20/0251/49

CONTRIBUTION OF HEALTH SCIENCES RESEARCH TO HEALTH DEVELOPMENT

*Chitr Sitthi-amorn**

Abstract

Basic medical and population research such as epidemiology have independently contributed to health development in different ways. Population health research such as epidemiology opens the door for the development of system for surveillance of diseases of national as well as global importance. Case control studies provide the world with a powerful tool to study the risk factors for many chronic diseases. Cohort studies and historical cohort techniques help identify the risk factors for many diseases as well as help guide clinical interventions and disease prevention. Randomized control trials have progressively become the standards for evaluation of health care focusing on the efficacy and effectiveness of clinical and community interventions. Basic medical sciences have rendered the world more understanding of cellular structures, functions, metabolism, normal and abnormal growth and cell deaths. Vaccines, drugs and diagnostic tests resulting from basic science research have provided new opportunities for humans to enjoy health. Despite some successes, there is an increasing health and technology gaps between the rich and the poor. The genomic era can widen technology and health gaps even further. Basic medical and population sciences have to work together to bridge these gaps by targeting not only individuals and their diverse risks, but also equity in health through population based interventions. Explicit knowledge from basic sciences can be combined with contextual knowledge from population research to bring technology to bear on human health. It is clear that research is important in bringing technology to where diseases and health problems prevail to make people get equitable access to, and enjoy full benefit of technological advances.

Key words: Health science research, Epidemiology, Health development

*Director of Institute of Health Research and Dean of College of Public Health, Chulalongkorn university, Pathumwan, Bangkok

การวิจัยวิทยาศาสตร์สุขภาพกับการพัฒนาสุขภาพ

*จิตร สิทธิอมร**

บทคัดย่อ

ศาสตร์ด้านระบาดวิทยาช่วยเปิดประตูแห่งการพัฒนาระบบเฝ้าระวังโรคทั้งโรคติดต่อและไม่ติดต่อที่สำคัญของประเทศและของโลก ตัวอย่างที่ผ่านมา เช่น วิธีการศึกษากรณีเป็นเครื่องมือที่มีประโยชน์ในการใช้ศึกษาปัจจัยเสี่ยงของโรคเรื้อรัง วิธีศึกษาแบบติดตามไปข้างหน้านำไปสู่การพัฒนารูปแบบการป้องกันปัจจัยเสี่ยงต่อโรค การทดลองทางคลินิกเป็นการสร้างมาตรฐานการประเมินประสิทธิภาพและสัมฤทธิผลของการรักษา ในทำนองเดียวกัน การวิจัยทางวิทยาศาสตร์การแพทย์พื้นฐานทำให้มนุษย์เข้าใจโครงสร้าง, การทำงาน, เมตาโบลิสม, กลไกการเจริญ, การเกิด และการตายของเซลล์ร่างกายมนุษย์ วิจัยทางวิทยาศาสตร์การแพทย์พื้นฐานยังทำให้เรามียา วัคซีน และชุดตรวจซึ่งช่วยในการป้องกันโรคและเสริมสุขภาพ ทำให้มนุษย์มีโอกาสที่มีสุขภาพดีอย่างไม่เคยเป็นมาก่อน การพัฒนาวิทยาศาสตร์ด้าน **genomics** ทำให้มนุษย์มีโอกาสพัฒนาสุขภาพได้มากขึ้น อย่างไรก็ตาม นอกเหนือจากความสำเร็จดังกล่าว ยังคงมีข้อจำกัดและความจำเป็นที่จะต้องแก้ไขช่องว่างทางสุขภาพและเทคโนโลยีระหว่างประเทศและชุมชนที่ร่ำรวยกับประเทศและชุมชนที่ยากจน ในอนาคตนั้นการป้องกันปัจจัยเสี่ยงมิได้จำกัดเพียงเฉพาะบุคคล แต่จำต้องพิจารณาการป้องกันในระดับมวลชนด้วย ประเทศด้อยพัฒนาและประเทศกำลังพัฒนาต้องเสริมสร้างความร่วมมือระหว่างองค์กรต่าง ๆ ทั้งภายในและต่างประเทศ เพื่อพัฒนาความเข้มแข็งทางการวิจัยด้านสุขภาพทั้งด้านวิทยาศาสตร์การแพทย์พื้นฐาน และการวิจัยระบาดวิทยาของการเกิดและการควบคุมโรคในชุมชนมากขึ้น ความร่วมมือกันด้านการวิจัยพื้นฐาน และนำความรู้มาประยุกต์โดยการวิจัยระบาดวิทยา พฤติกรรมสุขภาพและระบบสุขภาพ เป็นสิ่งสำคัญในการกระจายเทคโนโลยีให้ประชาชนได้รับประโยชน์จากการพัฒนาสุขภาพให้ดีขึ้นอย่างเท่าเทียม

