

diabetes®

EDITOR IN CHIEF

Martin G. Myers Jr., MD, PhD

SENIOR ASSOCIATE EDITORS

David A. D'Alessio, MD

Maureen A. Gannon, PhD

Randy J. Seeley, PhD

ASSOCIATE EDITORS

Karin Bornfeldt, PhD
 Frank C. Brosius, MD
 Alessandro Doria, MD, PhD
 James Granneman, PhD
 Maria B. Grant, MD, FARVO
 Kevan C. Herold, MD

Jeffrey F. Horowitz, PhD
 Jiandie D. Lin, PhD
 Carey Nien-Kai Lumeng, MD, PhD
 Ormond A. MacDougald, PhD
 Massimo Pietropaolo, MD
 Rodica Pop-Busui, MD, PhD

Leslie Satin, PhD
 Norbert Stefan, MD, PhD
 Doris A. Stoffers, MD, PhD
 Qi-Qun Tang, MD, PhD
 Morris F. White, PhD

EDITORIAL BOARD

Amanda M. Ackermann, MD, PhD
 Laura C. Alonso, MD
 Ernesto Bernal-Mizrachi, MD
 David A. Bernlohr, PhD
 Sudha B. Biddinger, MD, PhD
 Barak Blum, PhD
 Shawn Burgess, PhD
 Alejandro Caicedo, PhD
 Jonathan E. Campbell, PhD
 Luiza Caramori, MD, MS, PhD
 William P. Cawthorn, PhD
 Miriam Cnop, MD, PhD
 Jason Collier, PhD
 Sheila Collins, PhD
 Farhad Danesh, MD
 Arup Das, MD, PhD, FARVO
 Dawn Belt Davis, MD, PhD
 E. Danielle Dean, PhD
 H. Henry Dong, PhD
 X. Charlie Dong, PhD
 Sven Enerback, MD, PhD
 Yong Fan, PhD
 Jorge Ferrer, MD, PhD, FMedSci
 Charles R. Flynn, PhD
 Katsuhiko Funai, PhD
 Katherine A. Gallagher, MD
 Adolfo Garcia-Ocaña, PhD

Maria L. Golson, PhD
 Struan F.A. Grant, PhD
 Shaodong Guo, PhD
 Rana K. Gupta, PhD
 Susan B. Gurley, MD, PhD
 Rebecca Haeusler, PhD
 Manami Hara, DDS, PhD
 Raymond Harris, MD
 Sean Hartig, PhD
 Jacob M. Haus, PhD
 John Cijiang He, MD
 Martin Heni, MD
 David Hodson, DVM, PhD
 Chad Hunter, PhD
 David Jacobson, PhD
 Karin Jandeleit-Dahm, MD, PhD, FRACP
 Sona Kang, PhD
 Francis Kim, MD
 Michelle E. Kimple, PhD
 Stephan Kissler, PhD
 Eckhard Lammert, PhD
 Brian T. Layden, MD, PhD
 Moshe Levi, MD, MS
 Yan Li, PhD
 Meilian Liu, PhD
 Susanne Mandrup, PhD
 Clayton Mathews, PhD

Matthew J. Merrins, PhD
 Aaron Michels, MD
 Daniel J. Moore, MD, PhD
 Gregory J. Morton, PhD
 Prabha Nagareddy, PhD
 Robert W. O'Rourke, MD
 Subramaniam Pennathur, MD
 Ling Qi, PhD
 Justin J. Rochford, PhD
 Patrick Rorsman, PhD
 Karen Ryan, PhD
 Philipp E. Scherer, PhD
 Patrick Seale, PhD
 Robert K. Semple, MB BChir, PhD
 Emily Sims, MD
 Kanakadurga Singer, MD
 Scott Soleimanpour, MD
 Lauren M. Sparks, PhD
 Lori Sussel, PhD
 Anders Tengholm, PhD
 Peter Tontonoz, MD, PhD
 John Ussher, PhD
 Phillip J. White, PhD
 Christian Wolfrum, PhD
 Jun Wu, PhD
 Mark Yorek, PhD

