

# **Trilateral Seminar on R&D Policies Related to Emerging and Re-emerging Infectious Diseases**

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## **A – Presentations by Distinguished Speakers**

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# **Emerging and Reemerging Infectious Diseases: Perspectives from the Institute of Medicine**

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## **Introduction**

I am delighted to greet you, and extend my welcome to those who have come so far from Korea and China to attend this Trilateral seminar on emerging and reemerging infectious diseases. I also would like to thank the meeting organizers including particularly Dr. Jerry Keusch, my old classmate and friend, for inviting my participation in this important meeting. It is rare to have an opportunity such as this to freely discuss problems and issues that confront each of us in our various corners of the world, and I look forward to our interactions over the next two days.

## **A Global Village**

First, I would like to share some personal experiences and perceptions that hopefully will help to illustrate the general themes of the meeting. Please bear with me, because these seemingly-unrelated observations do actually pertain to our topics for discussion. My wife Joyce and I have made many friends in distant places in the past few years. Where do these people come from? You say “Asia”? Well, you are correct, although the connection is not recent. I am referring to the Inuit people from the Central Arctic region of Canada, whose people migrated across the land bridge connecting Siberia and Alaska several thousand years ago. They live in a cold and treeless domain, often called the barren grounds, where few outsiders ventured until the past 80 years or so. This is a land of intense winter cold, ice and snow, fierce storms, and swarms of mosquitoes in the brief summer. However, this also is a place of incredible beauty on the broad (but not barren) tundra, rivers, and lakes. The abundance of caribou and wolves and musk oxen speak to an unspoiled wilderness. Thus it comes as a shock to read that the Inuit carry high levels of organic toxins<sup>1</sup>.

This “arctic paradox” stems from the Inuit diet which is rich in animals from the seas, which have become increasingly burdened by toxins from the developed world<sup>1</sup>. How might the toxins have been carried so far north? One answer it seems comes from migratory birds, which nest in profusion along many far northern cliffs and islands. Their droppings have literally seeded the northern seas with toxins from far to the south<sup>2-4</sup>,

proving not only that we all live in a single highly interconnected global village, but also that birds are important vectors of many health hazards, including H5N1 influenza. The latter is much in the news today, and is one reason we are holding this conference. These are only the latest in an ever-enlarging list of emerging and reemerging infections across the globe in the past 30 or more years.

Presence of organic toxins from the developed world in the wild far north is not the only evidence for our interconnectivity. Equally alarming is the evidence that the permafrost in Alaska and other sites is thawing, that many glaciers and ice fields are retreating, and that the great ice caps in the north and south are melting. This is a general phenomenon, from the Arctic to the Antarctic, including the snows on Mount Kilimanjaro at the equator, which are predicted to be gone entirely within this century. The evidence for these phenomena is clear, although the root causes are not yet without debate. The conclusion that we have entered into an era of man-made global warming is the most attractive hypothesis, even if some world leaders would like to have us believe this is not so. If this is accepted, one must conclude that what one culture does influences all others, and that we share a common responsibility for our global future.

### **Historical Perspectives**

Infectious diseases of course have been both a local and an international phenomenon for as long as people and animal have traveled. Humans have evolved under the powerful selective pressures of culling by infectious diseases, and our gene pools reflect regional differences in the historical pressures of particular infectious agents. Indeed, Jared Diamond convincingly argued in his book *Guns Germs and Steel* that the rise and fall of civilizations was linked to the transmission of infection from invading populations with partial herd immunity to populations with no immunity, resulting in severe epidemics that changed history<sup>5</sup>. Most of these infections were acquired originally from animals raised by farming populations in certain favored parts of the world, to which the populations developed some immunity over time. If the concept of a single global village is the first concept, the second is that emerging infectious diseases often are zoonoses<sup>6</sup>.