Key words: การวิจัยวิทยาศาสตร์สุขภาพ, ระบาดวิทยา, การพัฒนาสุขภาพ

*ผู้อำนวยการสถาบันวิจัยวิทยาศาสตร์การแพทย์ และ คณบดีวิทยาลัยการสาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย ปทุมวัน กรุงเทพฯ

Development of Basic and Health Sciences at the Global Level:

In ancient time, sickness was thought to result from man disruption of its interrelationship with nature. "Whoever wishes to pursue the science of medicine, must first investigate the seasons of the year and what occurs in them, observe and reflect upon winds, drinking waters, site, elevation, soil, climate, astrological features, and diet, the better to understand diseases and treatments" said Hippocrates, who believed that a harmony with external environment leads to 'internal equilibrium' and therefore the appropriate functional of mind and body. Malaria was thought to have been caused by "mal air" or bad air. This explained why the Romans stationed their garrisons on the Seven Hills of Rome to guard against sickness of the soldiers. Charles Darwin theory, "survival of the fittest", maintained that a positive interaction between organism and the environment was needed if the organism is to compete with it adversaries and survive. Some eastern cultures proposed health as a result of a harmony between the yin' and 'yang' elements (a focus in a positive balance). Others proposed a harmonious interplay between soil, water, wind and fire elements. Spiritual and astrological components were also introduced to explain health and illnesses.

The ecological approach to disease started before the science of epidemiology particularly during the context of social and political reform in Europe. Several social surveys occurred in France around the time of the French revolution, some aiming at testing social influence on health. John Snow pioneered in the use of comparison groups to control cholera epidemic[1]. He observed that most of those who died clustered around a water pump on Broad Street in London that receive water on one supply system, while those who use water from another supply system were not as affected. Thus, he was able to control the cholera epidemics before the cholera bacteria were identified[1].

Bacteriological Era including the Koch's postulates in the 19th & 20th Century opened the door for infectious disease health research[2]. The development and refinement of polio vaccines by Salk and Sabins and others made it possible for the first time to systematically control poliomyelitis[3-5]. These have given rise to the development of a system for surveillance of communicable diseases of national as well as global importance[6].

Case control studies pioneered by Sir Richard Doll[7] and perfected by others provided the world with a powerful tool to study the risk factors for many chronic diseases, such as smoking as risk for obstructive pulmonary diseases and oral contraceptives as risk of venous thromboembolic disorders[8-10]. Cohort studies such as the Flemingham and others[11-13] and historical cohort techniques helped identify the risk factors for many diseases such as hepatitis and

asbestosis as well as helped guide clinical interventions to modify lipid profiles for prevention of cardiovascular diseases and stokes[14]. Cohort studies also contributed to clinical practices in chronic infectious diseases, for example, by defining clinical parameters (e.g., the level of CD4) for initiating antimicrobial therapy (such as anti retroviral drugs) and for predicting opportunistic infections in HIV/AIDS patients[15].

Since early 1970s and more intensively in 1980s, randomized control trials have progressively become the standards for evaluation of health care focusing on the efficacy and effectiveness of clinical and community interventions. Methods have also been developed and refined to guide selections of parameters and techniques in clinical and community diagnosis based on diagnostic properties, such as sensitivity, specificity, likelihood ratios of diagnostic tests if positive or negative. During the 1980s, economic analysis has been incorporated into clinical and community diagnosis and interventions. The new standards for design, measurement and evaluation of health care have resulted in a proliferation of small studies, many of which have had insufficient powers. Therefore, since the late 1980s, methods for systematic reviews and meta-analysis have been developed and refined[16]. International collaborations, such as the Cochrane Collaboration, have been developed for systematically reviewing studies based on qualities on an on-going basis and the results periodically summarized[17]. Many websites and summaries have been developed accessible by practitioners in clinical and public health fields, leading to a new paradigm for clinical medicine and public health practices based on the best available evidences.

In terms of measurements, new instruments have been developed, refined and applied to measure more "abstract" attributes in individuals and populations, including the quality of life, activities of daily living, disability and a whole new sets of indicators developed by the World Health Organizations to measure the performance of health systems and research systems[18-21]. Although the attempts and the advances are laudable, care should be taken to understand the assumptions upon which the tools have been developed if these measurements will be used as the basis for resource allocations which can affect equitable access to social opportunities[22].

In additions to the new tools developed to measures abstract attributes such as quality of life, significant progresses have been made in areas of genomics, which have given interests in molecular research at the individual and population level. Advances in human genetic research can help us understand, predict and control health problems and diseases associated not only with single genes such as thalassemia and cystic fibrosis but also diseases associated with poly genes such as breast cancers and alzeimers[23]. New diagnostic tests are developed and applied at the individual and community levels and offer new opportunities to predict and control the problems

at the individual and community levels. In addition to study of human genomes, genetic research can be applied to pathogen genomes and can be instrumental in control of global epidemic of emerging and re-emerging diseases[24]. Genetic research has recently been used with other techniques (such as syndromic approach) to characterized the viruses responsible for epidemics by avian flu and SARS (severe acute respiratory distress syndromes). The techniques raised questions about potentially increasing the gaps between the rich and the poor, exploitation of developing countries for research and clinical trials, risk adjustment and exclusion from insurance, discrimination in jobs, marriage, housing and threats to privacy and confidentiality[25]. However, genetic research also provide new opportunities for new knowledge to engage and work with the political processes and social processes (such as the media) to get people change social norms and behaviors (tobacco, diet, exercise, injury prevention), to develop new infrastructures and policy to prevent diseases in high risk groups and communities. Finally, other disciplines such as social sciences have been introduced to strengthen our understandings of the complexity of the web of causation of health and diseases as well as and help improve health in the context of ever-changing paradigms, politics and policy[26-32].

