

HARVARD UNIVERSITY: Department of Biostatistics: 1922 – 2011

Nan Laird and Marvin Zelen

1. The Early Years: 1922 – 1961

In 1922 the Harvard School of Public Health (HSPH) was founded in the Harvard Longwood Medical Area of Boston. The Department of Biostatistics (then called Vital Statistics) was one of four core departments in the new school. Edwin B. Wilson was appointed as the Chair in Vital Statistics. Wilson came to HSPH from MIT where he had been Chair of the Physics Department. Trained as a physicist, Wilson's interests in science and its applications were very broad. He was also interested in the fundamentals of mathematics as applied to problems in public health. He published papers on mathematical epidemiology, discussed confidence intervals for a binomial probability in a 1927 publication, was president of the American Statistical Association and was the first managing editor of the Proceedings of the National Academy of Sciences for which he served for 50 years. Surviving correspondence from the 1930's demonstrates the intellectual interchange between E.B. Wilson and Professor Ronald A. Fisher as the latter was developing some of the foundational concepts of statistical inference. Wilson was a perceptive critic of Fisher's work, and Fisher's appreciative letters to Wilson bore this out. In 1931 Wilson recruited newly-minted Smith College mathematics major Jane Worcester to be his "computer." They coauthored approximately two dozen theoretical papers during their fifteen-year working relationship; Wilson retired from the chairmanship in 1945.

Hugo Muench succeeded Wilson as Chair of the Department (now re-named Biostatistics) in 1946 and served for 15 years. Muench was a physician, trained in biostatistics at the Johns Hopkins University (JHU). In 1947, Worcester successfully defended her dissertation and earned the Dr.PH degree in Biostatistics and Epidemiology – the first woman to earn this degree at the Harvard School of Public Health. Muench sought and received a faculty appointment for Worcester and mentored her to a later promotion to Associate Professor. During these years, Margaret (Marge) Drolette joined the Department as a teaching assistant after completing an outstanding undergraduate record in mathematics at Radcliffe College. Drolette subsequently earned her Ph.D. in Statistics in 1965 from the Harvard Faculty of Arts and Sciences (FAS) and ultimately became Professor of Biostatistics. Robert Reed came to the Biostatistics Department as a second generation biostatistician after completing his bachelor's degree at Johns Hopkins in Applied Statistics and receiving a Ph.D. in Sociology from the University of Chicago. Reed's father was the pioneering biostatistician Lowell J. Reed. The senior Reed was Professor of Biostatistics and later Dean of the School of Public Health at Johns Hopkins and President of JHU.

2. 1961 – 1977: Years of Consolidation

Robert Reed succeeded Muench as Chair of the Department of Biostatistics in 1961. During this period, the Department consisted of two full professors (Reed and Worcester), one lecturer (Drolette), two emeritus professors (Wilson and Muench), a handful of graduate students, and several research assistants and computer programmers. Reed served as Chair until 1973, and Jane Worcester was appointed the first female Chair of the Department. The Department had a school-wide reputation as being student friendly, especially to those in the MPH program, which numbered about 110 students per class, most of whom were physicians. The Department's *raison d'être* was principally as a service department for HSPH. However, the Department also had a robust Master of Science program and, together with the Department of Statistics in the Harvard FAS, offered a Doctor of Science program as well as a Doctor of Public Health degree.

It is impossible to overstate the importance of teaching quality to the mission of the Department of Biostatistics during the Reed-Worcester-Drolette era. The reputation of the Department was centered on the universal accessibility of its courses to all students at HSPH, and course evaluations by students documented the success of the Department in its reputation for quality instruction. Year after year, a Biostatistics Department faculty member was named "outstanding teacher of the year" for the School of Public Health. Often this recognition was given to Marge Drolette. This tradition of outstanding teaching has continued throughout the Department's history to the present time, with numerous faculty receiving prestigious teaching awards from the School.

