Salem, North Carolina
Behcet's Disease

Allan Gibofsky, M.D., J.D., F.A.C.P., F.C.L.M.

Professor
Medicine and Public Health
Weill Medical College of Cornell University
Attending Rheumatologist
Hospital for Special Surgery
New York, New York
Acute Rheumatic Fever and Poststreptococcal Arthritis

Mark H. Ginsberg, M.D.

Professor of Cell Biology
The Scripps Research Institute
La Jolla, California
Adjunct Professor
University of California School of Medicine
San Diego, California
Platelets and Rheumatic Diseases

Dafna O. Gladman, M.D., F.R.C.P.C.

Professor of Medicine/Rheumatology
University of Toronto
Senior Rheumatologist
University Health Network, Toronto Western Hospital
Toronto, Ontario, Canada
Psoriatic Arthritis

Joseph Golbus, M.D.

Associate Professor
Department of Medicine
Northwestern University Medical School
Chicago, Illinois
Head, Division of Rheumatology
Evanston Northwestern Healthcare
Evanston, Illinois
Monarticular Arthritis

Yale E. Goldman, M.D., Ph.D.

Professor, Institute Director
Physiology/Pennsylvania Muscle Institute
School of Medicine, University of Pennsylvania
Philadelphia, Pennsylvania
Muscle: Anatomy, Physiology, and Biochemistry

Mary B. Goldring, Ph.D.

Associate Professor of Medicine (Cell Biology)
Division of Medical Sciences
Harvard Medical School
Associate Professor of Medicine
Department of Medicine/Division of Rheumatology
Beth Israel Deaconess Medical Center
Boston, Massachusetts
Biology of the Normal Joint; Chondrocytes

Steven R. Goldring, M.D.

Professor of Medicine
Harvard Medical School
Chief of Rheumatology
Department of Medicine/Division of Rheumatology
Beth Israel Deaconess Medical Center
Boston, Massachusetts
Biology of the Normal Joint

Emilio B. Gonzalez, M.D.

Clinical Associate Professor
Internal Medicine
Emory University School of Medicine
Chief, Rheumatology Section
Atlanta Medical Center
Atlanta, Georgia
Cutaneous Small-Vessel Vasculitis

Duncan A. Gordon, M.D., M.A.C.R.

Professor
Department of Medicine
University of Toronto
Senior Rheumatologist
Division of Rheumatology
University Health Network, Toronto Western Hospital
Toronto, Ontario, Canada
Second Line Agents

Peter K. Gregersen

Professor of Medicine and Pathology
Department of Medicine and Pathology
New York University School of Medicine
New York, New York
Director
Robert S. Boas Center for Genomics and Human
Genetics
North Shore Long Island Jewish Research Institute
Manhasset, New York
Genetics of Rheumatic Diseases

Christine Grimaldi, Ph.D.

Instructor, Microbiology and Immunology
Albert Einstein College of Medicine
Bronx, New York
B Cells

Bevra Hannahs Hahn, M.D.

Chief of Rheumatology and Professor of Medicine
Department of Medicine
David Geffen School of Medicine
University of California, Los Angeles
Los Angeles, California
*Pathogenesis of Systemic Lupus Erythematosus;
Management of Systemic Lupus Erythematosus*

J. Timothy Harrington, M.D.

Associate Professor
Rheumatology Section, Department of Medicine
University of Wisconsin Medical School
Madison, Wisconsin
Mycobacterial and Fungal Infections

Edward D. Harris, M.D.

George DeForest Barnett Professor of Medicine,
Emeritus
Stanford University School of Medicine
Academic Secretary to Stanford University
Stanford, California
*Biological Markers; Fibromyalgia:
A Chronic Pain Syndrome;
Clinical Features of Rheumatoid Arthritis;
Treatment of Rheumatoid Arthritis*

Dick Heinegård, M.D., Ph.D.

Professor
Department of Cell and Molecular Biology
Lund University
Lund, Sweden
Matrix Glycoproteins and Proteoglycans in Cartilage

David B. Hellman, M.D.