Development of Basic Health Sciences in Developing Countries:

Community attempts to prevent and limit the spread of disease go back to antiquity. Many beliefs around effective practices such as avoiding eating inadequately preserved food have been known without modern understanding of etiology of diseases. In fact, people in Developing countries believed that to be healthy it is important to strike a balance between different elements (wind, fire, water and soil elements), to please the spirits of the environment, to indulge in prayers and sacrifices to the gods and to follow the astrological guide to health and diseases[33]. The earliest systematic investigations occurred around the control of parasitic diseases, which happened in China in the 1870s. Foreign scientists reported for the first time that the mosquito was the intermediate host and vector of *Wuchereria bancrofti* in 1877. Later, more foreign doctors from missionary hospitals setting up mainly in some trading ports, turned to the study of pathogenic parasites, among whom the outstanding representative was Maxwell, who published a book giving a full account of the state of parasitic diseases in China at that time. After 1920, Faust and other foreign parasitologists came to China and continued epidemiological and basic science investigations of parasitic diseases involving filariasis, schistosomiasis, clonorchiasis, fascio-liasis and some protozoan infections, started by foreign doctors in customs and missionary hospitals. Around 1930, a little number of Chinese epidemiologists and researchers made very important contributions to the early development of strategies for control of parasitic diseases in

China. It was obvious that after 1930, Chinese investigators had gradually replaced foreign doctors and scholars. Unfortunately, further development in this field was retarded until the mid 20th century, owing to the absence of funding and professionals resulting from neglect by the government of pre-revolutionary China and chaos caused by war[34-36].

It is worth noting also that our modern scientific understanding of diseases and the factors that affect them is largely a product of the last 150 years, with very rapid advances in the last half-century. This also holds for health research. In Europe, the discipline of epidemiology started in 1954. Epidemiology was not much known in Developing countries until late 1970 and early 1980 through the efforts of the Rockefeller Foundation and the Center for Disease Control. Now, epidemiology in Southeast Asia has become a cornerstone for public health. Public health measures now take into account a systematic search for evidence about the distribution of disease in populations and evaluation of interventions for disease prevention and therapy. Epidemiology can generate critical, valid and timely information that can guide planning and decision-making. Wrong information is not only useless but can do harm for the society. The validity of information generated from epidemiological investigations depends on the capacity of epidemiologists.

The number and quality of health sciences investigations in developing countries have improved constantly. Early papers reported anecdotal case and case series. Descriptive and population based studies prevailed in the 1960s. More analytical studies were reported in the 1970s. It was not until the 1980s and the 1990s that many more experimental, clinical, field and health system research were documented[37, 38]. Many have involved multi-disciplinary efforts. Before 1990, epidemiological investigations have been introduced to developing countries mainly through international collaborations. Most notable are:

The Tropical Disease Research (TDR) programs have been responsive to the development of research capacity for control of tropical disease. At some point, the TDR budget to Thailand exceeded 50% of the total TDR budget to Southeast Asia. TDR contributed significantly to strategic and applied research as well as capacity development for research. Many TDR programs have dealt with the control of parasitic diseases such as malaria. In China, health research for control of parasitic diseases started with some foreign doctors and scholars' work in the 1870s and then Chinese researchers began to do their own investigations in this field. The first research institute in China for tropical diseases with emphasis on parasitic diseases was set up in 1928 in Hangzhou, China, named Hangzhou Institute of Tropical Diseases followed by Central Program for Hygiene in 1932-1933, consisting of nine departments. Among them, one was a

parasitology department dealing with surveys and control of parasitic diseases. Later, a couple of local research institutes were established. Since 1950s, many research programs for control of tropical diseases in China have been highly productive and have led to numerous publications in journals. According to incomplete statistics, there were more than 20000 articles and reports on control of tropical diseases published in a variety of journals during 1949-1986 in China. Those articles and reports could be read in some international journals and local journals with English abstracts. These publications reflected the fact that successful controls of tropical diseases in China require application of epidemiological principles to the basic scientific discoveries, including development and application of diagnostic tools, mechanisms of pathogenesis and modulation of the host's immune responses with special attention to vaccine development and application[36, 39].