During this period, additional faculty were added to meet the growing demands for Biostatisticians in teaching and research. New faculty included Yvonne Bishop, Ray Neff (an alumnus of the Department who went on to head the Health Sciences Computing Facility at HSPH), and Nan Laird, who initially joined the Department to teach in the Executive Programs of the Department of Health Policy and Management.



Figure 1: Hugo Muench, Robert Reed and Jane Worcester circa 1950.

3. 1977- 1980. The Mosteller Years: A New Beginning

In 1970, Derek Bok became the youngest president in the history of Harvard University. After setting his first priority as the reform of undergraduate education, Bok turned his attention to the Medical Area with the appointment in 1972 of Howard Hiatt as Dean of the School of Public Health. Hiatt had great respect for the role of statistics in medical decision making, and was eager to expand the teaching and research of Biostatistics in the medical area. He began to consult regularly with Frederick Mosteller in the Statistics Department in the Faculty of Arts and Sciences (FAS) about strategies for improving statistical science at the School and finding a new chair for the Department. Together they organized an Interdisciplinary Faculty Seminar on Health and Medicine that was widely attended by faculty and graduate students from FAS, the Kennedy School, and the Schools of Medicine and Public Health.

In the spring of 1977, Mosteller accepted the position of Chair of the Biostatistics Department. Mosteller was a familiar and influential figure not only at Harvard,

but in the national and international statistical community as well, serving as President of the American Society for the Advancement of Science. Prior to accepting the post in Biostatistics, he had chaired the Statistics Department, served as faculty member in the Department of Psychology and Social Relations in FAS, and as a faculty member of the Committee on Public Policy of Harvard's School of Government.

Mosteller immediately set about creating a consolidating Biostatistics faculty scattered in other departments and creating an academic home for the many Biostatisticians in the Harvard medical area. He also began to recruiting new faculty. In the summer of 1977 the Department appointed Marvin Zelen Professor of Statistical Science. Zelen also founded the Department of Biostatistics and Epidemiology at the Sydney Farber Cancer Institute (later renamed the Dana-Farber Cancer Institute). He succeeded in bringing many members of his Statistical Laboratory at the State University of New York at Buffalo (SUNYAB) to HSPH, where they were appointed as junior faculty. This group included Colin Begg, Richard Gelber, David Schoenfeld and Kenneth Stanley. The following year, Marcello Pagano and Stephen Lagakos came from SUNYAB to join the HSPH faculty. Although the main focus of research activities for these faculty members was cancer clinical trials and collaborating/consulting at the Dana-Farber Cancer Institute (DFCI), Zelen viewed the Biostatistics Department at HSPH as most appropriate for their faculty appointments and teaching responsibilities. Bringing these faculty to HSPH was a major coup for the Department. Tripling the size of the Department overnight required no small measure of political savvy on Mosteller's part. In addition to soothing ruffled feathers among the other department chairs, he had to prove the benefits to the School would more than justify the financial investment. Mosteller's strategy was to approach department heads separately, and ask how they would accomplish this for their own department, then set out to follow their advice. Mosteller wrote, "It turned out that, when department and committee chairs understood what we were trying to do and how it could be financed, the benefit for the School seemed obvious, though the story took a great deal of explaining and ploughed through hills of skepticism." (Mosteller, Frederick, *The Pleasures of Statistics*).

In addition to recruiting the faculty group based at the Dana-Farber, Mosteller also recruited Christine Waternaux, James Ware, John Orav and Thomas Louis, all as faculty based at HSPH. When Mosteller resigned as Chair in 1981 to become Chair of the Department of Health Policy and Management at HSPH, the Department had 23 primary faculty and 37 graduate students.

One of Mosteller's priorities was to expand the teaching and graduate program. He set up an extensive set of Department Committees to implement this expansion. Zelen successfully secured a large training grant from the NIH's National Cancer Institute (NCI). Ware, who had been recruited from the NIH to collaborate with the School's environmental health program, was awarded a

second training grant from the NIH's National Institute of Environmental Health Sciences (NIEHS). It was an exciting time for the Department. Faculty meetings were held regularly and often, and all faculty were fully engaged and committed to building an outstanding Department.

