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Careers in Cardiovascular Disease Epidemiology and Prevention

Russell V. Luepker, MD, MS

Division of Epidemiology and Community Health, School of Public Health, University of Minnesota, Minneapolis

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Research careers in cardiovascular epidemiology, including cardiac and vascular diseases and stroke, continue to grow and provide opportunities for contributions to our understanding of the extent, diagnosis, prevention, and treatment of diseases. The pursuit of cardiovascular epidemiology research is compatible with academic, clinical, laboratory, industry, government, and other scientific positions.

Epidemiology is the study of disease patterns and outcomes in populations. Because of this public health perspective, epidemiologists also play a learning role in the study of disease prevention. Observational epidemiologists define the role of risk factors in predicting, preventing, and treating cardiovascular disease through population studies. Working with laboratory medical and behavioral scientists, they elucidate the underlying mechanisms and initiate large prevention and treatment trials. Our understanding of lipids, hypertension, smoking, diabetes, inflammation, and other factors leading to cardiovascular diseases originated in epidemiological observations.

This research continues with considerable vigor as epidemiologists evaluate new biomarkers and the genetics of cardiovascular disease. However, expanding opportunities also exist in the field, including the study of primary and secondary prevention, nutrition, clinical epidemiology, health services research, policy research, and other areas in the academic, public, and private schools where epidemiologic methodology and skills play a scientific role in the study of humans.

The need for formal training in epidemiology and associated fields is increasingly apparent. Training “on the job,” the norm for many senior people, has given way to more structured programs leading to graduate certificates and degrees. These range from training at well-established international and national seminars to Master of Public Health (MPH), Master of Science (MS), and doctoral (DrPH, PhD) programs. Postdoctoral experience supported by

Correspondence to Russell V. Luepker, MD, MS, Mayo Professor, Division of Epidemiology and Community Health, School of Public Health, University of Minnesota, 1300 S Second St, Suite 300, Minneapolis, MN 55454. luepker@epi.umn.edu.

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the National Heart, Lung, and Blood Institute (NHLBI), the American Heart Association, and other organizations is available at many centers.

Finally, in the current era, many data sets and stored biological samples are readily available to qualified investigators. A shortage of trained individuals to take advantage of these opportunities leads to almost certain job security in academia, industry, and government for well-trained scientists.

Background

The epidemic of atherosclerotic coronary heart disease, which characterized the 20th century, lacked explanation in the first half of the century. It was clear that industrialized countries were moving from infectious diseases as the leading causes of morbidity and mortality to chronic diseases associated with aging. There was a growing ability to diagnose acute events such as myocardial infarction and a better understanding of the pathology of atherosclerosis, although the underlying causal factors were debated.

Studies of individuals could shed some light on this issue, but population-wide studies are more suitable to characterize the epidemic that accounted for an increasing proportion of mortality in the United States and elsewhere. The history of the development of the field is reviewed extensively by Blackburn.¹

Early observations in 1916 by Cornelis De Langen,² a Dutch physician in Indonesia, noted the contrast between Colonial Dutch and native Javanese in the prevalence of cardiovascular and other diseases. He suggested that this may be the result of differing lifestyles, diet, and blood cholesterol levels. Years later, Isadore Snapper,³ who was teaching at the Peking Union Medical School, performed a systematic study of ECGs in Asian populations, reporting the rarity of abnormal tracings in Northern Chinese. In 1941, his well-known book, *Chinese Lessons to Western Medicine*, suggested that working Chinese were protected from vascular disease by their mainly vegetarian diet. Other individuals followed with their own observations in different populations around the world.¹

World War II provided additional insights as a number of studies noted a decrease in cardiovascular disease deaths in the European war-torn countries. In 1950, Malmros⁴ noted a decline in disease rates in Sweden, a country that was neutral during the war but suffered significant deprivation in food and other amenities of modern life. Malmros suggested that decreased dietary fat consumption underlay this improvement in disease mortality.

However, many of these observations were frequently crude and unsystematic. They involved casual clinical observations or retrospective review of medical data collected for other purposes.