Mary Betty Stevens Professor of Medicine
Johns Hopkins University School of Medicine
Chairman and Physician-in-Chief, Department of
Medicine
Johns Hopkins Bayview Medical Center
Baltimore, Maryland
Giant Cell Arteritis and Polymyalgia Rheumatica

George Ho, Jr., M.D.

Professor of Medicine
Division of Allergy, Immunology, and Rheumatology
Department of Internal Medicine
Brody School of Medicine at East Carolina University
Greenville, North Carolina
Arthritis Caused by Bacteria or Their Components

Jeffrey D. Horn, M.D.

Assistant Professor of Ophthalmology
Department of Ophthalmology and Visual Services
Vanderbilt University Medical Center
Nashville, Tennessee
The Eye and Rheumatic Disease

Gene G. Hunder, M.D.

Professor Emeritus
Department of Medicine
Mayo Medical School
Rochester, Minnesota
*History and Physical Examination of the Musculoskeletal
System; Giant Cell Arteritis and Polymyalgia Rheumatica*

Johannes W.G. Jacobs, M.D., Ph.D.

Associate Professor
Department of Rheumatology and Clinical
Immunology
University Medical Center Utrecht
Utrecht, The Netherlands
Glucocorticoid Therapy

Charles A. Janeway, Jr., M.D. (Deceased)

Professor
Section of Immunobiology and Howard Hughes
Medical Institute
Yale University School of Medicine
New Haven, Connecticut
Innate Immunity

Joseph L. Jorizzo, M.D.

Professor and Former (Founding) Chair
Department of Dermatology
Wake Forest University School of Medicine
Winston-Salem, North Carolina
Behcet's Disease

Sue Joan Jue, M.D.

Associate Professor of Pediatrics
Section of Infectious Diseases
Greenville Hospital Systems
Greenville, South Carolina
Arthritis Caused by Bacteria or Their Components

George A. Karpouzas, M.D.

Clinical Instructor, Assistant Researcher
Department of Medicine
David Geffen School of Medicine
University of California, Los Angeles
Los Angeles, California
Pathogenesis of Systemic Lupus Erythematosus

Arthur Kavanaugh, M.D.

Professor of Medicine
Director of the Center for Innovative Therapy
Division of Rheumatology, Allergy and Immunology
University of California, San Diego
San Diego, California
Anticytokine Therapies

William N. Kelley, M.D.

Professor
Department of Medicine
University of Pennsylvania
Philadelphia, Pennsylvania
Gout and Hyperuricemia

Edward Keystone, M.D., F.R.C.P.(C).

Professor of Medicine
Department of Medicine
University of Toronto
Rheumatologist
Mount Sinai Hospital
Toronto, Ontario, Canada
Emerging Therapies in Rheumatoid Arthritis

Hans P. Kiener, M.D.

Research Fellow
Harvard Medical School
Research Fellow
Brigham and Women's Hospital
Boston, Massachusetts
Synoviocytes

Alice V. Klinkhoff, M.D., F.R.C.P.

Clinical Associate Professor
Department of Medicine
University of British Columbia
Medical Director
Mary Pack Arthritis Program
Vancouver General Hospital
Vancouver, British Columbia, Canada
Second Line Agents

Alisa E. Koch, M.D.

William D. Robinson and Frederick Huetwell
Endowed Professor
University of Michigan
Ann Arbor, Michigan
*Endothelial Cell Biology, Angiogenesis, and Recruitment
of Cells*

Joseph H. Korn, M.D.

Alan S. Cohen Professor of Medicine in Rheumatology
Director, Arthritis Center
Boston University School of Medicine
Boston, Massachusetts
Fibroblast Function and Fibrosis

Brian L. Kotzin, M.D.

Professor of Medicine and Immunology
Co-Head, Division of Clinical Immunology
University of Colorado Health Sciences Center
Denver, Colorado
Autoimmunity

Joel M. Kremer, M.D.

Clinical Professor of Medicine
Department of Medicine, Division of Rheumatology
Albany Medical College
Albany, New York
Nutrition and Rheumatic Diseases

Hilal Maradit Kremers, M.D., M.Sc.