New course proposals were submitted to the School's Curriculum Committee almost monthly. At one point a question arose in a School-wide faculty meeting as to when the Department of Biostatistics would finally get its curriculum fixed and stop changing its courses? Mosteller answered very firmly, "Never."



Figure 2: Nan Laird, Frederick Mosteller, and Marvin Zelen, early 1990.

4. 1980-1990. Marvin Zelen's Decade of Leadership.

Marvin Zelen became acting Chair during the 1980-81 academic year when Mosteller went on sabbatical leave. He was appointed Chair the following year. During Zelen's chairmanship, the Department continued to expand. The Department had 27 masters and doctoral students in 1979-80 and this number increased to 60 by 1990. Faculty increased from 28 to 34. Among the faculty, four professors (Laird, Lagakos, Pagano and Ware) received tenure at HSPH and Bernard (Bernie) Rosner received tenure in the Medical School, and secondarily in this Department. Forty-five doctorates were awarded in this ten-year period. The Department ranking, as determined by the National Research

Council (as well as other compilations), was always amongst the top biostatistics/statistics departments in the U.S.

The Department continued to expand its teaching function in the School of Public Health, especially for students in subject matter departments. A high proportion of students elected to take more advanced courses in the Department after taking the mandatory biostatistics course. During 1985-90 period the Biostatistics' student credit hours averaged 21% of the entire School's credit hours. High enrollment in the department's classes was due to the growing awareness of the importance of Biostatistics in Public Health and the easy availability of computing. It also reflected the high quality of teaching in the Department.

During this time period, the rapidly-growing Biostatistics department at the Dana-Farber served as the largest focus for the HSPH-based Department's collaborative research program. The critical mass of biostatistical scientists at the DFCI motivated research on the many new methodological problems encountered in cancer research. HSPH faculty appointed to the DFCI Department of Biostatistics during this period included: James Anderson, Dianne Finkelstein, Rebecca Gelman, Robert Gray, David Harrington, Myrto Lefkopoulou, Louise Ryan and Anastasios Tsiatis.

Faculty based at the DFCI were heavily involved in national and international multi-center cancer clinical trials. At one time there were eight cancer clinical trial cooperative groups having their statistical centers at the DFCI. This constituted about one-third of the National Cancer Institute's multi-center clinical trials program. These included the Statistical Centers for the Eastern Cooperative Oncology Group (ECOG), led by Zelen and Harrington, Cancer and Acute Leukemia Group B (CALGB), led by James Anderson, and the International Breast Cancer Study Group (IBCSG), led by Richard Gelber. These activities made the Department the world center for carrying out multi-center cancer clinical trials. Hundreds of cancer trials were carried out through these eight Cooperative Clinical Trial Groups. Many of the ideas and methods, considered routine today for carrying out multi-center trials, were developed during that time -- especially in the ECOG.

In addition to the large biostatistical group at the DFCI, smaller statistical groups were being seeded within the Harvard-affiliated hospitals. The Massachusetts General Hospital (MGH) appointed Schoenfeld and Finkelstein to organize a biostatistical collaborative and consulting group, and Waternaux headed a biostatistics group at McLean Hospital.

Under the leadership of James Ware, the Department played a major role in the Harvard Six Cities Study of air pollution and health. The School's Department of Environmental Health had initiated this project in the 1970's with the collaboration of Yvonne Bishop. The Six Cities Study was one of the most influential,

innovative, and longest-running studies concerning the health effects of air pollution in the U.S. For the first time in this country, public health researchers directly correlated environmental exposure to toxins with health impacts; their findings served as key inputs to the Environmental Protection Agency in setting standards for air pollution. Many of the Department's faculty collaborated in the project, including Laird and Louis, as well as newly-recruited Victor DeGruttola and later Andrea Rotnitzky. Work on this project was instrumental in developing innovative methods for the statistical analysis of longitudinal data, and made the Department a leading center for developing methods for longitudinal data analysis.