The Human Reproduction Program of the World Health Organization (WHO) has assisted Developing countries in using capacity development for family planning using multi-disciplinary approach from laboratory sciences to population and epidemiological studies. Several mechanisms and capacities were developed and used to link research into policy, practice and actions. The Institute of Health Research at Chulalongkorn University as well as many other research institutes in the regions have benefited from the WHO collaboration in Human Reproduction Program.

International Donors have also contributed to the development of research capacity such as the Sasakawa Foundation, the Regional Networking Group for Strengthening Surveillance and Control of Asian Schistosomiasis. Many programs have been supported by NIH in USA, EC, private foundations and grants from foreign collaborators. Under the leadership of Kerr White and Scott Halstead, **the Rockefeller Foundation has** contributed to the establishment of the National Epidemiology Board in many countries of Southeast Asia and the several Clinical Epidemiology Units in the regions, most notably in the Philippines, Indonesia and Thailand[40,41]. Many clinical epidemiology units are having important multiplying effects and have been contributing to strengthening epidemiological capacities in the region and have been instrumental in improving epidemiological capacities globally[42]. These capacities have been used for policy development at the national and facility levels. For example, the National Epidemiology Board of Thailand (NEBT), established in 1989, coordinated researchers from various disciplines to work together for solving common national problems. It has highlighted to importance of health research management, as a distinct capacity needed by developing countries. Multi-disciplinary

competencies (i.e., epidemiology, biostatistics, medical economics and behavioral sciences) have been the crux of research of the Clinical Epidemiology Units and training.

The International Epidemiology Association (IEA) has also contributed to the development and strengthening of regional activities. Through its own efforts as well as joint activities, the IEA has helped develop and strengthen of regional epidemiological activities[43-45]. This is manifested by the record of the regional meetings and international publications coming from Southeast Asia. The Regional meetings in Southeast Asia have been regular since 1987 meeting in Pattaya, Thailand. With the effort of the IEA, INCLEN, and FETP carrying out several joint meetings, the growth and interest in epidemiology and the enormous improvement in the quality, as well as the quantity of epidemiological research has been particularly notable in South East Asia. Many countries had but a few epidemiologists in the late 1970s. There is now (2005) a flourishing national associations and societies with its own publications in English and local languages. Thailand is the host for the IEA World Congress of Epidemiology (WCE) in 2005. The number of participants in the WCE 2005 from China, India, Indonesia, Malaysia, the Philippines, Vietnam, Lao PDR, Cambodia, Bangladesh, Singapore and Thailand illustrates the increasing penetration of our discipline. The growth and strengthening of epidemiology outside Europe and North America has also led to an increase in bids to act as a host for an International meeting.

The Center for Disease Control (CDC) and the World Health Organization (WHO) have been instrumental in establishing the Field Epidemiology Training Program serving many disease surveillance and disease control function. In 1951 the Centers for Disease Control and Prevention created the Epidemic Intelligence Service to provide training and epidemiologic service on the model of a clinical residency program. By January 2001, an additional 28 applied epidemiology and training programs (FETPs) had been implemented around the globe (with over 1000 graduates and 420 person currently in training). Field Epidemiology Training Programs and Public Health Schools Without Walls are the most common models. Applied epidemiologists, or field epidemiologists, use science as the basis for intervention programs designed to improve public health. AETPs train people by providing them with health competencies through providing service to public health intervention programs and strengthening health systems. FETPs are relatively expensive to create and maintain, but they are highly sustainable and can produce immediate benefits. Of the 19 programs that began before 1997, 18 (95%) continue to produce graduates. The Training Programs in Epidemiology for Public Health Interventions Network was organized in 1997 to provide support, peer review, and quality assurance for AETPs. In 2001,

new programs are planned or in development in India, Argentina, China, and Russia[46]. In Thailand, many graduates from the FETP program are the Provincial Chief Medical Officer and have influenced decisions at the provincial levels. Most notably, is the internationally recognized sentinel surveillance methodology for HIV/AIDS epidemics as well as the use of effective epidemiological surveillance and responses to natural disasters such as the tsunami in 2004-2005, which has led to much fewer deaths and expected.

After 1990, members of the NEBT and the Thai research communities have incorporated the concept of essential national health research or ENHR in some **National Research Initiatives funded by the Thai Government.** The most notable are the Health System Research Institute (HSRI) and the Thailand Research Funds (TRF).

The Health System Research Institute (HSRI) in Thailand has supported area based research program to strengthen the capacity of local researchers. Researchers and epidemiologists in specific catchment areas have been gloomed in problem- and need- driven research relevant to local problem for eventual decentralization and sustainability of health care system. **Pairing of** health care providers, practitioners with epidemiologists and researchers in academic institutions to tackle local problems is another effort to use epidemiological principles and policy and practices in many countries in the Region. This has helped build epidemiological and research capacities among the providers and help orient academics in posing appropriate questions.

