



FRONTIERS IN OPHTHALMOLOGY



Harvard Medical School
Department of Ophthalmology

**Harvard Medical School
Department of Ophthalmology
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243 Charles Street, Suite 800
Boston, Massachusetts 02114
(617) 573-3526
www.MassEyeAndEar.org
eyenews@meei.harvard.edu

Editors-in-Chief

Joan W. Miller, MD
*Chief and Chair
Department of Ophthalmology
Massachusetts Eye and Ear Infirmiry
Massachusetts General Hospital
Harvard Medical School*

John I. Loewenstein, MD
*Associate Professor of
Ophthalmology
Harvard Medical School
Associate Chief for Graduate
Medical Education
Massachusetts Eye and Ear Infirmiry*

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Charles Ruberto, PhD
Melanie Saunders
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Administrative Manager:

Janet Cohan

Photography:

John Earle Photography
www.johnearlephoto.com

Design:

Visual Dialogue
Designers: Fritz Klaetke,
Rita Ferreira, Kimber Couzo,
Benjamin Shaykin
www.visualdialogue.com

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“The pace and progress of vision science is hurtling forward at momentous speed, spurred on by a host of exciting new research discoveries, an unprecedented culture of collaboration, and the unflagging efforts of our clinicians, scientists, and educators.”

— JOAN W. MILLER, MD

WELCOME

MESSAGE FROM THE CHAIR

Welcome colleagues, friends and supporters to the Harvard Medical School (HMS) Department of Ophthalmology’s inaugural edition of *Frontiers in Ophthalmology*. I am proud and excited to share with you this first report, which highlights significant clinical, scientific, and educational milestones of the department’s world-class affiliated hospitals and research institutions. Our report reflects on two decades of discovery and progress in the field of vision science, and the tools and technologies that are transforming the lives of people and patients across the globe.

From Boston to Bangladesh, improving ophthalmic care and its delivery to millions of people worldwide is a shared vision and singular goal of the HMS ophthalmic community. Advancing technology, expanded global connections, and thriving new alliances among HMS affiliates and across the broader scientific community are fueling gains in vision science, education, and medicine. As you’ll read in the following pages, HMS scientists, physicians, and academics from all ophthalmic disciplines and across every subspecialty are brainstorming in the lab, the classroom, and the clinic. Their shared knowledge is driving ideas forward and, ultimately, improving care to patients.

Educating the next generation of leaders

The HMS Department of Ophthalmology has a proud history of teaching, training, and mentoring generations of students who become leaders in their field. In the last several years, we’ve reinvigorated, refined and retooled our educational program to challenge and inspire students at every level of their medical education.

Our training program features a newly restructured surgical curriculum for residents, which now integrates lectures and customized wet lab sessions supervised by attending physicians. Groundbreaking faculty efforts are reshaping resident education with the development of revolutionary, computer-simulated technologies that fine-tune surgical knowledge and skills outside the operating room. Innovative courses and conferences—including our nationally recognized cataract course and new vitreoretinal course—offer students added venues of scientific inquiry and learning, and attract prominent, international speakers. We continue to forge strong alumni ties through our expanded lecture series, a robust visiting professors program, a new AMD symposium, and a newly revamped and expanded three-day Annual Meeting & Alumni Reunion. Across the HMS community and abroad, our expanded alliances with affiliates and partners have sparked unprecedented opportunities for surgical, clinical, and research training. All of these endeavors offer an unparalleled educational experience for our brilliant young trainees.

Advancing science

Thanks to a paradigm shift in collaboration among basic researchers and clinician scientists, insights gained in the lab are accelerating bench-to-bedside discoveries faster than ever before. The last decade has seen

groundbreaking advances in human genetics, regenerative medicine, and inflammation and immunology; these, in turn, have led to a host of new treatments, technologies, and therapies aimed at alleviating the suffering associated with eye diseases and blindness. HMS researchers have focused intensely on these areas, and are beginning to unravel some of the mysteries surrounding disease processes, and the biological mechanisms or environmental influences that may cause them to go awry.

For example, you’ll read about advances in age-related macular degeneration (AMD) pioneered by the HMS Angiogenesis Research Group. The foundations of the group’s work not only illuminated how new blood vessel formation in the eye (neovascularization) contributes to severe forms of AMD, but also spurred revolutionary clinical treatments that halt and sometimes reverse pathological blood vessel growth. Today, anti-VEGF inhibitors and therapies developed in our labs have saved or improved the sight of nearly a million people around the world. Recent and exciting results from a large-scale, phase 3 clinical trial for treating macular edema in diabetic patients showed dramatic visual improvement using the anti-VEGF drug Lucentis®. These groundbreaking efforts represent a quantum leap in treatment for patients with diabetes—the first in 25 years—and are rapidly establishing new standards of care.