During the Zelen chairmanship, the well known environmental study, often referred to as the "Woburn Study" was carried out by Lagakos and Zelen. The study was named for its setting in a small town of about 35,000 residents located a few miles north of Boston. The study was prompted by the observation of a childhood leukemia cluster in East Woburn. Residents received a blend of water from eight wells, two of which were found to be contaminated with trichloroethylene (TCE), an industrial solvent. Lagakos and Zelen were able to demonstrate an association between exposure to well water and the leukemia cases as well as an array of birth defects. The Woburn Study generated a huge amount of publicity, resulting in several books, popular articles, a PBS Nova program in which Lagakos and Zelen were interviewed, congressional testimony by Zelen and the motion picture "A Civil Action". An important feature of the Woburn Study was the organization of 250 volunteers to collect data using random telephone dialing. This was the founding of what is now referred to today as "citizen epidemiology".

5. 1990-2009: Laird, Lagakos and Ryan: The Tradition Continues

Nan Laird was appointed Department Chair in 1990, Stephen Lagakos in 1999, and Louise Ryan in 2007. Traditions of departmental growth and excellence continued during this twenty-year period, marked by new directions in research, building stronger connections with the HSPH Department of Epidemiology, and the establishment of industry partnerships. In 1990, the Department had just completed more than a decade of unprecedented growth in faculty, students and space. Dean Harvey Feinberg established two endowed chairs for Department members: the Henry Pickering Walcott Professorship for the Department Chair, and the Frederick Mosteller Professorship, which was awarded to Ware when he became the HSPH Academic Dean, a position he held until 2009. The Department's academic program was firmly in place, but research programs were still expanding and the Department had grown in size to nearly 80 doctoral and master's students and over 30 faculty.



Figure 3: Department Senior Faculty on Retreat, 1990.

In the wider world of public health, HIV/AIDS had emerged as a major threat to populations throughout the world.—In 1989, the Department's focus on clinical trials expanded greatly when Lagakos was awarded an NIH contract to lead the Statistical Center for the AIDS Clinical Trial Group (ACTG), a multi center cooperative clinical trial group formed to carry out clinical trials in HIV/AIDS. The ACTG was the NIH/NIAID main program for carrying out HIV/AIDS clinical trials. The award was large and led to the establishment of an independent center named the Center for Biostatistics in AIDS Research (CBAR). CBAR served as the Department's focus on AIDS. In addition to being the home of the Statistical Center, CBAR generated seminars, faculty/student support and enhanced the Department's methodological research on AIDS. It was important in attracting a new training grant concentrating on AIDS/HIV led by Pagano.

The ACTG Statistical Center award provided opportunities to recruit new faculty. Among these new faculty were Michael Hughes, Kenneth Stanley (returning to HSPH from the WHO), Paige Williams, Rebecca Betensky, and Lee-Jen Wei. Additional faculty were recruited in subsequent years, including Tianxi Cai and Judith Lok. In addition, the project required numerous biostatistical scientists ranging from master's level statisticians to senior and Principal Research Scientists. The project was fortunate in that DeGruttola had earlier been interested in the scientific problems of AIDS and had become one of the most knowledgeable faculty at the School on the scientific aspects of the disease. He and Lagakos provided the initial intellectual leadership for CBAR, which became one of the research hubs at HSPH for HIV/AIDS. Lagakos and DeGruttola also formed strong research ties to the work undertaken by Max Essex in the HSPH Department of Immunology and Infectious Diseases.