Assistant Professor of Epidemiology
Mayo Medical School
Rochester, Minnesota
Research Associate, Department of Health Sciences
Research
Mayo Clinic College of Medicine
Rochester, Minnesota
Epidemiology of the Rheumatic Diseases

Irving Kushner, M.D.

Professor of Medicine and Pathology
Case-Western Reserve University
Attending Physician
MetroHealth Medical Center
Cleveland, Ohio
Laboratory Evaluation of Inflammation

Robert Lafyatis, M.D.

Associate Professor of Medicine
Rheumatology Section
Boston University School of Medicine
Associate Professor of Medicine
Department of Rheumatology
Boston University Medical Center
Boston, Massachusetts
Fibroblast Function and Fibrosis

R. Elaine Lambert, M.D.

Adjunct Clinical Associate Professor
Department of Internal Medicine
Stanford School of Medicine
Palo Alto, California
Iron Storage Disease

Nancy E. Lane, M.D.

Associate Professor of Medicine in Residence
Department of Medicine
University of California at San Francisco
Department of Medicine and Division of
Rheumatology
San Francisco General Hospital
San Francisco, California
Metabolic Bone Disease

Daniel M. Laskin, DDS, MS

Professor and Chairman Emeritus
Department of Oral and Maxillofacial Surgery
Virginia Commonwealth University School of
Dentistry
Attending Oral and Maxillofacial Surgeon
Medical College of Virginia/Virginia Commonwealth
University Hospital
Richmond, Virginia
Temporomandibular Joint Pain

Meryl S. LeBoff

Associate Professor
Department of Internal Medicine
Harvard Medical School
Director
Skeletal Health and Osteoporosis
Division of Endocrine, Diabetes and Hypertension
Brigham and Women's Hospital
Boston, Massachusetts
Metabolic Bone Disease

David M. Lee, M.D., Ph.D.

Instructor of Medicine
Harvard Medical School
Division of Rheumatology, Immunology and Allergy
Department of Medicine
Brigham and Women's Hospital
Boston, Massachusetts
Synoviocytes

Michael D. Lockshin, M.D.

Professor of Medicine and Obstetrics and Gynecology
Joan and Sanford Weill Medical College of Cornell
University
Attending Physician
Hospital for Special Surgery
New York, New York
Antiphospholipid Antibody Syndrome

Pilar Lorenzo, Ph.D.

Cell and Molecular Biology
Lund University
Rheumatology
Lund University Hospital
Lund, Sweden
Matrix Glycoproteins and Proteoglycans in Cartilage

Kate R. Lorig, RN, DrPH

Professor
Department of Medicine
Stanford University
Palo Alto, California
Education of Patients

Carlos J. Lozada, M.D.

Associate Professor of Medicine
Director, Rheumatology Fellowship Program
Division of Rheumatology and Immunology
University of Miami School of Medicine
Director
Rheumatology Fellowship Training Program and
Rheumatology Clinical Services
Jackson Memorial Hospital
Miami, Florida
Management of Osteoarthritis

Maren Lawson Mahowald, M.D.

Professor of Medicine
University of Minnesota
Rheumatology Section Chief
Minneapolis VA Medical Center
Minneapolis, Minnesota
Chronic Musculoskeletal Pain

Scott David Martin, M.D.

Assistant Professor of Orthopedics
Harvard Medical School
Brigham and Women's Hospital
Boston, Massachusetts
Shoulder Pain

W. Joseph McCune, M.D.

Professor of Medicine
Department of Internal Medicine/Rheumatology
University of Michigan Medical Center
Ann Arbor, Michigan
Monarticular Arthritis

Iain B. McInnes, MRCP, Ph.D.

Professor
Division of Immunology, Infection and Inflammation
University of Glasgow
Consultant Rheumatologist
Centre for Rheumatic Diseases
Glasgow Royal Infirmary
Glasgow, Scotland, United Kingdom
Cytokines

Richard T. Meehan, M.D., FACP, FACR

Chief of Rheumatology
Associate Professor of Medicine
National Jewish Medical and Research Center
Associate Clinical Professor of Medicine
Rheumatology, Department of Medicine
University of Colorado Health Sciences Center
Denver, Colorado
Sarcoidosis

Sohail K. Mirza, M.D.