With some initial successes, momentum has been built to strengthen epidemiology and research capacities in Southeast Asia. The Ministry of Public Health in Thailand has become the center for FETP training for the region. The Philippines and India have been the Executive Offices for the global INCLEN network. The current Chair of the INCLEN network comes from India. In Thailand, the Thailand Research Fund (TRF) has been developed to support inter-disciplinary, epidemiological and basic research in all branches of science. Recently, the TRF has received approval from the Thai Cabinet to launch the Royal Golden Jubilee Project commemorating the 50th anniversary of the ascension to the throne of His Majesty the King. The Funds give sufficient no-bonded research grants to each student for Ph.D. studies in Thai universities. Each grant covers not only the student's stipend, tuition and research allowance, but also a budget to pursue elective studies, research and data analysis in any collaborating universities abroad. Many significant projects heavily rely on epidemiological investigations. These various momentum and successes efforts have enabled developing countries to be more or less self sufficient in practices and training of basic health sciences capacity and have resulted in essential university and government infrastructures in addition to production of epidemiological researchers

Thus, health sciences capacities in developing countries have come a long way despite tremendous odds (compared to clinical medicine). Nevertheless, bright young epidemiologists through the support of international linkages have recognized the importance of context and the importance of diversity and local knowledge, and a problem-based approach to addressing the major public health problems using appropriate technology. These debates formed the background for a plenary session on 'International Epidemiology and International Health' at the recent International Epidemiological Association (IEA) meeting in Montreal. By empowering developing countries to take health research as a tool to solve local problem, we are encouraging the development of a truly global health research, which not only better address the public health problems in non-Western populations, but can shed light on the current limitations of sciences in addressing the major public health problems in the West[38,46-48].

Gaps and Needs:

Despite some successes, there are gaps and needs. If we look at those who received Nobel prizes in health sciences in the past, it becomes clear that these individuals have lived in countries where research environments have been conducive in to invest their talents in sciences. These countries have invested as percent of GDP far more than Thailand has done in the past. These investments have not been aimed at producing quick results but have ended up in socio-economic returns far more than expected.

A recent study showed that tuberculosis infection is still prevalent among immigrants from developing countries. Tuberculosis is nearly universal among Tibetans settling in Minnesota, suggesting that research is much needed in countries where these migrants come from[49]. With the rampant epidemics of HIV/AIDS in Asia (particularly in India), Dengue Hemorrhagic fever, the Avian Flu epidemics and SARS, the importance of multi-disciplinary research including epidemiology can not be overemphasized.

Knowledge has to be fed into the policy and social process to lead to effective control. At present, at least 300,000,000 people are affected by malaria globally, and there are between 1,000,000 and 1,500,000 malaria deaths per year. Malaria is generally endemic in the tropics, with extensions into the subtropics. Most cases are in Africa, with the remainder clustered in nine countries: India, Brazil, Afghanistan, Sri-Lanka, Thailand, Indonesia, Vietnam, Cambodia and China, suggesting that knowledge alone insufficient for disease control[50]. International policy among countries sharing the same border is critical for a successful disease control.

A recent meeting organized by the TRF highlighted the weakness in basic science research in Thailand and most countries in developing countries. Although fungus has been a

source of useful substances to make beer, bread and antibiotics worldwide, Thailand have only recorded 10% of the 12,000 fungal species registered in Britain. For a tropical country with much more biodiversity, the number is clearly highly underestimated and might deprive the country of an opportunity for revenue generation. Basic sciences are also needed to develop the so-called "orphan drugs". These drugs have not been a priority for development by international industries due to low market values.

Another example is how to capitalize on genetic research advances. Innovative techniques for the detection of the DNA may help us cope with the etiology of present and future documented human epidemic in the region[51], including those due to plague, typhus or viral diseases such as smallpox.

For health system issues, epidemiology as well as other capacity will be needed to optimize the linkage between various levels of policies since each level would have different objectives. Optimization the linkage between different policy levels is relevant during the current technological imbalances because developing countries are still dependent on imported medicines and technology. Research is important in bringing technology to where diseases and health problems prevail to make people get full benefit of technological advances.

We also need to develop epidemiological and other capacities to understand the short and long-term consequences on equity and health by the current trend in globalization and protection of intellectual property rights. How do we cope with the major powerful forces of foreign industries and World Trade Organization requirement? This will require a deep analysis linking several disciplines from international trade and law, international economics, population health, epidemiology to the analysis of health equity. New tools may also need to be developed to understand and control the problem.

The Way forward:

There is a trend in recent years with multi and cross national companies, the vaccine and pharmaceutical companies and Cochrane Collaboration and health management organizations that provide health to some and not health for all. The global trend sees the environmental risk increasing yearly. The result of the current trend is worrisome in that there is a wide and increasing health and technology gap between the rich and the poor country.

All politics are local and they are the building blocks for and operate within the bigger framework of national political system. There is a vibrant consciousness within every country of the world about the role of national research in health care and health care system. The past decade has seen a dramatic advances and changes in many countries in the world with respect to

the level of sophistication of commitment beyond expectation. The challenge is how and where Thailand will go in the next decade. Thailand must build on the essential national health research and create a framework for essential health research that is global. Since global health and problems will transcend national boundaries. Thailand has to address this by sharing knowledge and cooperative actions. By this definition, global health knowledge belongs to every one and is considered public goods and not just to the countries that produce the knowledge. The global research embraces individuals and institutions and not so much nation states.

