

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
 Charles F. Burant, MD, PhD
 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
 Manuela Bartoli, PhD
 Ernesto Bernal-Mizrachi, MD
 David A. Bernlohr, PhD
 Pengpeng Bi, PhD
 Sudha B. Biddinger, MD, PhD
 Julia V. Busik, PhD
 Jonathan E. Campbell, PhD
 William P. Cawthorn, PhD
 Jason Collier, PhD
 Sheila Collins, PhD
 Robert V. Considine, PhD
 Arup Das, MD, PhD, FARVO
 Dawn Belt Davis, MD, PhD
 E. Danielle Dean, PhD
 Marc Y. Donath, MD
 H. Henry Dong, PhD
 X. Charlie Dong, PhD
 Lena Eliasson, PhD
 Sven Enerback, MD, PhD
 Carmela Evans-Molina, MD, PhD
 Yong Fan, PhD
 Jorge Ferrer, MD, PhD, FMedSci
 Katherine A. Gallagher, MD

Adolfo Garcia-Ocaña, PhD
 Paula Goforth, PhD
 Maria L. Golson, PhD
 Laurie J. Goodyear, PhD
 Struan F.A. Grant, PhD
 Rana K. Gupta, PhD
 Susan B. Gurley, MD, PhD
 Eric Hajduch, PhD
 Manami Hara, DDS, PhD
 Jacob M. Haus, PhD
 Martin Heni, MD
 Mark A. Herman, MD
 Ken Inoki, MD, PhD
 Masao Kaneki, MD, PhD
 Sona Kang, PhD
 Francis Kim, MD
 Michelle E. Kimple, PhD
 Stephan Kissler, PhD
 Brian T. Layden, MD, PhD
 Chih-Hao Lee, MD
 Moshe Levi, MD, MS
 Xiaoying Li, MD, PhD
 Meilian Liu, PhD
 Susanne Mandrup, PhD
 Clayton Mathews, PhD
 Rory J. McCrimmon, MD, MBChB

Matthew J. Merrins, PhD
 Gregory J. Morton, PhD
 Rama Natarajan, PhD
 Robert W. O'Rourke, MD
 Subramaniam Pennathur, MD
 Diego Perez-Tilve, PhD
 Vincent Poyntout, DVM, PhD
 Matthew J. Potthoff, PhD
 Ling Qi, PhD
 Justin J. Rochford, PhD
 Patrick Rorsman, PhD
 Gaetano Santulli, MD, PhD
 Philipp E. Scherer, PhD
 Robert K. Semple, MB BChir, PhD
 Kanakadurga Singer, MD
 Lauren M. Sparks, PhD
 Lori Sussel, PhD
 Anders Tengholm, PhD
 Peter Tontonoz, MD, PhD
 Fumihiko Urano, MD, PhD
 Adrian Vella, MD
 Phillip J. White, PhD
 Christian Wolfrum, PhD
 Jun Wu, PhD
 Yang Kevin Xiang, PhD

AMERICAN DIABETES ASSOCIATION OFFICERS

CHAIR OF THE BOARD
 Umesh Verma

PRESIDENT, MEDICINE & SCIENCE
 Robert H. Eckel, MD

PRESIDENT, HEALTH CARE & EDUCATION
 Mary de Groot, PhD

SECRETARY/TREASURER
 Martha Parry Clark, MBA

CHAIR OF THE BOARD-ELECT
 John Schlosser

PRESIDENT-ELECT, MEDICINE & SCIENCE
 C. Ronald Kahn, MD

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

SECRETARY/TREASURER-ELECT
 Christopher Ralston, JD

CHIEF EXECUTIVE OFFICER
 Tracey D. Brown, MBA, BChE



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 © 2020 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 CONTENT MANAGER

Theresa M. Cooper

ADVERTISING REPRESENTATIVES

AMERICAN DIABETES ASSOCIATION

Paul Nalbandian

Associate Publisher, Advertising &

Sponsorships

pnalbandian@diabetes.org

(703) 549-1500, ext. 4806

EDITORIAL OFFICE DIRECTOR

Lyn Reynolds

TECHNICAL EDITOR

Donna J. Reynolds

Tina Auletta

Senior Account Executive

tauletta@diabetes.org

(703) 549-1500, ext. 4809

PEER REVIEW MANAGER

Jane Castner

PRODUCTION COORDINATOR

Saleha Malik

ASSOCIATE MANAGER, PEER REVIEW

Joan Garrett

DIRECTOR, MEMBERSHIP/ SUBSCRIPTION SERVICES

Donald Crowl

PHARMACEUTICAL/DEVICE DIGITAL ADVERTISING

eHealthcare Solutions

R.J. Lewis

President & CEO

rlewis@ehsmail.com

(609) 882-8887, ext. 101

DIRECTOR, SCHOLARLY JOURNALS

Heather Norton Blackburn

SENIOR ADVERTISING MANAGER

Julie DeVoss Graff

jgraff@diabetes.org

(703) 299-5511

ASSOCIATE DIRECTOR, SCHOLARLY JOURNALS

Keang Hok