Another transforming event was the beginning of the Human Genome Project in 1990 and the expansion of investigations for genes underlying disease. The Department's research program in Statistical Genetics began in the 1990's when Laird initiated a Working Group seminar series. She received funding for methodological research in Statistical Genetics from the NIMH which led to the recruitment of Christoph Lange. They developed both innovative research methods and software packages which are widely used in genetic analysis throughout the world.

Over the years, several faculty working in the area of Statistical Genetics, including Peter Kraft, Liming Liang and Alkes Price, were appointed jointly in Epidemiology and Biostatistics. The success of the Statistical Genetics Program has attracted many visitors, postdoctoral fellows and students. It has generated collaborative research with colleagues throughout the Harvard medical community on a large spectrum of health problems, including cancer, asthma, COPD, bipolar disorder, nicotine addiction, behavioral inhibition, Alzheimer's disease, sleep disorders, malaria and birth defects.

The Human Genome Project brought many new technological advances in molecular biology and generated new fields of investigation in genomics ; e.g. high-dimensional data analysis, bioinformatics, and computational biology. The Department made many new appointments in this area beginning in the early 2000s. The newly re-named Department of Biostatistics and Computational Biology at the Dana-Farber Cancer Institute, chaired by David Harrington, led the way for the School. Among those appointed were Wing Wong and John Quackenbush at the senior level, and Robert Gentleman, Xiaole Shirley Liu, Cheng Li, Guocheng Yuan and Armin Schwartzman at the junior levels. Although both Wing Wong and Robert Gentleman ultimately left the Department, major open source software systems were developed during this period with Robert Gentleman starting the development of Bioconductor and Cheng Li continuing the development of the d-Chip system. These two software systems are used world-wide for the analysis of genomic data.



Figure 4: Steve Lagakos and Louise Ryan, circa 2000.

During Louise Ryan's chairmanship, the School-wide interdisciplinary Program in Quantitative Genomics (PQG) was established under the leadership of Xihong Lin, John Quackenbush and David Hunter. To strengthen this program, computational biologists Winston Hide and Curtis Huttenhower were recruited into the Department. The goal of the PQG is to improve health through the study of genetics, behavior, environment, and medicine and encourage interdisciplinary training in quantitative genomics. Today the PQG is directed by Lin, Kraft, Quackenbush, and Hide, and incorporates the Harvard Bioinformatics Core.

The tradition of working closely with researchers in the Department of Environmental Health continued during this period, with the formation of the Program in Environmental Statistics in the Department. Several faculty were recruited to work in this area, including Matthew Wand, Brent Coull, Chris Paciorek, and Xihong Lin. The program in cancer research and clinical trials centered at DFCI continued to flourish with the appointment of several new faculty including Kyungmann Kim, Stuart Lipsitz, Yi Li, Donna Neuberg, Joe Ibrahim and Armin Schwartzman. The Biostatistics Group at the MGH continues to flourish. Interaction with the Department of Population Sciences was started with the joint appointment of Grace Wyshak, who has studied many issues in women health.

Ties with Epidemiology were greatly strengthened during this period with several additional secondary faculty appointments. Among these were: James Robins, Donna Spiegelman, Eric Tchetgen Tchetgen and Tyler VanderWeele. A new

program of research in causal inference, initiated by Robins, has attracted faculty, postdocs and students from both departments, and has made HSPH a noted center for research in this area. Faculty working on causal inference include Robins, Rotnitzky, Lok, Tchetgen Tchetgen, and VanderWeele.

Many faculty, whose primary home is in the Harvard Medical School, received secondary appointments in the Department as they took on substantial training or teaching roles at HSPH. They include Bernard (Bernie) Rosner, Kimberlee Gauvreau, Robert Glynn and Sharon-Lise Normand. John Orav, first appointed in the 80's, continues to play a leadership role in the Clinical Effectiveness Program, a Master's Degree Program designed for physicians.

