

## Perspectives on Epidemiological Investigations at the End of this Century

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### SUMMARY

This century is the scientific apogee for epidemiology — which has moved from an obscure science to an important disease control tool, first for infectious diseases, and now for chronic and environmental problems. The USA is currently well supplied with epidemiologists trained in a variety of investigative techniques, and has epidemiologists located in state and cities as well as academic centers. The teaching of epidemiology has become a recognized career. However, the rest of the world is not as well supplied with epidemiologists trained in the diseases now causing the most deaths and disabilities, such as injuries and addiction control. Academic centers must begin to address this lack of trained epidemiologists, and governments must recognize their needs for government epidemiologists at a variety of levels, as well as equipping their staff with modern computers and software for them to keep up with this rapidly expanding scientific field.

*Key words: Epidemiology; Research; Education; Research Support.*

### PERSPECTIVAS EN LA INVESTIGACIÓN EPIDEMIOLÓGICA AL FINAL DE ESTE SIGLO

#### RESUMEN

Este siglo ha significado el apogeo científico de la Epidemiología, la cual ha pasado de ser una ciencia oscura a una importante herramienta para el control de las enfermedades, primero para las infecciosas y ahora para las crónicas y los problemas ambientales. Los Estados Unidos actualmente disponen de epidemiólogos formados en distintas técnicas de investigación, y tienen epidemiólogos en centros estatales y metropolitanos al igual que en centros académicos. La ciencia de la epidemiología se ha convertido en una profesión reconocida. Sin embargo, el resto del mundo no tiene suficientes epidemiólogos preparados para afrontar las enfermedades que actualmente causan la mayor cantidad de muertes y discapacidades, como las injurias y el control de la adicción. Los centros académicos deben comenzar a afrontar esta falta de epidemiólogos experimentados, y los gobiernos deben reconocer sus necesidades de epidemiólogos en diferentes niveles, así como equipar su cuerpo técnico con computadoras y software modernos para que puedan desarrollarse al ritmo del avance científico.

*Palabras claves: Epidemiología; Investigación; Educación; Apoyo a la Investigación.*

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Epidemiology is the science of mathematics applied to medicine. It is a science that has come into its own in the twentieth century, although it was practiced by a few select investigators, like John Snow (1) in the last century. With the discovery of bacteriology and the aid of new light microscopes at the turn of the last century, the epidemiology of most of the common bacterial diseases of man was worked out and became relatively common knowledge. With the advent of virology in the 1930s and the ability to maintain the cell culture lines necessary to define the viral causes of common diseases of man, viral and bacterial diseases, and their epidemiology became organized and one of the main courses taught in the US medical schools of the mid twentieth century. By mid-century the attention of academic epidemiologists became directed at chronic diseases of importance, and studies of heart disease such as the Framingham Study in Massachusetts in 1964 became the focus of academic centers of public health such as Harvard, or the Tecumseh Michigan studies directed by the Michigan School of Public Health. With the publication of the first US Surgeon General's report on smoking and health in 1964 (2), which was a thorough review of perhaps 150 studies in the US, Canada and England, epidemiology of chronic diseases such as lung cancer and heart diseases came into the public awareness. In January of 1966, the Center for Disease Control (CDC) taught its first chronic disease Epidemiologic Intelligence Service course for its EIS officers, assisted by Ian T. Higgins, MD from the National Institutes of Health (NIH), and Clark W Heath, Jr., MD—two now well known chronic disease epidemiologists although at that time Heath was the sole chronic disease epidemiologist at CDC. Today, 32 years later, CDC now has more epidemiologists doing noninfectious diseases than infectious diseases. This is entirely understandable when one reviews the list of mortality contributors in the US — heart disease, cancer, stroke, etc. Only one infectious disease, pneumonia — influenza is on the USA top ten mortality cause list at this time, and appropriately the nations public health efforts and financial support are directed at the major causes of disease and death (Table 1).

