

Fertility and Sterility®

OFFICIAL JOURNAL OF THE AMERICAN SOCIETY FOR REPRODUCTIVE MEDICINE, Society for Reproductive Endocrinology and Infertility, Society of Reproductive Surgeons, Society for Assisted Reproductive Technology, Society for Male Reproduction and Urology, Society of Reproductive Biologists & Technologists (SRBT) and the Pacific Coast Reproductive Society.



Editors-in-Chief

CRAIG NIEDERBERGER, M.D.
Chicago, Illinois

ANTONIO PELLICER, M.D.
Valencia, Spain

Video and New Media Editor

STEVEN PALTER, M.D.
Syosset, New York

Editorial Editors

ROBERT CASPER, M.D.
Toronto, Canada

MARCELLE CEDARS, M.D.
San Francisco, California

RENE FRYDMAN, M.D.
Paris, France

NERI LAUFER, M.D.
Jerusalem, Israel

DAVID MELDRUM, M.D.
Los Angeles, California

ZEV ROSENWAKS, M.D.
New York, New York

WILLIAM SCHLAFF, M.D.
Philadelphia, Pennsylvania

MARK SIGMAN, M.D.
Providence, Rhode Island

KURT BARNHART, M.D.,
M.S.C.E.
Philadelphia, Pennsylvania

ROBERT BRANNIGAN, M.D.
Chicago, Illinois

OWEN DAVIS, M.D.
New York, New York

JACQUES DONNEZ, M.D.,
Ph.D.
Brussels, Belgium

TOMMASO FALCONE, M.D.
Cleveland, Ohio

RICHARD LEGRO, M.D.
Hershey, Pennsylvania

PAULINE MENDOLA, Ph.D.
Hyattsville, Maryland

CARLOS SIMÓN, M.D., Ph.D.
Valencia, Spain

BRAD VAN VOORHIS, M.D.
Iowa City, Iowa

Editorial Board

MOHAMED ABOULGHAR, M.D.
Cairo, Egypt

ASHOK AGARWAL, Ph.D.
Cleveland, Ohio

AYMAN AL-HENDY, M.D., Ph.D.
Nashville, Tennessee

VALERIE BAKER, M.D.
Stanford, California

PEDRO BARRI, M.D., Ph.D.
Barcelona, Spain

ERIN BELL, Ph.D.
Rensselaer, New York

ANGELINE BELTSOS, M.D.
Glenview, Illinois

SUSAN BENOFF, Ph.D.
Manhasset, New York

ZEEV BLUMENFELD, M.D.
Haifa, Israel

FRANCISCO BOLUMAR, M.D., Ph.D.
Madrid, Spain

ANDREA BORINI, M.D.
Bologna, Italy

ERNESTO BOSCH, M.D.
Valencia, Spain

PHILIPPE BOUCHARD, M.D.
Paris, France

RICHARD BRONSON, M.D.
Stony Brook, New York

MICHAEL CANIS, M.D.
Clermont, France

ETTORE CAROPPO, M.D.
Bari, Italy

WILLIAM CATHERINO, M.D., Ph.D.
Bethesda, Maryland

NASSER CHEGINI, Ph.D.
Gainesville, Florida

GREGORY CHRISTMAN, M.D.
Ann Arbor, Michigan

ANA COBO, Ph.D.
Valencia, Spain

JACQUES COHEN, Ph.D.
West Orange, New Jersey

CHRISTOPHER DE JONGE, Ph.D.
Minneapolis, Minnesota

PAUL DEVROEY, M.D., Ph.D.
Brussels, Belgium

DOMINIQUE DE ZIEGLER, M.D.
Paris, France

THOMAS D'HOOGHE, M.D., Ph.D.
Leuven, Belgium

MICHAEL DIAMOND, M.D.
Detroit, Michigan

ANUJA DOKRAS, M.D., Ph.D.
Philadelphia, Pennsylvania

MARIE-MADELEINE DOLMANS, M.D., Ph.D.
Louvain, Belgium

ESTHER EISENBERG, M.D., M.P.H.
Nashville, Tennessee

NAVID ESFANDIARI, D.V.M., Ph.D.
Toronto, Canada

ASGERALLY FAZLEABAS, Ph.D.
Grand Rapids, Michigan

EVE FEINBERG, M.D.
Chicago, Illinois

ANNA PIA FERRARETTI, M.D.
Bologna, Italy

MARCO FILICORI, M.D.
Bologna, Italy

DAVID FRANKFURTER, M.D.
Washington, D.C.

JUAN A. GARCIA-VELASCO, M.D.
Madrid, Spain

CAROLINE GARGETT, Ph.D.
Clayton, Australia

NICOLÁS GARRIDO, Ph.D.
Valencia, Spain

LUCA GIANAROLI, M.D.
Bologna, Italy

WILLIAM GIBBONS, M.D.
Houston, Texas

SUZANNE GILBOA, Ph.D.
Atlanta, Georgia

PAUL GINDOFF, M.D.
Washington, D.C.

