

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.
Rome, Italy

Video and New Media Editor

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

Editorial Editors

ROBERT BRANNIGAN, M.D.
Chicago, Illinois

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

MATS BRÄNNSTRÖM, M.D., PH.D.
Gothenburg, Sweden

RICHARD LEGRO, M.D.
Hershey, Pennsylvania

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

WILLIAM SCHLAFF, M.D.
Philadelphia, Pennsylvania

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

PAULINE MENDOLA, PH.D.
Hyattsville, Maryland

CYNTHIA FARQUHAR, M.B.Ch.B.,
M.D., M.P.H.
Auckland, New Zealand

MARK SIGMAN, M.D.
Providence, Rhode Island

MICHAEL EISENBERG, M.D.
Stanford, California

RICHARD SCOTT, M.D.
Basking Ridge, New Jersey

RICHARD PAULSON, M.D.
Los Angeles, California

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

NICOLÁS GARRIDO, PH.D.
Valencia, Spain

ANNE STEINER, M.D., M.P.H.
Chapel Hill, North Carolina
MARY STEPHENSON, M.D., M.Sc.
Chicago, Illinois

Associate Editors

Specialty Editors

DOMINIQUE DE ZIEGLER, M.D.
Paris, France

EVE FEINBERG, M.D.
Chicago, Illinois

WILLIAM GIBBONS, M.D.
Houston, Texas

JIM HOTALING, M.D., M.S.
Salt Lake City, Utah

SUSAN KLOCK, PH.D.
Chicago, Illinois

STEVEN R. LINDHEIM, M.D.
Dayton, Ohio

ROBERT JOHN NORMAN, M.D.
Adelaide, Australia

RANJITH RAMASAMY, M.D.
Miami, Florida

MARGRIT URBANEK, PH.D.
Chicago, Illinois

Interactive Associates

MICAH J. HILL, D.O., INTERACTIVE ASSOCIATE-IN-CHIEF
Bethesda, Maryland

HIMANSHU ARORA, PH.D.
Miami, Florida

EMILY BARNARD, D.O.
Pittsburgh, Pennsylvania

PIETRO BORTOLETTO, M.D.
Boston, MA

KATHERINE CAMERON, M.D.
Philadelphia, Pennsylvania

LAURA COONEY, M.D.
Middleton, Wisconsin

ALI A. DABAJA, M.D.
Detroit, Michigan

JAKOB DOBLINGER, M.D.
Valencia, Spain

JAMES M. DUPREE, M.D., M.P.H.
Ann Arbor, Michigan

JASON M. FRANASIAK, M.D., HCLD/ALD (ABB)
Basking Ridge, New Jersey

RANI FRITZ, D.O., PH.D., F.A.C.O.G.
New York, New York

AUDREY GASKINS, B.S.E.
Boston, Massachusetts

DANIEL J. KASER, M.D.
Basking Ridge, New Jersey

SCOTT MORIN, M.D.
Basking Ridge, New Jersey

GEORGE PATOUNAKIS, M.D., PH.D.
Lake Mary, Florida

MARINE POULAIN, PHARM.D, PH.D.
Paris, France

ALEXANDER M. QUAAAS, M.D., PH.D.
San Diego, California

MARY SAMPLASKI, M.D.
Los Angeles, California

SAMUEL SANTOS-RIBEIRO, M.D., PH.D.
Lisbon, Portugal

Managing Editor

MEREDITH SAULS
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. KEMPERS, M.D., EDITOR 1976-1997