Associate Professor
Department of Orthopaedics and Sports Medicine
Harborview Medical Center
University of Washington
Seattle, Washington
Low Back Pain

Kevin G. Moder, M.D.

Assistant Professor
Division of Rheumatology
Department of Internal Medicine
Mayo Clinic
Rochester, Minnesota
History and Physical Examination of the Musculoskeletal System

Stanley J. Naides, M.D.

Thomas B. Hallowell Professor of Medicine
Chief, Division of Rheumatology
Medicine, Microbiology and Immunology and
Pharmacology
Pennsylvania State University College of Medicine
Professor and Chief
Division of Rheumatology
The Milton S. Hershey Medical Center
Hershey Pennsylvania
Viral Arthritis

Kenneth K. Nakano, M.D.

Clinical Professor of Medicine
Albany Medical College
Director of Research
The Center for Rheumatology
Attending Physician
Albany Medical Center Hospital
Albany, New York
Neck Pain

Lee S. Newman, M.D., MA, FCCP

Professor of Medicine
Professor of Preventive Medicine and Biometrics
University of Colorado Health Sciences Center
Professor of Medicine
Head, Division of Environmental and Occupational
Health Sciences
National Jewish Medical and Research Center
Denver, Colorado
Sarcoidosis

Urs E. Nydegger, M.D.

Titular Professor
Faculty of Medicine
University of Bern
Leitender Arzt
University Clinic for Cardiovascular Surgery
Universitätsklinik für Herz und Gefäßchirurgie
Insel Spital
Bern, Switzerland
Immune Complexes

Denis M. O'Day, M.D., F.A.C.S.

Professor of Ophthalmology
Department of Ophthalmology and Visual Sciences
Vanderbilt University School of Medicine
Nashville, Tennessee
The Eye and Rheumatic Disease

James R. O'Dell, BS, M.D.

Professor of Medicine
Chief, Section of Rheumatology and Immunology
Vice-Chairman, Department of Internal Medicine
University of Nebraska Medical Center
Omaha, Nebraska
Methotrexate, Leflunomide, and Combination Therapies

Yasunori Okada, M.D., Ph.D.

Professor and Chairman
Department of Pathology
School of Medicine
Keio University
Tokyo, Japan
Proteinases and Matrix Degradation

Richard S. Panush, M.D.

Clinical Professor
Department of Medicine
Mount Sinai School of Medicine
Chair
Department of Medicine
Saint Barnabas Medical Center
Livingston, New Jersey
Occupational and Recreational Musculoskeletal Disorders

Stanford L. Peng, M.D., Ph.D.

Assistant Professor
 Department of Internal Medicine, Division of
 Rheumatology
 Washington University School of Medicine
 Assistant Professor
 Department of Internal Medicine, Division of
 Rheumatology
 Barnes-Jewish Hospital
 St. Louis, Missouri
Antinuclear Antibodies

Jean-Charles Piette, M.D.

Medecine Interne 2
 Hospital Pitie-Salpetriere
 Paris, France
Relapsing Polychondritis

Lorenzo Pilar, Ph.D.

Department of Cell and Molecular Biology
 Lund University
 Lund, Sweden
Matrix Glycoproteins and Proteoglycans in Cartilage

Michael H. Pillinger, M.D.

Assistant Professor
 Department of Medicine and Pharmacology
 New York University School of Medicine
 Section Chief, Rheumatology
 New York Harbor Veterans Health Care System,
 Manhattan Campus
 New York, New York
Neutrophils and Eosinophils

Robert S. Pinals, M.D.

Professor and Vice-Chairman
 Department of Medicine
 University of Medicine and Dentistry of New Jersey
 Robert Wood Johnson Medical School
 Chief, Rheumatology Service
 Robert Wood Johnson University Hospital
 New Brunswick, New Jersey
Felty's Syndrome

Steven A. Porcelli, M.D.

Associate Professor
 Department of Microbiology and Immunology
 Department of Medicine
 Albert Einstein College of Medicine
 Bronx, New York
Innate Immunity

Darwin J. Prockop, M.D., Ph.D.

Director and Chairman
 Center for Gene Therapy
 Tulane University Health Sciences Center
 New Orleans, Louisiana
Collagen and Elastin

Eric L. Radin, M.D.