ELIZABETH GINSBURG, M.D.
Boston, Massachusetts

JEFFREY GOLDBERG, M.D.
Cleveland, Ohio

MARC GOLDSTEIN, M.D.
New York, New York

GEORG GRIESINGER, M.D., Ph.D., M.Sc.
Lübeck, Germany

ROGER HART, M.D.
Perth, Australia

DAVID HEALY, Ph.D., M.D.
Melbourne, Australia

KATHLEEN HOEGER, M.D.
Rochester, New York

HEFENG HUANG, M.D.
Hangzhou, PR China

WILLIAM HURD, M.D., M.Sc., M.P.H.
Cleveland, Ohio

ALAYMAN H.F. HUSSEIN, M.B.B.Ch, M.Sc., M.D.
El-Minia, Egypt

KEITH ISAACSON, M.D.
Newton, Massachusetts

CALEB KALLEN, M.D., Ph.D.
Atlanta, Georgia

SULEENA KANSAL KALRA, M.D., M.S.C.E.
Philadelphia, Pennsylvania

DAVID KEEFE, M.D.
New York, New York

EDWARD KIM, M.D.
Knoxville, Tennessee

ISAAC KLIGMAN, M.D.
New York, New York

EFRATIOS KOLIBIANAKIS, M.D., Ph.D.
Thessaloniki, Greece

PHILIPPE KONINCKX, M.D., Ph.D.
Leuven, Belgium

DOLORES LAMB, Ph.D.
Houston, Texas

DAN LEBOVIC, M.D.
Madison, Wisconsin

WILLIAM LEDGER, M.D.
Randwick, Australia

LARRY LIPSHULTZ, M.D.
Houston, Texas

DANELLE LOBBELL, M.S., Ph.D.
Research Triangle Park, North Carolina

TYCHO LOCK, M.D.
Utrecht, the Netherlands

MAURIZIO MACALUSO, M.D., Dr.P.H.
Cincinnati, Ohio

NICK MACKLON, M.D., Ph.D.
Southampton, United Kingdom

GUILLERMO MARCONI, M.D.
Buenos Aires, Argentina

(EDITOR, SOUTH AMERICAN EDITION)

PETER MCGOVERN, M.D.
Newark, New Jersey

KELLE MOLEY, M.D.
St. Louis, Missouri

STEVEN NAKAJIMA, M.D.
Louisville, Kentucky

CAMRAN NEZHAT, M.D.
Stanford, California

ROBERT NORMAN, M.D.
Adelaide, Australia

ROBERT OATES, M.D.
Boston, Massachusetts

MOIRA O'BRYAN
Clayton, Australia

STEVEN ORY, M.D.
Margate, Florida

ALLAN PACEY, Ph.D.
Sheffield, United Kingdom

KELLY PAGIDAS, M.D.
Providence, Rhode Island

FIRUZA PARIKH, M.D.
Mumbai, India

(EDITOR, INDIAN EDITION)

PASQUALE PATRIZIO, M.D.
New Haven, Connecticut

RICHARD PAULSON, M.D.
Los Angeles, California

ALAN PENZIAS, M.D.
Waltham, Massachusetts

MARK PERLOE, M.D.
Atlanta, Georgia

ELIZABETH PUSCHECK, M.D.
Detroit, Michigan

CATHERINE RACOWSKY, Ph.D.
Boston, Massachusetts

DANIEL RAPPOLEE, Ph.D.
Detroit, Michigan

JARED ROBINS, M.D.
Providence, Rhode Island

REBECCA ROBKER, Ph.D.
Adelaide, Australia

MARY SAMMEL, Sc.D.
Philadelphia, Pennsylvania

JAY SANDLOW, M.D.
Milwaukee, Wisconsin

JOSEPH SANFILIPPO, M.D.
Pittsburgh, Pennsylvania

PETER SCHLEGEL, M.D.
New York, New York

WILLIAM SCHOOLCRAFT, M.D.
Lone Tree, Colorado

BEATA SEEBER, M.D., M.S.C.E.
Innsbruck, Austria

JAMES SEGARS, M.D.
Bethesda, Maryland

MARCOS FELIPE SILVA DE SA, M.D., Ph.D.
Ribeirao Preto, Brazil

ANNE STEINER, M.D., M.P.H.
Chapel Hill, North Carolina

MARY STEPHENSON, M.D., M.Sc.
Chicago, Illinois

CARLOS SUELDO, M.D.
Buenos Aires, Argentina

HUGH TAYLOR, M.D.
New Haven, Connecticut

ALFREDO ULLOA-AGUIRRE, M.D., D.Sc.
Mexico City, Mexico

MONICA VAZQUEZ-LEVIN, Ph.D.
Buenos Aires, Argentina

MOSHE WALD, M.D.
Iowa City, Iowa

ROBERT WILD, M.D., Ph.D., M.P.H.
Oklahoma City, Oklahoma

CYNTHIA ZIEMER, M.Div., Psy.D.
Oak Park, Illinois

Managing Editor

NANCY KUCIK
Birmingham, Alabama

Former Editors

PENDLETON TOMPKINS, M.D., EDITOR 1950-1952
M. EDWARD DAVIS, M.D., EDITOR 1953-1969
LUIGI MASTROIANNI, JR., M.D., EDITOR 1970-1975
ROGER D. KEMPEL, M.D., EDITOR 1976-1997
ALAN H. DeCHERNEY, M.D., EDITOR 1997-2011

Editorial Assistant

CARLA STEC, M.A.
Birmingham, Alabama