A systematic approach to cardiovascular epidemiology began to flourish after World War II. In 1947, Keys and colleagues⁵ initiated the Minnesota Business and Professional Men Study, a cohort of healthy executives followed up for >3 decades to observe cardiovascular disease occurrence. At that time, coronary heart disease was considered a disease of successful businessmen. In 1948, the National Heart Institute began planning of the Framingham Heart

Study, a population cohort from a town outside Boston. Data collection was initiated in 1949, and the Framingham population continues to be followed up today, along with 2 generations of offspring.⁶ The Framingham study first proposed the risk factor concept in which physiological and behavioral characteristics such as blood pressure, blood lipids, and cigarette smoking predicted subsequent disease events. Keys⁷ extended this work in the early 1950s, collecting cohorts of men around the world in what became known as the Seven Countries Study. This study took advantage of large international differences in lifestyle, physiological characteristics, and disease outcomes. Numerous other studies around the world followed in subsequent decades, confirming that the risk factors described by early surveys predicted disease outcomes in different populations.

The elucidation of predictive risk factors led to a call for studies of interventions to reduce subsequent disease, namely coronary artery disease, stroke, hypertension, and heart failure. In the late 1970s and early 1980s, large randomized studies of risk factor reduction were initiated by the National Institutes of Health, medical research councils in different countries, and the World Health Organization.^{8,9} These early studies and their successors today consistently demonstrate that control of blood pressure, smoking cessation, and a reduction in atherogenic lipids result in reduced cardiovascular disease morbidity and mortality. These studies also led to a wide variety of secondary prevention studies in individuals with known atherosclerotic disease.⁹ Findings from these studies, many of which continue, have clearly demonstrated a reduction in recurrent disease associated with secondary prevention strategies, including intervention on the classic and other risk factors.

The success of these trials then led to a series of studies of community approaches to risk reduction through smoking cessation, healthier diets, increased physical activity, and blood pressure control. They were undertaken predominantly by cardiovascular epidemiologists but supported by numerous other disciplines.

The development of the field of cardiovascular epidemiology based on large observational and intervention studies brought with it a number of outcomes. In 1956, Paul Dudley White (among the founders of the AHA) and Ancel Keys brought epidemiology into mainstream cardiology by advancing its presence in the International Society and Federation of Cardiology (ISFC) and the AHA structures.¹⁰ Training programs to initiate physicians and students in the field began. The ISFC International Seminar on Cardiovascular Disease Epidemiology and Prevention held its first annual meeting in 1968 and continues today, 40 years later.¹¹ The same leaders also initiated in 1975 a regional meeting in the United States at Lake Tahoe supported by the AHA, Centers for Disease Control and Prevention, and NHLBI. Similar seminars in other languages have been held around the world. They have exposed thousands of younger investigators from many countries to rigorous training in study design, implementation, and analysis. More discussion of these and other training opportunities are described below.

Career Opportunities

The 20th century was marked by an explosive growth of observational epidemiology as investigators sought to understand the causes and trends in cardiovascular diseases in

populations around the world. This work continues as new risk factors are explored in populations and the much predicted transition to chronic diseases in developing countries is documented and confronted.¹² Numerous opportunities exist for cardiovascular epidemiologists interested in observational studies in the United States and around the world.

The parallel trend of interventional studies for disease prevention also continues, with new behavioral, drug, and other interventions constantly being tested in large population groups. These studies will provide important new knowledge and substantial career opportunities for those well trained in designing and measuring cardiovascular disease outcomes in populations.

However, there are also expanding opportunities in the field for those interested in other careers. The core methods of epidemiology, which include precise measurement in human populations, development of new measurement tools for human use, design of population-based studies, and analysis of those studies, are in considerable demand in many different fields. Working in teams, as epidemiologists commonly do, opportunities exist, including clinical trials studying behavioral, interventions, drug, and other treatments for cardiovascular diseases; genetic studies emphasizing geneenvironment interactions; nutritional studies assessing the effect of foods on cardiovascular outcomes; and quality-of-care and outcomes research on the effects and effectiveness of medical interventions.

The opportunities in academia, research institutes, health departments, government agencies, and private industry are substantial and diverse. For individuals with clinical training plus skills in the methods taught by epidemiology, there are numerous possibilities. Studies of supply of cardiovascular epidemiologists and job opportunities consistently indicate that there are more positions available than well-trained people to fill them. This perception is confirmed by the recently released (2007) NHLBI Strategic Plan: Shaping the Future of Research, which emphasizes the application and monitoring of new technologies to improve public health.¹³

Training

Training for careers in cardiovascular epidemiology, like many other emerging specialties, has historically been on the job. Trainees would work with experienced mentors in a site with ongoing population studies. As in many mature scientific specialties, training has become more systematic and formal. For clinicians seeking a career in cardiovascular epidemiology, a master's degree (MPH, MS) is an indication of formal experience in the needed methods. For some clinicians, a PhD degree is sought that includes a multiyear research experience. The PhD degree also is an increasingly common path for nonclinicians to pursue careers in cardiovascular epidemiology. A formal degree includes courses in epidemiological methods, biostatistics, data collection, clinician trials, ethics, and other relevant topics. Particularly useful is specific training in the unique methods used to study cardiovascular diseases. Most master's and doctoral programs include all of these elements. They include a research experience that allows individuals to obtain practical exposure to studying populations of patients or healthy individuals.