ALAN H. DECHERNEY, M.D., EDITOR 1997-2011

Assistant Managing Editor

THEA RYAN
Birmingham, Alabama

Editorial Board

MOHAMED ABOULGHAR, M.D. <i>Cairo, Egypt</i>	ANNA PIA FERRARETTI, M.D. <i>Bologna, Italy</i>	S. SAMUEL KIM, M.D. <i>Kansas City, Kansas</i>	MARY ELLEN PAVONE, M.D., M.S.C.I. <i>Chicago, Illinois</i>
AYMAN AL-HENDY, M.D., PH.D. <i>Chicago, Illinois</i>	MARCO FILICORI, M.D. <i>Bologna, Italy</i>	ISAAC KLIGMAN, M.D. <i>New York, New York</i>	ALAN PENZIAS, M.D. <i>Waltham, Massachusetts</i>
MINA ALIKANI, PH.D., H.C.L.D. <i>New York, New York</i>	ERIC J. FORMAN, M.D., H.C.L.D. <i>New York, New York</i>	TAYLOR KOHN, M.D., M.PHIL. <i>Baltimore, Maryland</i>	MARK PERLOE, M.D. <i>Atlanta, Georgia</i>
KENNETH ASTON, PH.D. <i>Salt Lake City, Utah</i>	ELPIDA FRAGOULI, PH.D., M.SC. <i>Oxford, United Kingdom</i>	EFRATIOS KOLIBIANAKIS, M.D., PH.D. <i>Thessaloniki, Greece</i>	JOHN C. PETROZZA, M.D. <i>Boston, Massachusetts</i>
VALERIE BAKER, M.D. <i>Stanford, CA</i>	JASON MICHAEL FRANASIAK, M.D., H.C.L.D./ A.L.D (ABB) <i>Haddon Heights, New Jersey</i>	PHILIPPE KONINCKX, M.D., PH.D. <i>Bierbeek, Belgium</i>	THOMAS B. POOL, PH.D. <i>San Antonio, Texas</i>
EMILY S. BARRETT, PH.D. <i>Rochester, New York</i>	DAVID FRANKFURTER, M.D. <i>Washington, D.C.</i>	JONATHAN KORT, M.D., M.B.A. <i>San Francisco, California</i>	ELIZABETH PUSCHECK, M.D. <i>Detroit, Michigan</i>
BALA BHAGAVATH, M.D. <i>Rochester, New York</i>	SOFIA GAMEIRO, PH.D. <i>Cardiff, United Kingdom</i>	STEPHEN KRAWETZ, PH.D. <i>Detroit, Michigan</i>	GWENDOLYN P. QUINN, PH.D. <i>Tampa, Florida</i>
ZEEV BLUMENFELD, M.D. <i>Haifa, Israel</i>	JUAN A. GARCIA-VELASCO, M.D. <i>Madrid, Spain</i>	ALLEN R. KUNSELMAN, M.A. <i>Hershey, Pennsylvania</i>	CATHERINE RACOWSKY, PH.D. <i>Boston, Massachusetts</i>
CHRISTINA E. BOOTS, M.D. <i>Chicago, Illinois</i>	AUDREY J. GASKINS, SC.D. <i>Boston, Massachusetts</i>	DOLORES LAMB, PH.D. <i>New York, New York</i>	DAVID REICHMAN, M.D., F.A.C.O.G. <i>New York, New York</i>
ANDREA BORINI, M.D. <i>Bologna, Italy</i>	MARK GIBSON, M.D. <i>Salt Lake City, Utah</i>	DAN LEBOVIC, M.D. <i>Madison, Wisconsin</i>	ILANA B. RESSLER, M.D. <i>Norwalk, Connecticut</i>
ERNESTO BOSCH, M.D. <i>Valencia, Spain</i>	SUZANNE GILBOA, PH.D. <i>Atlanta, Georgia</i>	LARRY LIPSHULTZ, M.D. <i>Houston, Texas</i>	MARY RIDDLE, PH.D. <i>State College, Pennsylvania</i>
NANCY BRACKETT, PH.D. <i>Miami, Florida</i>	PAUL GINDOFF, M.D. <i>New York, New York</i>	DANELLE LOBDELL, M.S., PH.D. <i>Research Triangle Park, North Carolina</i>	JARED ROBINS, M.D. <i>Chicago, Illinois</i>
RICHARD BRONSON, M.D. <i>Stony Brook, New York</i>	ELIZABETH GINSBURG, M.D. <i>Boston, Massachusetts</i>	TYCHO LOCK, M.D. <i>Utrecht, Netherlands</i>	JAY SANDLOW, M.D. <i>Milwaukee, Wisconsin</i>
JOHN BUSTER, M.D. <i>Providence, Rhode Island</i>	JEFFREY GOLDBERG, M.D. <i>Cleveland, Ohio</i>	NICK MACKLON, M.D., PH.D. <i>Southampton, United Kingdom</i>	JOSEPH SANFILIPPO, M.D. <i>Pittsburgh, Pennsylvania</i>