The Department was awarded several new NIH training grants during this period. The first was awarded from the NIMH, joint with Epidemiology, headed by Laird and Waterman. Subsequently, Garrett Fitzmaurice was recruited to work in Psychiatric Statistics and currently heads this effort. As previously mentioned, when the Department expanded its research focus to HIV/AIDS, a training grant from NIAID was awarded to the Department. Betensky developed a training program funded by NINDS for students and postdoctoral fellows working in Neurostatistics and Neuroepidemiology. Most recently, the Department has developed a program funded by the NIGMS to train students working in quantitative genomics, computational biology and genetic epidemiology. This training grant was initially headed by Wei, and is currently directed by Lin and Quackenbush. In addition, Lagakos established an endowed scholarship program, named in honor of his immigrant father Vasilios Stavros Lagakos, to train international doctoral students from developing countries who intend to return home to continue their careers.

In 1991, the Department was approached by statisticians at Schering-Plough to form a new type of Academic-Industry Partnership. Its goal was to create an interactive relationship between HSPH and Schering-Plough biostatisticians for the promotion of methodological research and its application to the scientific challenges facing the pharmaceutical industry. The Partnership sponsors an annual joint scientific workshop at HSPH, with an average attendance of 150-200 attendees from academia, government and industry. A sampling of workshop themes includes: Global Clinical Trials, Vaccines and Control of Disease, Individualized Medical Treatments, Strategies in Drug Safety and Monitoring, Emerging Strategies in the Design and Monitoring of Clinical Trials, Interim Analysis, Adaptive Design and Bayesian Methods in Clinical Trials. Due to the success of the Schering-Plough partnership, the Department soon developed similar relationships with Pfizer, Wyeth, and the Genetics Institute. In 2003, the American Statistical Association awarded the Harvard-Schering Plough Partnership the Statistical Partnerships in Academe, Industry and Governments Prize, "For an outstanding statistical partnership representing a collaboration between academia and industry of eleven years, which has resulted in the annual Harvard/Schering-Plough Workshop, a unique forum for discussing

emerging topics in drug development; interdisciplinary visits between the two institutions to exchange and generate research ideas; a summer intern program at Schering-Plough; and the funding of student training and faculty research at Harvard university. This award is recognition of excellence within the SPAIG concept.” When Merck and Schering Plough merged in 2010, the tradition continued with a re-named Harvard-Merck Partnership.

In 2000, the Department launched an academic partnership with Kitasato University in Tokyo, Japan. Kitasato had recently formed the first graduate degree program in Biostatistics in Japan, and the newly-formed Department of Biostatistics was (and continues to be) chaired by Masahiro Takeuchi, a graduate of the Department’s doctoral program. The Partnership involves Department faculty both in the development of Kitasato’s doctoral program and in research on statistical issues relating to drug development in Japan and Asia. The Kitasato – Harvard Workshop, held each year in Tokyo, attracts between 500-700 attendees from major universities, hospitals, government health departments and pharmaceutical organizations, mainly from Japan, and focuses on drug development problems in Japan and the Pacific Rim countries.

Three annual lecture series were established during this time period to bring distinguished speakers into the Department. The Myrto Lefkopoulou lectureship award was established in 1992 to honor the memory of a beloved colleague who died of cancer at the age of 34. It is given to honor an individual within 15 years of receiving the doctorate who has distinguished him/herself in biostatistics. The Marvin Zelen Leadership Award was established in 1997, on Zelen’s 70th birthday, to honor individuals who have provided leadership in biostatistical programs in academia, industry or government. Finally, the Alumni Award was established in 2004 to honor the Department’s graduates who have gone on to make notable contributions to biostatistics through their careers in academia, government, or industry.

Under the leadership of Ryan, and now Betensky, the Department has made great efforts to increase the diversity of quantitative scientists working in biomedical research. The Department has been very successful in attracting minority students to its doctoral program, in part through improving “pipeline” efforts with its Summer Program in Quantitative Sciences, instituted in 1994. In 2009, the Department received an award from the American Mathematical Society, which noted its successful efforts in creating a replicable model for bringing more underrepresented minority undergraduates into the pipeline leading to an advanced degree in the mathematical sciences

In 2003, the Department of Biostatistics began to award the PhD under an agreement between HSPH and the Harvard Faculty of Arts and Sciences (FAS). Previously, the Department of Biostatistics had offered the doctor of science (SD) degree. One motivation for the switch was the greater visibility of the PhD over the SD.