Adjunct Professor
 Orthopaedic Surgery
 Tufts University School of Medicine
 Boston, Massachusetts
Biomechanics of Joints

Jaya K. Rao, M.D., MHS

Medical Epidemiologist
 Health Care and Aging Studies Branch
 Centers for Disease Control and Prevention
 Adjunct Clinical Associate Professor
 Division of Rheumatology
 Department of Medicine
 Emory University School of Medicine
 Atlanta, Georgia
*Alternative Care for Arthritis and Related Musculoskeletal
 Diseases*

John D. Reveille, M.D.

George S. Bruce Professor in Arthritis and Other
 Rheumatic Diseases
 Rheumatology, Internal Medicine
 The University of Texas Health Science Center at
 Houston
 Director, Division of Rheumatology
 Hermann Hospital
 Houston, Texas
*Rheumatic Manifestations of Human Immunodeficiency
 Virus Infection*

Marco Rizzo, M.D.

Assistant Professor
 Division of Orthopaedic Surgery
 Duke University Medical Center
 Durham, North Carolina
Osteonecrosis

W. Neal Roberts, Jr., M.D.

Director
 Rheumatology Training Program
 C.W. Thomas Associate Professor of Medicine
 Virginia Commonwealth University
 Medical College of Virginia
 Richmond, Virginia
Psychosocial Management of the Rheumatic Diseases

Andrew E. Rosenberg, M.D.

Associate Professor
 Department of Pathology
 Harvard Medical School;
 Associate Pathologist
 Department of Pathology
 Massachusetts General Hospital
 Boston, Massachusetts
Tumors and Tumor-like Lesions of Joints

Keith T. Rott, M.D., Ph.D.

Assistant Professor
 Division of Rheumatology and Immunology
 Department of Medicine
 Emory University School of Medicine
 Atlanta, Georgia
Cutaneous Small-Vessel Vasculitis

David Rowe, M.D.

University of Connecticut Health Science Center
Heritable Disorders of Structural Proteins

Clinton T. Rubin, Ph.D.

Professor and Chair
Department of Biomedical Engineering
Director, Center for Biotechnology
State University of New York
Stony Brook, New York
Biology, Physiology, and Morphology of Bone

Janet E. Rubin, M.D.

Professor of Medicine
Division of Endocrinology and Metabolism
Emory University School of Medicine
Physician
Endocrinology and Metabolism
Atlanta Veterans Affairs Medical Center
Atlanta, Georgia
Biology, Physiology, and Morphology of Bone

Perry J. Rush, M.D.

Assistant Professor
Department of Medicine
University of Toronto
Chief Physiatrist
Department of Medicine
St. John's Rehabilitation Hospital
Toronto Ontario Canada
Rehabilitation of Patients with Rheumatic Diseases

Tore Saxne, M.D., Ph.D.

Professor
Department of Rheumatology
Lund University
Lund, Sweden
Matrix Glycoproteins and Proteoglycans in Cartilage

H. Ralph Schumacher, Jr., M.D.

Professor of Medicine
University of Pennsylvania School of Medicine
Chief of Rheumatology
VA Medical Center
Philadelphia, PA
Hemoglobinopathies and Arthritis

Edward M. Schwarz, Ph.D.

Associate Professor
Department of Orthopaedics
University of Rochester School of Medicine and
Dentistry
Rochester, New York
Signal Transduction in Rheumatic Diseases

James R. Seibold, M.D.

Professor of Medicine
Director, Scleroderma Program
University of Medicine and Dentistry of New Jersey
Robert Wood Johnson Medical School Attending
Physician
Internal Medicine and Rheumatology
Robert Wood Johnson University Hospital
New Brunswick, New Jersey
Scleroderma

David C. Seldin, M.D., Ph.D.

Associate Professor of Medicine and Microbiology
Boston University School of Medicine
Attending Physician, Section of Hematology-Oncology
Department of Medicine
Boston Medical Center
Boston, Massachusetts
Amyloidosis

John S. Sergent, M.D.