ETTORE CAROPPO, M.D. <i>Bari, Italy</i>	JAMES M. GOLDFARB, M.D. <i>Cleveland, Ohio</i>	GUILLERMO MARCONI, M.D. <i>Buenos Aires, Argentina</i>	PETER SCHLEGEL, M.D. <i>New York, New York</i>
WILLIAM CATHERINO, M.D., PH.D. <i>Bethesda, Maryland</i>	MARC GOLDSTEIN, M.D. <i>New York, New York</i>	PETER MCGOVERN, M.D. <i>Newark, New Jersey</i>	BEATA SEEBER, M.D., M.S.C.E. <i>Innsbruck, Austria</i>
JORGE E. CHAVARRO, M.D., SC.D. <i>Boston, Massachusetts</i>	STEPHAN GORDTS, M.D. <i>Leuven, Belgium</i>	MARCOS MESEGUER, PH.D. <i>Valencia, Spain</i>	JAMES SEGARS, M.D. <i>Baltimore, Maryland</i>
YOUNG MIN CHOI, M.D., PH.D. <i>Seoul, Republic of Korea</i>	TIMUR GURGAN, M.D. <i>Ankara, Turkey</i>	YOSHIHARU MORIMOTO, M.D., PH.D. <i>Osaka, Japan</i>	STEVEN D. SPANDORFER, M.D. <i>New York, New York</i>
GREGORY M. CHRISTMAN, M.D. <i>Gainesville, Florida</i>	MICHELE R. HACKER, SC.D. <i>Boston, Massachusetts</i>	SUNNI L. MUMFORD, PH.D. <i>Bethesda, Maryland</i>	JUDY E. STERN, PH.D. <i>Lebanon, New Hampshire</i>
RAUL I. CLAVIJO, M.D. <i>Sacramento, California</i>	KARIN HAMMARBERG, PH.D., R.N., B.SC. <i>Melbourne, Australia</i>	AJAY NANGIA, M.B.B.S. <i>Kansas City, Kansas</i>	H. IRENE SU, M.D, M.S.C.E. <i>La Jolla, California</i>
ANA COBO, PH.D. <i>Valencia, Spain</i>	KATHLEEN HOEGER, M.D. <i>Rochester, New York</i>	CAMRAN NEZHAT, M.D. <i>Stanford, California</i>	ERIC S. SURREY, M.D. <i>Lone Tree, Colorado</i>
CHRISTOPHER DE JONGE, PH.D. <i>Minneapolis, Minnesota</i>	HEATHER GIBSON HUDDLESTON, M.D. <i>San Francisco, California</i>	MICHELLE NISOLLE, M.D, PH.D. <i>Liege, Belgium</i>	HUGH TAYLOR, M.D. <i>New Haven, Connecticut</i>
THOMAS D'HOOGHE, M.D., PH.D. <i>Leuven, Belgium</i>	KEITH ISAACSON, M.D. <i>Newton, Massachusetts</i>	HIROSHI OKADA, M.D., PH.D. <i>Koshigaya, Japan</i>	NATHAN R. TREFF, PH.D. <i>Basking Ridge, New Jersey</i>
ANUJA DOKRAS, M.D., PH.D. <i>Philadelphia, Pennsylvania</i>	TIM JENKINS, PH.D. <i>Salt Lake City, Utah</i>	KUTLUK OKTAY, M.D. <i>New York, New York</i>	ALFREDO ULLOA-AGUIRRE, M.D., D.SC. <i>Mexico City, Mexico</i>
MARIE-MADELEINE DOLMANS, M.D., PH.D. <i>Brussels, Belgium</i>	CALEB KALLEN, M.D., PH.D. <i>Philadelphia, Pennsylvania</i>	STEVEN ORY, M.D. <i>Margate, Florida</i>	MONICA VAZQUEZ-LEVIN, PH.D. <i>Buenos Aires, Argentina</i>
ALICE D. DOMAR, PH.D. <i>Waltham, Massachusetts</i>	HEY-JOO KANG, M.D. <i>New York, New York</i>	FIRUZA PARIKH, M.D. <i>Mumbai, India</i>	ROBERT WILD, M.D., PH.D., M.P.H. <i>Oklahoma City, Oklahoma</i>
OLIVIER DONNEZ, M.D., PH.D. <i>Avignon, France</i>	DANIEL J. KASER, M.D. <i>Marlton, New Jersey</i>	(EDITOR, INDIAN EDITION)	ELENA YANUSHPOLSKY, M.D. <i>Boston, Massachusetts</i>
ERMA Z. DROBNIS, PH.D. <i>Columbia, Missouri</i>	EDWARD KIM, M.D. <i>Knoxville, Tennessee</i>	LAURI PASCH, PH.D. <i>San Francisco, California</i>	EDWINA YEUNG, PH.D. <i>Bethesda, Maryland</i>
SHELLEY EHRLICH, M.D., SC.D., M.P.H. <i>Cincinnati, Ohio</i>	HELEN H. KIM, M.D. <i>Chicago, Illinois</i>	ALEXANDER W. PASTUSZAK, M.D., PH.D. <i>Houston, Texas</i>	HEPING ZHANG, PH.D. <i>New Haven, Connecticut</i>
NAVID ESFANDIARI, D.V.M., PH.D. <i>Lebanon, New Hampshire</i>			