6. 2009-Present: The Department Today.

The field of Biostatistics is constantly invigorated through developments in biomedical science that require new quantitative approaches, and advances in computing that expand the range of possible methods. When Louise Ryan returned to Australia in 2009 to take a position at the Commonwealth Scientific and Industrial Research Organization, Victor DeGruttola was appointed Chair of the Department. DeGruttola has responded to new opportunities by increasing faculty in a variety of quantitative sub-disciplines while maintaining a core in mathematical statistics. He fosters ongoing discussion about the training of statisticians to provide a basis for the lifelong learning that will be necessary to address future challenges. This focus leads not only to development of an academic base for genomics and bioinformatics but also to provide integrated instruction in Biostatistics and Epidemiology, expanding in new directions while maintaining current strengths. Thus, the Department remains poised to develop and expand into emerging new areas of public health.



Figure 5: Victor DeGruttola, 2009

Sadly, Steve Lagakos was killed in a tragic automobile accident in 2009, cutting short his distinguished career. Steve was respected as a scholar and leader and is greatly missed by colleagues, students and staff.

Today, the Department continues to grow and thrive. Two new senior faculty members joined the Department in the fall of 2009, Francesca Dominici and Giovanni Parmigiani. Parmigiani succeeded Harrington as Chair of the Department of Biostatistics and Computational Biology at the DFCI, while Dominici's appointment greatly strengthened the environmental statistics program. Ware returned to the Department after serving as academic dean for 19

years. In the fall of 2011, Franziska Michor, Christopher Barr and Sebastien Haneuse were appointed to the junior faculty ranks.

The Department continues its tradition of excellence in methodological research which has important substantive applications in Public Health. The faculty based at the DFCI and others in the Department are engaged both in applied and methodological work in all aspects of cancer. Senior faculty engaged in this work include Gray, Harrington, Lin, Parmigiani, Wei and Zelen. The Environmental Statistics Program continues to flourish under the leadership of Professors Coull, Dominici and Lin. Professors Lin, Quackenbush, Wei and Laird are engaged in the continuing development of programs in genomics and statistical genetics. Hughes succeeded Lagakos as director of CBAR. DeGruttola, Pagano and Wei continue to work on important problems in clinical trials, prevention and surveillance for HIV/AIDS. Gray is leading the Statistical Center of the Eastern Cooperative Oncology Group, succeeding Harrington. Ware and Betensky lead the Department's work in Catalyst, the Harvard Clinical and Translational Science Center (CTSC). Wei continues to lead the Department's involvement with industry partnerships.

Major methodological areas of research include the design and analysis of clinical trials, survival analysis, sequential methods, statistical genetics, longitudinal analysis, semi-parametric methods, causal inference, measurement error, Bayesian methods, surveillance, screening for the early detection of diseases, bioinformatics, computational biology, personalized medicine, signal and image processing and computationally-intensive statistical methods. The number of publications by department members in the ten year period ending in 2010 is 1880. (reference: Google Scholar) As this is being written, the Department has 14 master's students, 66 doctoral students, 67 research fellows and associates, 33 research scientists, and 58 faculty at all levels, both primary and secondary.

The Department's history is evidence that its research agenda is driven by current Public Health problems. By long standing tradition, an environment has been created in which research and practice can thrive together. Research in biostatistics theory without input from applications is likely to be sterile and applications without a solid basis of theory can be misleading and inefficient. The curriculum and research agenda continues to change to meet new challenges. The goals in the future are to maintain the Department's leadership role in biostatistical science and to train the leaders of tomorrow.