Professor of Medicine
Vanderbilt University School of Medicine
Vice Chairman for Education
Department of Medicine
Vanderbilt Medical Center
Nashville, Tennessee
*Polyarticular Arthritis; Polyarteritis and Related
Disorders; Arthritis Accompanying Endocrine and
Metabolic Disorders*

Jay R. Shapiro, M.D.

Professor
Department of Medicine
Uniformed Services University
Bethesda, Maryland
Director
Osteogenesis Imperfecta Program
Kennedy Krieger Institute
Baltimore, Maryland
Heritable Disorders of Structural Proteins

Leonard H. Sigal, M.D., FACP, FACR

Clinical Professor
Departments of Medicine
Department of Pediatrics
Department of Molecular Genetics and Microbiology
University of Medicine and Dentistry of New Jersey
Robert Wood Johnson Medical School
Attending, Rheumatology Service
Robert Wood Johnson University Hospital
New Brunswick, New Jersey
Lyme Disease

Anna Simon, M.D.

Resident
Department of Medicine
Division of General Internal Medicine
University Medical Center St. Radboud
Nijmegen, The Netherlands
Familial Autoinflammatory Syndromes

Sheldon R. Simon, M.D.

Professor of Clinical Orthopaedics
Albert Einstein School of Medicine
Bronx, New York
Chief Division of Pediatric Orthopaedics
Department of Orthopaedics
Beth Israel Medical Center
New York, New York
Biomechanics of Joints

Martha Skinner, M.D.

Professor
 Department of Medicine
 Boston University School of Medicine
 Director, Amyloid Program
 Boston Medical Center
 Boston, Massachusetts
Amyloidosis

Clement B. Sledge, M.D.

John B. and Buckminster Brown
 Professor of Orthopedic Surgery, Emeritus
 Harvard Medical School
 Chairman, Department of Orthopedic Surgery,
 Emeritus
 Brigham and Women's Hospital
 Boston, Massachusetts
*Introduction to Surgical Management of Patients with
 Arthritis*
Principles of Reconstructive Surgery for Arthritis

Nicholas A. Soter, M.D.

Professor of Dermatology
 The Ronald O. Perelman Department of Dermatology
 New York University School of Medicine
 Attending Physician
 Tisch Hospital
 The University Hospital of NYU
 New York, New York
The Skin and Rheumatic Diseases

Timothy M. Spiegel, M.D., MPH

Department of Medicine/Rheumatology
 Cottage Hospital
 Santa Barbara, California
Ankle and Foot Pain

Paul A. Sponseller, M.D.

Professor and Vice-Chair
 Department of Orthopaedics
 Head, Pediatric Orthopaedics
 Johns Hopkins University
 Boston, Massachusetts
Heritable Disorders of Structural Proteins

C. Michael Stein, M.D.

Associate Professor of Medicine
 Associate Professor of Pharmacology
 Vanderbilt University School of Medicine
 Nashville, Tennessee
Immunoregulatory Drugs

John H. Stone, M.D., MPH

Associate Professor of Medicine
 Division of Rheumatology
 Johns Hopkins University
 Director
 The Johns Hopkins Vasculitis Center
 Baltimore, Maryland
The Classification and Epidemiology of Systemic Vasculitis

Vibeke Strand, M.D.

Adjunct Clinical Professor
 Division of Immunology and Rheumatology
 Stanford University School of Medicine
 Palo Alto, California
Emerging Therapies in Rheumatoid Arthritis

Stephanie Studenski, M.D., MPH

Professor
 Department of Medicine
 University of Pittsburgh
 Staff Physician
 Geriatric Research Education and Clinical Center
 Virginia Pittsburgh Healthcare System
 Pittsburgh, Pennsylvania
Pharmacology and the Elderly

Carrie R. Swigart, M.D.

Assistant Clinical Professor
 Department of Orthopaedics and Rehabilitation
 Yale University School of Medicine
 Associate
 Yale–New Haven Hospital
 New Haven, Connecticut
Hand and Wrist Pain

Zoltan Szekanecz, M.D., Ph.D., DSC

Associate Professor of Medicine, Rheumatology and
 Immunology
 Head of Rheumatology Division
 Third Department of Medicine
 Rheumatology Division
 Debrecen, Hungary
*Endothelial Cell Biology, Angiogenesis, and Recruitment
 Cells*

Paul P. Tak, M.D., Ph.D.