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.



Global Associates

PILAR ALAMA, M.D., PH.D.
Valencia, Spain

DIANA ALECSANDRU, M.D., PH.D.
Madrid, Spain

NATALIA BASILE, PH.D.
Madrid, Spain

LUIS CARMONA, PH.D.
Las Palmas, Spain

IRENE CERVELLÓ, PH.D.
Valencia, Spain

PATRICIA DÍAZ-GIMENO, PH.D.
Valencia, Spain

CESAR DÍAZ, M.D., PH.D.
London, United Kingdom

MARGA ESBERT, PH.D.
Barcelona, Spain

HORTENSIA FERRERO, PH.D.
Valencia, Spain

MANUEL FERNANDEZ, M.D., PH.D.
Seville, Spain

SONIA HERRÁIZ, PH.D.
Valencia, Spain

EVELIN LARA, M.D.
Barcelona, Spain

BARBARA LOTTI, M.D.
Buenos Aires, Argentina

ELKIN MUÑOZ, M.D., PH.D.
Vigo, Spain

MANUEL MUÑOZ, M.D.
Alicante, Spain

FERNANDO NEUSPILLER, M.D.
Buenos Aires, Argentina

ANDRÉS REIG, M.D.
Milford, Connecticut

M^A JOSÉ DE LOS SANTOS, PH.D.
Valencia, Spain

JOSÉ SERNA, M.D., PH.D.
Zaragoza, Spain

MARGA TORRES, M.D.
Mallorca, Spain

VANESSA VERGARA, M.D.
Madrid, Spain

CARLOS VÁSQUEZ, PH.D.
Panama City, Panamá