There are also programs in which individuals with previous experience or those desiring some exposure can learn the basics in the study of cardiovascular diseases in populations. The field is particularly well organized at all levels, offering workshop experiences, formal coursework, formal degrees, and postdoctoral fellowships. In addition, others may take coursework in nutrition, health behavior, health education, health services research, and other topics aimed at their career goals.

National and International Seminars

The original meeting of Drs Keys, Stamler, and White in 1956 with ISFC leadership resulted in support for training activities.¹⁰ International seminars and those in the United States became established vehicles for clinicians interested in a career in cardiovascular epidemiology. These short and intense courses continue today.

Ten-Day International Teaching Seminar on Cardiovascular Epidemiology and Prevention

Beginning in 1968, the Ten-Day International Seminar on Cardiovascular Epidemiology and Prevention has educated >1000 health professionals in cardiovascular disease epidemiology and prevention. Held in a different country each year, it is now in its 42nd year. It is truly international in scope, featuring senior faculty from around the world with support from the World Heart Federation and World Health Organization. Approximately 2 individuals are chosen from each applying country. They are usually sponsored by a local cardiology society or heart foundation. Held in cities in all continents except Antarctica, the seminar is noted for its international flavor and intense workload in both traditional didactics and participant projects. Graduates of the program are now international leaders in cardiovascular epidemiology and prevention. Living expenses incurred while at the seminar are supported by the local host. Travel expenses are generally the responsibility of the individual or his or her organization, but some scholarship money for travel is available. More information can be obtained from Professor Key-Tee Khaw (kk101@medschl.cam.uk) and at <http://www.councilhearthealth.org>.

AHA Ten-Day Seminar on Epidemiology and Prevention of Cardiovascular Disease

Following the model of the international seminar, the AHA developed its Ten-Day Seminar on Epidemiology and Prevention of Cardiovascular Disease in 1975. It is held annually at the Granlibakken Conference Center in Tahoe City, Calif, during the summer for 30 fellows. The primary goal of the seminar is to provide an intensive introduction to the epidemiology and prevention of major cardiovascular disease. It is aimed at health professionals who are planning a career in research, teaching, or practice in this area. It is taught by a group of senior epidemiologists, biostatisticians, and prevention researchers in a lecture, tutorial, and discussion mode. Students also develop projects. Candidates are usually at the postdoctoral level and are close to finishing or have finished their formal training. Preference is shown for residency in the United States; however, residents of Canada and Mexico are sometimes accepted.

The seminar has been organized by the AHA for many years. It was supported by the NHLBI for many years and more recently by the Centers for Disease Control and

Prevention. The costs in 2008 were approximately \$2500 to cover accommodations, meals, and taxes. Tuition is free. A limited number of travel stipends are available to cover partial travel costs for fellows and trainees. A minority investigator stipend also is available for eligible minority participants who are either citizens or permanent residents of the United States. Application instructions can be found at <http://www.americanheart.org/presenter.jhtml?identifier=3059403> or by contacting Scientific Conferences at www.heart.org.

Regional Seminars in the Epidemiology and Prevention of Cardiovascular Disease

Local seminars based on a model similar to that of the Ten-Day International Seminar have been held around the world. Recently, a group in South and Central America has begun a seminar held in Spanish. It targets health professionals in Spanish-speaking countries. The faculty are from Latin America, Spain, and the United States. The first workshop in 2007 was held in Guatemala. Two subsequent annual seminars were held. They provide important opportunities for those unable to attend the other seminars. For further information, contact Ricardo Granero, MD (ricardogranero@yahoo.com).

Summer Programs

For >30 years, schools of public health in both the United States and Europe have taught at summer institutes devoted to epidemiology and biostatistics. These summer sessions provide an opportunity for working professionals to attend courses geared to their schedules. Usually taught by very experienced faculty, the sessions include basic courses in epidemiology, biostatistics, health services research, nutrition, and other topics relevant to cardiovascular disease.

Many of these programs provide academic course credit toward an MPH degree or a certificate that documents learning accomplishments. Such programs, although costly, have grown in recent years as professionals would like to expand their experience and update their knowledge on a more convenient basis than the usual academic year.