In cornea, HMS faculty members are pursuing novel translational research that has shed new light on the roles of angiogenesis and inflammation in ocular disease. Clinical trials in these areas are providing a robust baseline of data—facilitating the development of therapies to combat these diseases. HMS cornea scientists are also leading industry efforts to harness powerful, new imaging technologies that more precisely target,

track, and treat corneal disease, and ultimately improve patient outcomes. You'll also read about advances to our Boston Keratoprosthesis (Kpro)—the most widely used corneal prosthesis in the world—coupled with aggressive outreach efforts to make it available to patients worldwide. To date, some 5,000 people in 50 countries, including the United States, are beneficiaries of our KPro programs.

In 2005, significant advances in whole-genome screening technologies, coupled with increasingly powerful computing capabilities, are enabling us to explore DNA inheritance with unimaginable precision and speed. For the first time, opportunities to examine gene-gene and gene-environment interactions will help us determine who may be at increased risk for specific diseases. Efforts within the department are already underway to exploit this potential: we are currently integrating information and expertise across the department through new centers of excellence, building a massive biorepository of donor tissue and DNA samples, integrating vast amounts of genetic and clinical information, and launching our new Ocular Genomics Institute. All of these efforts welcome a new era of personalized medicine—which ultimately means better care for everyone.

Pursuing excellence in patient care

The cornerstone of our mission is the quality of care we provide to patients. Significant efforts by HMS faculty are impacting our full spectrum of patient care—from prevention to treatment to rehabilitation. For example, cutting-edge technologies are giving us better prognostic information that enables us to diagnose and treat ocular diseases faster and more efficiently. More targeted and less invasive drug treatments and therapies are preventing, saving, and sometimes restoring sight in patients, young or old. Recent and exciting developments in lens technology—already helping to improve Kpro outcomes—may soon offer great therapeutic benefits across a broad range of eye disorders and diseases. Pioneering advancements in rehabilitative medicine are enabling site-challenged patients to maximize their vision—sometimes even restoring sight—with new tools, technologies, and therapies that improve their quality of life.

Physicians and faculty across the HMS ophthalmic community have a long tradition of collaborating on patient care, research, and academic activities. We've recently forged critical new alliances that have enabled unprecedented expansions in service to our patients and enhanced our quality of care. For example, we've boosted our presence in the Longwood Medical Area by launching a new outpatient practice at Joslin Diabetes Center's Beetham Eye Institute, and by adding emergency eye trauma coverage and inpatient consultation at Brigham & Women's Hospital. The Massachusetts Eye and Ear Infirmary and Massachusetts General Hospital officially joined forces when Mass. Eye and Ear established a formal department of ophthalmology at Mass General, enabling highly coordinated patient care

and expanding educational and research partnerships. Children's Hospital Boston and Mass. Eye and Ear have integrated their pediatric services, and now offer general pediatric ophthalmology and highly specialized pediatric strabismus care at both institutions. The recent merger between Schepens Eye Research Institute and Mass. Eye and Ear has created the world's largest ophthalmology research enterprise. We've also welcomed a cadre of bright, talented physicians and clinician scientists to support these important endeavors and to meet a steady rise in patient volume.

The future is now

The pace and progress of vision science is hurtling forward at momentous speed, spurred on by a host of exciting new research discoveries, an unprecedented culture of collaboration, and the unflagging efforts of our premier group of clinicians, researchers, and educators. As you'll read in these pages, our affiliate institutions that comprise the HMS Department of Ophthalmology have made remarkable gains in medical science and ophthalmic practice that are both broad in scope and high in impact.

Despite these gains, there is much to accomplish and a growing imperative to do so; as our population grows older, we can expect a significant rise in the number of people who become blind or visually impaired due to age-related diseases such as macular degeneration, glaucoma, and cataracts. An epidemic rise in the United States of type 2 diabetes is also triggering a surge in diabetic retinopathy—another leading cause of blindness in American adults. According to a study sponsored by the National Eye Institute, blindness or low vision affected 3.3 million Americans age 40 or older in 2004; by 2020, that number is projected to rise to 5.5 million Americans. These are sobering statistics that underscore the relevance of our mission and the call to action for continuing investments in vision science.

Thanks to you, our generous friends and supporters, our quest for innovation continues unabated across the HMS ophthalmic community. As you read on, I hope you'll share our excitement about the significant progress made to date and of the discoveries yet to come. It's a marvelous, inspiring, and empowering time to be at the forefront of vision science.