Take the genome project as an example. The projects are driven by high technology. Innovations sometimes are not driven by the most humane motivation. The previous emphasis of the projects has been on diseases in the industrialized world. However, increasingly these diseases are more and more important in the developing countries. There has also been much work on the pathogen genomes which have been carried out by many scientists who work on the project not only for profit but also with deep commitment to make a contribution, including studies about the cause of leprosy and tuberculosis, meningitis, pneumonia, syphilis, Chagas disease and study of anolpheles so that they may be changed and engineered not to transmit malaria. All these are diseases, which have low market value and have been carried out through joint efforts by scientists in developed and developing countries around the world. These people want to make the knowledge to make a difference. The genome project will change the way we perceive knowledge about health. All epidemiology up to now has deal mainly with external or extrinsic risks. The genome project will allow epidemiologist to study the intrinsic risk of diseases. There are increasing tools to work on these risks that were inconceivable ten years back.

There are more than 80,000 genes in our chromosomes or genome. Man now can know which genes under which circumstances are on or off through the use of micro laser chips. This gives scientists a vast amount of information which has given mankind the necessity for the sophisticated informative to study the individual differences and the means to formulate and test hypothesis between people and population and determine the susceptibility and resistance to diseases. Scientists in developed countries are making gene chips, which showed different level of expressions. Scientists can then have patterns of genes expressed and unexpressed in individuals in a coherent way. These patterns can let scientists identify that the gene of melanoma are quite different from those of colon cancer in their expression. In breast cancer, the study of gene using gene expression technology has allowed pathologists to predict which women will die in less than five years versus those who will live more than five years. This is the first

step for differential gene expression screening which has been published. This will allow us to identify risk. After this first step, scientists can design the drugs to intervene by using computer, such as a protease inhibitor for HIVs. These computer-designed drugs have potentials of almost always working the first time. If they do not work the first time, scientists only have to use new methods of chemistry that can be carried out in small laboratories producing 50,000 new compounds a week more than what major companies can currently produced in a year. Scientists can now study what might be an antigen, synthesize and study the antigens in mice to make a new protein vaccines using new DNA technology within a short period. This has been done in Italy and Washing for N. meningitides and pneumonia.

For damaged tissues, there are real possibilities successful in mice for putting early stem cells currently obtained from embryos which scientists hope might be obtained from blood back into people and have them repopulate damaged tissue with completely new cells.

Scientists are less optimistic about gene therapy or trying to correct genes that are not working well or not optimal to make them work optimally like a complete gene. Since this will be difficult, it will lead to a demand for preventive treatment to prevent the intrinsic risks we know on individuals.

The down sides are becoming clear. Individuals have different risks. People in the same countries will have his or her own chips or gene patterns. Therefore, the world will have more gaps between rich and poor because only the rich can know their gene patterns. There will be exploitations of developing country for clinical trials. Where risks are known, people may be excluded by insurance, discrimination in marriage, jobs and housing and certainly the threat to confidentiality during this information age.

It will have tremendous impact on drugs, of the 80,000 human genes we currently have only some limited number of known drug targets. A large proportion of the existing drugs are me-too drugs. These are drugs similar to the existing ones with only different structures with implications on actions and side effects. Drug costs are rising. If the predictions are right, there will be a demand for preventive therapy. When the chips tell a person that the risk of lung cancer from smoking is high, there will be a pill to target lung cancer.

Most of the money for research goes to the basic sciences research and mainly to scientists in developed countries. Thailand and other developing countries need more understanding and support for applied research such as epidemiology to solve local problems. Regrettably, that kind of research is not driven by market forces. It will take humanitarian forces to change that around. The target of future interventions is towards individuals and their diverse

risks. Yet from the point of view of the world as a whole the most effective things are the population based interventions and mass treatment like vaccines.

Scientists in developing countries such as Thailand can contribute to global health research, if given the right opportunities. The government must understand and give more investment in basic science research. Basic sciences are a key to global health research as evidenced from the Nobel Laureates awarded during the 20th century.

Thailand cannot do research with integrity without having trained researchers for the future. Capacity building is intrinsic to research but not funded as intrinsic to research. Scientists also need to have humility. Scientists know every thing about sickle cell anemia from the genome project such as the genes, the proteins, the mutations, the lost of functions but we cannot do anything about it. There are limits that scientists can do.