Professor of Medicine
 Director, Division of Clinical Immunology and
 Rheumatology
 Academic Medical Center
 University of Amsterdam
 The Netherlands
*Synovial Fluid Analyses, Synovial Biopsy, and Synovial
 Pathology; Biological Markers*

Johan M. TeKoppele, Ph.D.

Head, Division of Biomedical Research
 TNO Prevention and Health
 Netherlands Organization for Applied Scientific
 Research
 Leiden, The Netherlands
Biological Markers

Jerry Tenenbaum, M.D., FRCPC

Professor of Medicine
 University of Toronto;
 Director
 Ontario International Medical Graduate Program
 Mount Sinai Hospital
 Toronto, Ontario, Canada
Hypertrophic Osteoarthropathy

Robert Terkeltaub, M.D.

Professor of Medicine in Residence
Director, Rheumatology Training Program
University of California at San Diego
Chief, Rheumatology Section
VA Medical Center
San Diego, California
Diseases Associated with Articular Deposition of Calcium Pyrophosphate Dihydrate and Basic Calcium Phosphate Crystals

Ranjey Thomas, M.D.

Associate Professor
Centre for Immunology and Cancer Research
University of Queensland
Consultant Rheumatologist
Princess Alexandra Hospital
Brisbane, Australia
Antigen-Presenting Cells

Thomas S. Thornhill, M.D.

John B. and Buckminster Brown
Professor of Orthopaedics
Harvard Medical School
Orthopaedist-in-Chief
Brigham and Women's Hospital
Boston, Massachusetts
Shoulder Pain

Helen Tighe, Ph.D.

Associate Professor of Medicine
University of California San Diego
La Jolla, California
Rheumatoid Factor

Betty P. Tsao, Ph.D.

Professor of Medicine
David Geffen School of Medicine University of
California at Los Angeles
Los Angeles, California
Pathogenesis of SLE

Zuhre Tutuncu, M.D.

Assistant Clinical Professor of Medicine
Center for Innovative Therapy
Division of Rheumatology
University of California at San Diego
San Diego, California
Anticytokine Therapies

Katherine S. Upchurch, M.D.

Associate Professor of Medicine
University of Massachusetts Medical School
Associate Chief, Division of Rheumatology
University of Massachusetts Memorial Medical Center
Worcester, Massachusetts
Hemophilic Arthropathy

James R. Urbaniak, M.D.

Virginia Flowers Baker Professor of Orthopedic
Surgery
Duke University Medical Center
Durham, North Carolina
Osteonecrosis

Désirée van der Heijde, M.D., Ph.D.

Professor of Rheumatology
Department of Internal Medicine
Division of Rheumatology
University Hospital Maastricht
Maastricht, The Netherlands
Ankylosing Spondylitis

Sjef van der Linden, M.D., Ph.D.

Professor of Rheumatology
Department of Internal Medicine
Division of Rheumatology
University Hospital Maastricht
Maastricht, The Netherlands
Ankylosing Spondylitis

Jos W.M. van der Meer, M.D., Ph.D., FRCP

Professor of Internal Medicine
Department of Medicine
Division of General Internal Medicine
University Medical Center St. Radboud
Nijmegen, The Netherlands
Familial Autoinflammatory Syndromes

Philippe Vinceneux, M.D.

Medecine Interne 2
Hospital Pitie-Salpetriere
Paris, France
Relapsing Polychondritis

Michael M. Ward, M.D., MPH

Senior Investigator, Intramural Research Program
National Institute of Arthritis and Musculoskeletal and
Skin Diseases
National Institutes of Health
U. S. Department of Health and Human Services
Bethesda, Maryland
*Assessment of Health Outcomes; Pharmacology and the
Elderly*

Yasmine Wasfi, M.D.

Instructor, Parker B. Francis Fellow
Department of Medicine
National Jewish Medical and Research Center
Instructor, Division of Pulmonary Sciences and Critical
Care Medicine
University of Colorado Health Sciences Center
Denver, Colorado
Sarcoidosis