Accordingly, as students and practitioners of epidemiology start with descriptive and analytic studies of disease, and move into cohort and case control studies, their abilities to apply these techniques to other than infectious diseases and their control became important. With the invention of mainframe computers,

and finally in the 1980s desktop computers cheap enough so that almost all epidemiologists in the US could have easy access to them, the employment of their use in all phases of epidemiological investigations became a natural. It took the foresight of now CDC epidemiologist Andrew Dean, MD to imagine a "professor of epidemiology in a box" tied to an eager EIS officer as she (he) headed out into the field as the logical next step. He and three colleagues Burton, Dicker and Jeff Dean created EPI INFO, a software package for the early portable (lugable perhaps a more appropriate description for the early versions) that would assist a field epidemiologist with the creation of line listings while doing an investigation, set up tables of analysis, test the results of statistical significance, and assist with the writing of the rough draft of report, all done while in the field. We now teach all this computer epidemiology in the summer EIS course, and more. And EPI INFO is now available in a half dozen languages, including Russian.

**Table N° 1:** Top 15 causes of death in the USA, 1997.\*

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|-----|-----------------------|
| 1.  | Heart Disease         |
| 2.  | Cancer                |
| 3.  | Stroke                |
| 4.  | Lung Disease          |
| 5.  | Accidents (Injuries)  |
| 6.  | Pneumonia/Influenza   |
| 7.  | Diabetes              |
| 8.  | Suicide               |
| 9.  | Kidney Disease        |
| 10. | Chronic Liver Disease |
| 11. | Blood Poisoning       |
| 12. | Alzheimer's Disease   |
| 13. | Homicide              |
| 14. | AIDS                  |
| 15. | Hardening of Arteries |
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\* National Center for Health Statistics, NCHS, *MMWR Atlanta Journal & Constitution* Oct 8 1998.

Simultaneously with the evolution of the practice of epidemiology at CDC and elsewhere in the USA, the state epidemiologists were evolving their own roles and programs. In 1965 few state epidemiologists were in fact trained epidemiologists — most were retired clinical doctors or retired physicians from clinical services in the military. Most states had just one state epidemiologist, if they were lucky. Surveillance was a sometime thing — diseases were reported when the medical practitioners were so moved to report. State epidemiology reports were occasionally sent out, but few were regular and more than just tables of reported and reportable diseases. The state epidemiologist conference, called the Council of State and Territorial Epidemiologists (CSTE), began to meet regularly with the CDC staff and by 1975 had embarked on a review and standardization of the definition of all the reportable diseases to CDC. Today the definition of a case of measles in Texas is the same as a case in Maine, not the situation in 1966 when CDC began its first national attack on the disease. In 1983 Gunn et al did a national survey of all state health department epidemiology programs and established for the first time a national recommendation for adequate staffing of epidemiologists (3). Today (1998) 25 of the state and territorial senior epidemiologists have come through the EIS program, and another 20 of the 55 have epidemiology training through schools of public health (4). Most states of any size now have full-time epidemiologists running various subdivisions of their epi programs, such as chronic, environmental, injury, etc. The numbers of public health schools and public health training programs have doubled in the past 40 years, and all have well attended and extensive training programs in epidemiology and statistics. Jobs for well trained and experienced epidemiologists in the US seem to be plentiful at this time, with the EPI MONITOR, an Atlanta-based epidemiology oriented newspaper, listing more than 160 jobs every month on its Epi Job Bank list this year. For the present the USA is reasonably positioned to face the new century and its public health challenges with adequate supplies of academic and practicing epidemiologists.

### **But what of the rest of the world?**

For the past 5 years, a joint study by the World Health Organization, World Bank, and Harvard School of Public Health has been directed at defining, if possible,

the global burden of disease, both acute and chronic and disabling diseases. This enormous undertaking is now resulting in a series of publications called the Global Burden of Disease Series (GBD) (5). The first 2 books of an eventual nine are now in print and available worldwide. (I urge all international epidemiologists to add these books to their libraries if at all possible.) It is apparent that if we do not have good data on health and disease it is impossible to make accurate comparisons from place to place and time to time. The large GBD study persisted against insurmountable odds to give us the best estimates of the status of disease today (1996), and for the next two decades, for the entire world. Where hard national data was just not available, as in the heart of Africa, the Middle East, India and China, and parts of Latin America, surveys were carried out by a variety of methods to reach reasonable conclusions. But it is apparent throughout, that a general plea for better data is in order, for most of the world outside the established market economies of North America, Western Europe and Australia. And that means that more and better trained epidemiologists are a necessity to direct disease control programs, control outbreaks and provide the best data available for political leaders and health planners.