In fifty years, scientists will be able to untangle in molecular terms the processes of thinking with possibility to alter them. Scientists will need many more measurable and objectives tools for changing behaviors. Both biomedical sciences and measurements of human behaviors must go hand in hand. Many times, human behaviors are influenced by the social environments in which individuals live. Scientists should not believe that individual behaviors are entirely individual responsibility. Actually, the behaviors are patterned through society norms and scientists have not done a good job in recognizing them and change social patterns. Targeting high-risk behaviors without changing social patterns and environment will fail. It is not an optimal way to change diseases. If actors target people we also have to target the communities, and the media to make people involve in changing the social patterns that are unhealthy. Many of the diseases are preventable by targeting individuals and social patterns.

It is clear that developing countries need to strengthen collaboration, optimize the use of resources for research, develop appropriate infrastructures for relevant disciplines, and adopt innovative plan for capacity development for research. These will include schemes to promote research as a viable career; a Tri-partite arrangement between international bodies, local institutions and local human resource for research. The College of Public Health has developed the Learning- at- the- Workplace programs to make local problems an important entry point to education. Finally, a consensual validation through Kalayanamitra or the friend-helping-friends philosophy will be essential if we will fulfill our commitment towards epidemiology and research as an important link to equity in health for development. This will definitely require the unselfish and intelligent solidarity of national and international bodies, a solidarity which can survive through well-organized exchanges of expertise and networking for a healthier world.

References

1. Daly J., Kellehfar A. and Gliksman M. 1997. The Public Health Researcher: A Methodological Guide. Chapter 1: pp 1-19; Oxford University Press.
2. Louis PCA. 1835. Recherches sur les Effets de Ia Saignee dans quelques Maladies Inflammatoires, Bailleire, Paris.
3. Francis T., Voighr RB., Boisen M., Hemphill FM., Napier IA., *et al.* 1955. Evaluatlon of the 1954 Field Trials of Poliomyelitis Vaccine. Am J Public Health 45(5, Part 2): 1-63.
4. Brown GC. and Kendrick PL. 1965. Serologic response of infants to combined inactivated measles-poliomyelitis vaccine. Am J Public Health Nations Health 55(11): 1813-1819.
5. Ward NA., Milstein JB., Hull HF. and Kim-Farley RJ. 1993. The WHO EPI Initiative for the global eradication of polomyelitis. Biologicals 21(4): 327-333.
6. Langmuir A. 1963. Survelllance of communicable diseases of natlonal importance. New Eng J Med 268: 182-192.
7. Doll R. 1959. Smoking and lung cancer. Report to the Sub-Committee for the Study of the Risks of Cancer from Air Pollution and the Consumption of Tobacco. Acta Unio Int Contra Cancrum 15: 1283-1296.
8. Doll R., Peto R., Hall E., Wheatley K. and Gray R. 1994. Mortality in relation to consumption of alcohol: 13 Years' observations on male British doctors, Br Med J 309: 911-918.
9. Doll R., Peto R., Hall E., Wheatley K., Gray R. and Sutherland I. 1994. Mortality in relation to smoking: 40 Years' observations on male British doctors, Br Med J 309: 901-910.
10. Spitzer WO., Lewis MA., Heinemann LA., Thorogood M. and MacRae KD. 1996. Third generation oral contraceptives and risk of venous thromboembolic disorders: an international case-control study. Transnational Research Group on Oral Contraceptives and the Health of Young Women. Br Med J 312: 83-88.
11. Dawber TR., Kannel WB. and Luelle LR. 1963. An approach to longitudinal studies in a community: The Framingham Study. Ann NY Acad Sci 107: 539-556.
12. Knekt P., Jarvinen R., Reunanen A. and Maatela J. 1996. Flavonoid intake and coronary mortality in Finland: a cohort study. Br Med J 312: 478-481.

13. Morris J.N., Kagan A., Pattison DC. and Gardner MJ. 1966. lncidence and prediction of ischemic heart disease in London busmen. Lancet 2(7463): 553-559.
14. Nay P., Kannel WB., Castelli WP. and McNamara PM. 1975. The omnicardiogram Study of a proposed method for detecting coronary heart disease in an asymptomatic population. Circulation 51: 462-466.
15. Tarwater PM., Mellors J., Core ME., Margolick JB., Phair J., Detels R, *et al.* 2001. Methods to assess population effectiveness of therapies in humaanimmunodeficiency virus incident and prevalent cohorts. Am J Epidemiol 154: 675-681.
16. Warshafsky S., Kamer RS. and Sivak SL. 1993. Effect of garlic on total serum cholesterol. A meta-analysis. Ann Intern Med 119:599-605.
17. Cochrane AL. 1971. Effectlveness and efficlency: random reflectlons on health services. The Nuffield Provincial Hospitals Trust, London.
18. Torrance GW. 1976. Social preferences for health states: an empirical evaluation of three measurement techniques. Socio-Economic Planning Sciences 103: 29-36.
19. Andresen EM. and Meyers AR. 2000. Health-related quality of life outcomes measures. Arch Phys Med Rehabil 81: s30-s45.
20. Berman P. 2000. Organization of ambulatory care provision: a critical determinant of health system performance in developing countries. Bull World Health Org. 78: 791-802.
21. Mannion R. and Davies HT. 2002. Reporting health care performance: learning from the past, prospects for the future. J Eval Clin Pract 8: 215-228.
22. Larkins R. 1996. Basic research and the ethics of resource allocation. In J. Daly (ed.), Ethical Intersections: Health research, methods and researcher responsibility, AIlen & Unwln, Sydney.
23. Bobb AJ., Castellanos FX., Addington AM. and Rapoport JL. 2005. Molecular genetic studies of ADHD: 1991 to 2004. Am J Med Genet B Neuropsychiatr Genet 132: 109-125.
24. Fung YW., Lau LT. and Yu AC. 2004. The necessity of molecular diagnostics for avian flu. Nat Biotechnol 22: 267.
25. Ramsay S. 2001. Ethical implications of research on the human genome. Lancet 357: 535.
26. Oakley A. 1985. Social support in pregnancy: the "soft" way to increase birthweight. Soc Sci Med 21(11): 1259-1268.