Welcome to our world of vision.

Joan W. Miller, MD

Henry Willard Williams Professor of Ophthalmology
Chief and Chair, Department of Ophthalmology
Massachusetts Eye and Ear Infirmary
Massachusetts General Hospital
Harvard Medical School

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Massachusetts General Hospital

Harvard Medical School

Dr. Joan Whitten Miller was born in Toronto, Ontario, Canada and is a graduate of Massachusetts Institute of Technology and Harvard Medical School. She completed her ophthalmology residency and vitreoretinal fellowship at Massachusetts Eye and Ear Infirmary. Dr. Miller joined the HMS faculty in 1991. She became the first woman physician to attain the rank of HMS Professor of Ophthalmology and, in 2003, became the first woman to serve as chair of the department. Additionally, Dr. Miller is director of Mass. Eye and Ear's Angiogenesis Laboratory and a vitreoretinal surgeon in the Retina Service.

Dr. Miller is a preeminent leader in the field of retinal research, and her seminal contributions have helped save the sight of countless individuals suffering from age-related macular degeneration (AMD) and diabetic retinopathy. Her main research interests focus on ocular neovascularization and retinal disease; besides elucidating the molecular mechanisms of angiogenesis and neuroprotection, she leads studies that contribute the development of effective therapies and drug delivery systems. She and her colleagues at Mass. Eye and Ear pioneered the development of photodynamic therapy (PDT) using verteporfin (Visudyne®), the first pharmacologic therapy for AMD able to reduce and slow vision loss. The group also identified the importance of vascular endothelial growth factor (VEGF) in neovascular AMD, and helped develop the prominent anti-VEGF therapies, pegaptanib and ranibizumab—the latter able to improve vision in about one-third of patients with neovascular AMD. While these approaches have improved the outlook for patients with AMD, Dr. Miller and her colleagues continue investigations to elucidate the pathophysiology and to develop next-generation therapies for AMD.

Throughout her tenure as Chair, Dr. Miller has sought vigorously to grow and diversify the core missions of the HMS Department of Ophthalmology, and to establish the department as the undisputed global leader in ophthalmic medicine, education, and research. She has fostered numerous initiatives that have unified and built upon the intellectual and innovative force of the faculty. Substantial investments in leadership and resources, expanded educational and training venues, new research

initiatives, and the establishment of new healthcare alliances have all contributed to the department's strong growth and increasing national and international presence. In 2008, Dr. Miller created five HMS Vice Chair positions to lead the areas of basic research, academic programs, centers of excellence, medical education, promotions, and reappointments. This new leadership structure has helped integrate the efforts of HMS affiliates and partners—promoting communication and multidisciplinary collaborations in all three mission-critical areas.

Dr. Miller is emphatically committed to supporting the incredible talent and dedication of HMS faculty. She has championed numerous administrative supports that have created a progressive and rewarding 21st century work environment. Dr. Miller has vigorously promoted superb faculty funding and mentoring programs, a renewed emphasis on promotions and appointments, and new venues for professional advancement and recognition; she also received national recognition for her strong advocacy efforts as the 2010 recipient of the Women in Ophthalmology (WIO) Suzanne Veronneau-Troutman Award. WIO president, Jennifer Lim, MD, lauded Dr. Miller as a “pioneer in enhancing the position and involvement of women in ophthalmology locally and nationally. Women have achieved parity guided by your gender-neutral policies, efforts to encourage women...to leadership positions in patient-care, teaching, research and administration and your support of their academic achievement...You stand out as a strong female voice in the ophthalmology community.”

A committed teacher and mentor, Dr. Miller has supervised more than fifty clinical and research fellows, most of whom now hold positions in academic ophthalmology around the world. Her outstanding contributions to retinal science make her a sought-after lecturer in the United States and abroad. She has published more than 140 peer-reviewed papers and 55 book chapters and review articles. She is co-editor of Albert and Jakobiec's Principles and Practice of Ophthalmology, 3rd ed. and a named inventor on nine U.S. patents. She has been honored with numerous awards, including the Rosenthal Award and Donald J. Gass Medal of the Macula Society, the Retina Research Award from the Club Jules Gonin, the Alcon Research Institute Award, the ARVO/Pfizer Ophthalmic Translational Research Award, the Founder's Award from the American Society of Retinal Specialists, the HMS 2010 Joseph B. Martin Dean's Leadership Award for the Advancement of Women Faculty, the Suzanne Veronneau-Troutman Award from Women in Ophthalmology, and the Paul Henkind Memorial Award from the Macula Society.