Degree Programs

All schools of public health and many departments of preventive medicine and community health in the United States are accredited to give MPH degrees in epidemiology. Chronic disease is an important topic, and many schools emphasize cardiovascular epidemiology as a major theme. Some of the programs require a project equivalent to a master's thesis to develop the individual's research skills. A usual program takes 1.5 to 2 years as a full-time student. For many students, the program is spread out over several years.

Some universities also offer MS degrees in epidemiology. These programs do not have the same public health requirements required in an MPH. They allow a more intense focus on science. Most graduate programs require a master's level research thesis as part of the curriculum.

The PhD degree in epidemiology is offered at many universities. It requires substantial coursework and a doctoral-level thesis, which may include 2 to 4 published papers. The

usual PhD degree takes 3 to 6 years to complete, with much of that time devoted to an independent research project. For many with a previous doctoral- level clinical degree, a PhD adds significant time in formal studies. For those without previous clinical training, a PhD degree is essential for an independent research career in the field.

Training Support

Much of the support for training in cardiovascular epidemiology comes from local resources or the trainee's own income. However, in the mid 1970s, the NHLBI established predoctoral and postdoctoral training programs at universities around the country. Many of these programs exist today and present records of success in the training of research leaders. These programs focus on cardiovascular epidemiology and biostatistical approaches associated with that research. In more recent years, several have added the genetics of cardiovascular disease. In the late 1970s, the NHLBI expanded the programs to include behavioral aspects of cardiovascular disease in an attempt to increase research associated with diet, stress, compliance, physical activity, and other factors known to prevent morbidity and mortality. For these programs, Lorraine Silsbee at NHLBI (silsbeel@nhlbi.nih.gov) serves as a contact person.

The programs devoted to cardiovascular disease epidemiology and biostatistics are listed in Table 1, along with their program directors and e-mail addresses. Some of the programs offer predoctoral training scholarships for individuals interested in a PhD degree. Others focus on postdoctoral training for individuals at that stage of development. They may include a master's degree. Some programs have both predoctoral and postdoctoral positions. As with all National Institutes of Health training grants, applicants must be citizens or permanent residents.

The behavioral medicine training grants are listed in Table 2. The qualifications and expectations are identical to those described above.

Data Resources

For many entering the field of cardiovascular disease epidemiology, the need to collect data from population samples is a formidable obstacle. Collecting data on large numbers of patients and/or healthy individuals is both time and resource consuming. In addition, follow-up for disease events is complex and costly in an era of increased concerns over privacy. Such obstacles may lead to discouragement on the part of the new investigator.

Fortunately, the NHLBI has considered these issues carefully. In recent years, it has made available, through data-sharing agreements, scientific data on many of the major cohort and population studies supported by the institute. These studies are listed in Table 3, and a Website offers more information on each study (http://www.nhlbi.nih.gov/resources/deca/datasets_obv.htm).

The Framingham study has taken a leadership role in providing these data. It includes >9000 participants, many followed up for decades. It is phenotypically well characterized and includes many sophisticated laboratory and imaging tests. Importantly, Framingham also

provides DNA samples to qualified investigators who are interested in genetic studies. It can provide the opportunity to obtain stored and preserved blood samples from surveys. Other NHLBI studies are moving in this direction to capitalize on the enormous investment by the institute to collect these data. An appropriate delay to allow the original investigators time to analyze the data of their primary interests is allowed in each instance. However, the diversity of these data and the numerous variables collected allow many scientific questions to be addressed that would otherwise be forgotten.

There is an increasing trend, led by the NHLBI and genetic investigators, to provide data in computer form for other investigators to analyze. This provides unique opportunities for trainees and new investigators in the field.

Future Directions and Opportunities

The field of cardiovascular epidemiology is one with a proud history and tradition of accomplishment. The decline of cardiovascular disease in the United States and the industrialized world is, in substantial part, the result of the development of and understanding of risk factors and demonstration that treatment is effective and life-saving. In the predicted epidemic in developing countries, epidemiology has the potential to confront and reduce the impact of these disturbing trends.¹² But to do that, population data of high quality and reliability need to be collected and effectively conveyed to medical leaders and policy makers.

Epidemiology, like many other medical specialties, has moved from an unstructured apprentice system to systematic training in the tools of the field. These changes do not denigrate the need for mentors and a supportive environment for epidemiological work. However, the quality of research and its utility are undoubtedly enhanced by graduate training.