27. Trostle J. 1986. Early work in anthropology and epidemiology: from social medicine to germ theory, 1840 to 1920. In CR. James, R. StaII & SM. Gifford (eds), Anthropology and Epidemiology. D. Reldel Pubilshlng Company, Boston.
28. Weber RP. 1990. Basic Content Analysis. Sage, Newbury Park, California.
29. Krieger N. 1992. The making of public health data: paradigms, politics and policy. J Public Health Policy 13(4): 412-427.
30. Krieger N. 1994. Epidemiology and the web of causation: has anyone seen the spider? Soc Sci Med 39(7): 887-903.
31. Ruzek SB. 1993. Towards a more inclusive model of women's health. Am J Public Health 83 (l): 6-8.
32. Schoepfi BG. 1993. AIDS action-research with women in Kinshasa, Zaire. Soc Sci Med 37(11): 1401-1413.
33. Somchintana Thongthew Ratarasarn. 1989. The Principles and Concepts of Thai Classical Medicine. Thai Khadi Research Institute. Thammasat University. ISBN 974-570-663-9.
34. Wu GL. 2002. Emergence and development of parasitology and parasitic diseases. In Chen X, Wu GL, Sun X, et al, eds. Modern issue of parasitic diseases. Beijing: People's Press of Military Medicine pp 1-5.
35. Xu ZJ. 2000. Human parasitology. In Deng TT, Chen ZF, eds. General history of medicine in China. Beijing: People's Health Press, pp 377-381.
36. Mao SB. 1989. Development and mission of parasitology. Chin J Parasit Dis Con (Chin) 2:150-154.
37. Suwanwela C. and Poshyachinda V. 1986. Drug abuse in Asia. Bull Narc 38(1-2):41-53.
38. Cheah JS., Yeo PP., Thai AC., Lui KF., Wang KW., Tan YT., *et al.* 1985. Epidemiology of diabetes mellitus in Singapore: comparison with other ASEAN countries. Ann Acad Med Singapore 14 (2): 232-239.
39. Wu GL. 2005. Medical parasitology in China: a historical perspective. Chin Med J 118(9): 759-761.
40. White K. 1991. Healing the Schism: Epidemiology, Medicine and Public Health. Springer-Verlag, New York.
41. Halstead SB., Tugwell P. and Bennett K. 1991. The International Clinical Epidemiology Network (INCLEN): a progress report. J Clin Epidemiol 44(6):579-589.

42. Macfarlane SB., Evans TG., Muli-Musiime FM., Prawl OL. and So AD. 1999. Global health research and INCLEN. International Clinical Epidemiology Network. Lancet 353(9151): 503.

43. Breslow L. 2005. Origins and development of the International Epidemiological Association. Int J Epidemiol 34(4): 725-729.

44. Anonymous. 1977. The History of the International Epidemiological Association 1954-77. Int J Epidemiol 6(4): 309-324.

45. Anonymous. 1984. The History of the International Epidemiological Association brought up to date. Int J Epidemiol 13(2): 139-141.

46. White ME., McDonnell SM., Werker DH., Cardenas VM. and Thacker SB. 2001. Partnerships in international applied epidemiology training and service, 1975-2001. Am J Epidemiol 154(11): 993-999.

47. Mustaffa BE. 1985. Diabetes mellitus in peninsular Malaysia: ethnic differences in prevalence and complications. Ann Acad Med Singapore 14(2): 272-276.

48. Pearce N. 2004. The globalization of epidemiology: introductory remarks. Int J Epidemiol 33(5): 1127-1131.

49. Truong DH., Hedemark LL., Mickman JK., Mosher LB., Dietrich SE. and Lowry PW. 1997. Tuberculosis among Tibetan immigrants from India and Nepal in Minnesota, 1992-1995. JAMA 277(9): 735-738.

50. World Health Organization and UNICEF. 2005. World Malaria Report 2005. WHO/HTM/MAL/2005.1102. 294 pages.

51. Drancourt M. and Raoult D. 2002. Molecular insights into the history of plague. Microbes Infect 4(1): 105-109.