AMERICAN DIABETES ASSOCIATION OFFICERS

CHAIR OF THE BOARD
 John Schlosser

PRESIDENT, MEDICINE & SCIENCE
 Ruth Weinstock, MD, PhD

PRESIDENT, HEALTH CARE & EDUCATION
 Cynthia Muñoz, PhD, MPH

SECRETARY/TREASURER
 Christopher Ralston, JD

CHAIR OF THE BOARD-ELECT
 Glen Tullman

PRESIDENT-ELECT, MEDICINE & SCIENCE
 Guillermo Umpierrez, MD, CDE, FACP, FACE

PRESIDENT-ELECT, HEALTH CARE & EDUCATION
 Otis Kirksey, PharmD, RPh, CDE, BC-ADM

SECRETARY/TREASURER-ELECT
 Marshall Case

CHIEF EXECUTIVE OFFICER
 Tracey D. Brown, MBA, BChE

CHIEF SCIENTIFIC & MEDICAL OFFICER
 Robert A. Gabbay, MD, PhD



The mission of the American Diabetes Association is to prevent and cure diabetes and to improve the lives of all people affected by diabetes.

A JOURNAL OF THE AMERICAN DIABETES ASSOCIATION

diabetes®

Mission Statement for *Diabetes*

Diabetes publishes original research about the physiology and pathophysiology of diabetes mellitus. Submitted manuscripts can report any aspect of laboratory, animal, or human research. Emphasis is on investigative reports focusing on areas such as the pathogenesis of diabetes and its complications, normal and pathological pancreatic islet function and intermediary metabolism, pharmacological mechanisms of drug and hormone action, and biochemical and molecular aspects of normal and abnormal biological processes. Studies in the areas of diabetes education or the application of accepted therapeutic and diagnostic approaches to patients with diabetes are not published. More information about the journal can be found online at diabetes.diabetesjournals.org.

Copyright © 2021 by the American Diabetes Association, Inc. All rights reserved. Printed in the USA. Requests for permission to reuse content should be sent to Copyright Clearance Center at www.copyright.com or 222 Rosewood Dr., Danvers, MA 01923; phone: (978) 750-8400; fax: (978) 646-8600. Requests for permission to translate should be sent to Permissions Editor, American Diabetes Association, at permissions@diabetes.org.

The American Diabetes Association reserves the right to reject any advertisement for any reason, which need not be disclosed to the party submitting the advertisement.

Commercial reprint orders should be directed to Sheridan Content Services, (800) 635-7181, ext. 8065.

Single issues of *Diabetes* can be ordered by calling toll-free (800) 232-3472, 8:30 A.M. to 5:00 P.M. EST, Monday through Friday. Outside the United States, call (703) 549-1500. Rates: \$75 in the United States, \$95 in Canada and Mexico, and \$125 for all other countries.

Diabetes is available online at diabetes.diabetesjournals.org. Please call the numbers listed above, e-mail membership@diabetes.org, or visit the online journal for more information about submitting manuscripts, publication charges, ordering reprints, subscribing to the journal, becoming an ADA member, advertising, permission to reuse content, and the journal's publication policies.

PRINT ISSN 0012-1797

ONLINE ISSN 1939-327X

PRINTED IN THE USA

Periodicals postage paid at Arlington, VA, and additional mailing offices.

AMERICAN DIABETES ASSOCIATION PERSONNEL AND CONTACTS

ASSOCIATE PUBLISHER, SCHOLARLY JOURNALS
Christian S. Kohler

EDITORIAL OFFICE DIRECTOR
Lyn Reynolds

PEER REVIEW MANAGER
Jane Castner

ASSOCIATE MANAGER, PEER REVIEW
Joan Garrett

DIRECTOR, SCHOLARLY JOURNALS
Heather Norton Blackburn

ASSOCIATE DIRECTOR, SCHOLARLY JOURNALS
Keang Hok

EDITORIAL CONTENT MANAGER
Theresa M. Cooper

TECHNICAL EDITOR
Donna J. Reynolds

PRODUCTION COORDINATOR
Saleha Malik

DIRECTOR, MEMBERSHIP/
SUBSCRIPTION SERVICES
Donald Crowl

SENIOR ADVERTISING MANAGER
Julie DeVoss Graff
jgraff@diabetes.org
(703) 299-5511

ADVERTISING REPRESENTATIVES

AMERICAN DIABETES ASSOCIATION
Paul Nalbandian
Associate Publisher, Advertising &
Sponsorships
pnalbandian@diabetes.org
(703) 549-1500, ext. 4806

PHARMACEUTICAL/DEVICE DIGITAL ADVERTISING
eHealthcare Solutions
R.J. Lewis
President & CEO
rlewis@ehsmail.com
(609) 882-8887, ext. 101