In the industrialized world, the potential continues for epidemiology to contribute to the answering of public health questions. The methods of epidemiology and biostatistics are core to many other fields. Among the leading ones are clinical research and health services research. Both will gain increased prominence as aging populations result in increased chronic disease prevalence and burgeoning costs.

The future for a diversity of cardiovascular epidemiology careers is bright. There is a growing need within universities as new schools of public health are established and preventive medicine grows as a medical specialty. There are growing opportunities in international, federal, state, and local health departments in which surveillance, population risk assessment, and program and policy analyses are all increasingly needed. The private sector also has expanding job opportunities in the healthcare, insurance, pharmaceutical, and device industries.

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Table 1

NHLBI National Research Service Award Programs in Cardiovascular Epidemiology and Biostatistics

Program	Director Name(s)	Predocutorial/Postdoctoral	E-Mail Address
Brigham and Women's Hospital	Paul M. Ridker, MD, MPH; Julie E. Buring, ScD	Both	pridker@partners.org; jburing@rics.bwh.harvard.edu
Case Western Reserve University	Robert Elston, PhD	Predocutorial	rce@darwin.case.edu
Johns Hopkins University	Josef Coresh, MD, PhD	Both	coresh@jhu.edu
North Carolina State University	Marie Davidian, PhD; Elizabeth DeLong, PhD	Both	davidian@stat.ncsu.edu; elizabeth.delong@duke.edu
Northwestern University	Philip Greenland, MD	Postdoctoral	p-greenland@northwestern.edu
Stanford University	Stephen P. Fortmann, MD	Both	fortmann@stanford.edu
University of Alabama at Birmingham	David B. Allison, PhD; Hemant K. Tiwari, PhD	Both	dallison@uab.edu; htiwari@ms.soph.uab.edu
University of California San Diego	Michael H. Criqui, MD, MPH	Both	mcriqui@ucsd.edu
University of Minnesota	Aaron Folsom, MD, MPH	Both	folsom@epi.umn.edu
University of North Carolina at Chapel Hill	Gerardo Heiss, MD, PhD; Wayne D. Rosamond, PhD	Both	gerardo_heiss@unc.edu; wayne_rosamond@mail.csc.unc.edu
University of Pennsylvania	Brian Strom, MD	Both	bstrom@cceb.med.upenn.edu
University of Pittsburgh	Kim Tyrrell, DrPH, MPH	Both	tyrrell@edc.pitt.edu
University of Rochester	Thomas A. Pearson, MD, MPH, PhD	Postdoctoral	thomas_pearson@urmc.rochester.edu
University of Washington (Biostatistics)	Thomas Lumley, PhD	Predocutorial	tlumley@u.washington.edu
University of Washington (Cardiovascular Epidemiology)	David Siscovick, MD, MPH; Bruce M. Psaty, MD, PhD	Both	dsisk@u.washington.edu; psaty@u.washington.edu
University of Wisconsin-Madison	David L. DeMets, PhD	Predocutorial	demets@biostat.wisc.edu
Wake Forest University School of Medicine	David Herrington, MD	Postdoctoral	dherring@wfubmc.edu

Table 2

NHLBI National Research Service Award Programs in Behavioral Medicine

Program	Director	Predoctoral/Postdoctoral	E-Mail Address
Johns Hopkins University	David Levine, MD, ScD	Both	dlevine@jhmi.edu
University of Pittsburgh	Karen Matthews, PhD	Both	matthewska@upmc.edu
University of Miami	Neil Schneiderman, PhD	Both	nschneid@miami.edu
Miriam Hospital, Brown University	Rena Wing, PhD	Postdoctoral	rwing@lifespan.org

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Table 3**NHLBI Observational Epidemiology Studies**

Atherosclerosis Risk in Communities Study (ARIC)
Bogalusa Heart Study (BHS)
Cardiovascular Health Study (CHS)
Coronary Artery Risk Development in Young Adults (CARDIA)
Framingham Heart Study, Cohort
Framingham Heart Study, Offspring
Honolulu Heart Program (HHP)
Lipid Research Clinics, Prevalence Study (LRCPS)
Multi-Ethnic Study of Atherosclerosis (MESA)
NHLBI Growth and Health Study (NGHS)
National Longitudinal Mortality Study (NLMS)
Puerto Rico Heart Health Program (PRHHP)
Patient Registry for Primary Pulmonary Hypertension (PPH Registry)
Women's Health Initiative Observational Study (WHI-OS)

For details, see http://www.nhlbi.nih.gov/resources/deca/datasets_obv.htm.

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