If we take a look at a few tables of the GBS study data we can see that for the bulk of the world's population, the developing world, infectious diseases are still a problem (Table 2). Epidemiologists are needed everywhere in the developing world — and they must be trained in modern acute infectious diseases, surveillance and disease control programs. Note also that even today, there is a need for epidemiology work in the developing world on heart disease, stroke, perinatal diseases, chronic lung diseases, and injuries of all sorts, especially traffic and occupationally related.

At this centuries close, epidemiologists must not only be familiar with the routine analysis of rates and proportions, and elaborate case control studies and regression analysis and its interpretations, they must now expand their analysis of deaths to other studies of morbidity and the more classical chronic diseases. The GBD studies elaborated on the true meaning of disease burden in individual countries and the world — and that included mortality which is relatively clear in definition, and morbidity which is difficult but possible to define. But morbidity also includes the burden of the disabled on a population, and the GBD group

resurrected an old but reliable measure of disease in a population, called DALY (Disability Adjusted Life Years). One DALY is one lost year of healthy life, whether due to premature death or disability from a chronic disease. It is a combination of deaths and its impact, as well as total morbidity impact on a population. The standard to which the data is compared is the world longest living population, Japan. And is a clear statement that all people everywhere are equal in value, and that all matters in comparing health status is sex and age.

**Tabla N° 2.- The Ten Leading Causes of Death, Developing Regions, 1990.\***

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1.	Lower Respiratory Infections
2.	Ischaemic Heart Disease
3.	Cerebral Vascular Disease
4.	Diarrheal Disease
5.	Perinatal Conditions
6.	Tuberculosis
7.	Chronic Obstructive Pulmonary Disease
8.	Measles
9.	Malaria
10.	Road Traffic Accidents (Injuries)

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\* *Global Burden of Disease Vol. 1 p 178-179.*

If one returns to the world disease burden and creates a table of rank order of disease burden measured in DALYS, you get Table 3, and several surprises. Note chronic mental disorders, injuries due to road crashes and war rise to importance. Few if any countries today are addressing these needs now; few will be ready to address them by 2020. There is a significant lack of epidemiologists in the US and elsewhere, ready to deal with these disease groups.

If one looks ahead to 2020 and the new millennium beyond that, as the GBD study does in great detail, you can see even in Africa, the rise of chronic diseases, and

injury to an important level of public health concern. Tobacco related diseases become the number one concern of the world if current trends continue, and that seems certain at this point (Table 3). The disease burden from just tobacco rise from 2.6% of the worlds total, to 9% of the total world's burden by 2020. To quote the GBD editors, "this is a global health emergency that many governments have yet to confront" And we must remember this is a totally preventable disease today.

Therefore, what must we do? To be informed of a problem is just half the battle. We who are the teachers of the next generation of epidemiologists must redouble our efforts to be sure that our students are informed of the challenges facing them. We must not only see to their technical training so that they become the best possible epidemiologists, we must urge them to work on the real problems of public health. We must see that their training includes getting involved in the real problems of their own countries, and teach them how

**Table 3.- Rank order of disease burden for leading causes, World in 2020 in DALYS.\***

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1.	Ischaemic Heart Disease
2.	Unipolar Major Depression
3.	Road Traffic Accidents (Crashes)
4.	Cerebrovascular Disease
5.	Chronic Obstructive Pulmonary Disease
6.	Lower Respiratory Disease
7.	Tuberculosis
8.	War
9.	Diarrheal Diseases
10.	HIV
11.	Perinatal Conditions
12.	Violence
13.	Congenital Anomalies
14.	Self-inflicted Injuries
15.	Tracheal, Bronchus and Lung Cancers

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\* *GBD 1996 VOL. 1 P 375.*

to recognize these real problems. They must get outside the universities and the capitol cities, and work to improve surveillance of all problems that visit their populations. We must see to education of the next generations of epidemiologists to include inquisitiveness of problems not even known today — teach them to keep their eyes wide open to opportunities, to keep their curiosity high to areas new to their experience, to seek new opportunities to express epi interests in their societies— for that is what led John Snow to look at death certificates in London 150 years ago and wonder why the strange pattern in a uniform city area. And hundreds of epidemiologists since to wonder about similar disease patterns everywhere. That's what epi is really all about—wonderment.

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