**Influenza.** Emerging zoonoses occur periodically at different places for a variety of reasons, and get our attention either because they are particularly severe (e.g., the hemorrhagic fever virus such as marburg, ebola, lassa fever, and also SARS) or very common. When an emerging infection is both severe and common as in the case of the 1918-1919 influenza outbreak, a world-wide crisis may ensue. At present, there is great concern that the continued spread of H5N1 avian influenza in Asia and elsewhere<sup>7,8</sup> may be the forerunner of a severe human outbreak of pandemic influenza. The relatively few cases of H5N1 observed in humans during the current outbreak in domestic birds

suggests that the current strain has poor transmissibility to humans, although it does cause severe disease once a human is infected. Worries are heightened by recent demonstration that the 1918-1919 pandemic strain probably spread directly to humans from a bird reservoir<sup>9</sup>. Molecular analysis of the currently circulating H5N1 isolates and the 1918-1919 strain suggests only a few mutations separate us from another pandemic of human influenza<sup>9</sup>. Apparently, mutations of the viral polymerase gene are sufficient to promote increased host range of the influenza virus<sup>9,10</sup>. The current epidemic avian H5N1 strain is continuing to evolve rapidly, heightening worries about potential for increased virulence<sup>11</sup>. Moreover, demonstration that many of the current H5N1 isolates are resistant to amantadine<sup>12</sup>, and in addition may readily become resistant to oseltamavir during therapy<sup>13-15</sup> suggests that our ability to treat a pandemic might be quite limited. It is no surprise then that almost every issue of some of the most prominent scientific journals contains news about the further spread of the H5N1 strain, which as of this writing has spread from SE Asia to the Near East, Central and Eastern Europe, and West Africa. The principal vectors for transmission seem to be migratory fowl, suggesting there will be continued spread and that ordinary control measures will not be effective. Models of the impact of a new pandemic of influenza show that the consequences will be great, especially if the new outbreak coupled high transmission with the severity of disease associated with the 1918-1919 strain. Studies of the reconstructed 1918-1919 strain showed that it was a particularly virulent isolate, with direct cytotoxicity for lungs of experimental animals that exceeds that seen with most influenza isolates<sup>16</sup>.

**SARS.** An emerging infection does not have to be highly transmissible to have a major effect on the world. SARS emerged in China as a new human disease in 2002, and galvanized world attention for over a year. Case fatality rates were high, especially in older individuals, and secondary spread occurred sporadically. Rapid international travel resulted in export of the disease to many nations and particular cities. Toronto for instance was particularly hard hit. Although a definitive reservoir has yet to be established, there seems no doubt that this novel coronavirus is another example of a zoonotic infection which jumped across species to humans, just as HIV had done a few decades earlier. Unlike HIV, which proved to be sufficiently transmissible to cause a sustained and still growing pandemic, SARS had low transmissibility and seems to have completely died out as a result of imposition of relatively simple control measures, absent a therapy or a vaccine. Nevertheless, there were many important lessons, including the high economic impact of a dramatic infectious disease with relatively few victims, as was seen also in the 2001 outbreak of bioterrorist anthrax in the United States. The SARS episode also illustrated the importance of rapid communication of emerging infectious disease data, and the importance of global cooperation in stemming the spread of infection.

**Other emerging infections.** There have been many other emerging infectious disease problems, at the rate of at least one a year for over 30 years. The list includes relatively uncommon diseases such as the hantavirus pulmonary syndrome in the four corners region of the American Southwest; nipah virus and *streptococcus suis* in SE Asia; and staphylococcal toxic shock syndrome in the developed world. There also have been major outbreaks of novel diseases including HIV, and spread of old diseases to new regions including West Nile virus to the Americas and Rift Valley Fever virus from North Africa to the Middle East. Certain emerging diseases may have occurred previously but emerged to be more prevalent as a consequence of changed technologies, such as the toxic shock syndrome staphylococcus associated with particular tampon brands. The regularity of recognition of such problems suggests that we shall continue to be troubled by more such problems in the future. To these one may add the problem of reemerging old scourges, including plague in India, malaria and tuberculosis in much of the world, and the continued emergence of antimicrobial resistance in virtually every corner of the globe.

The problems of antimicrobial resistance deserve special mention, because we have come to take for granted our ability to treat infectious disease, especially bacterial diseases. It therefore seems particularly shocking to read of resistant pneumococci, staphylococci, and enteric gram negative bacteria, some of which are very difficult to treat with any existing drugs. Fortunately, new anti-staphylococcal and streptococcal antibiotics have come to market in the United States recently, but they are expensive and certainly not available to all in the world who might need them. Many of these bacteria are particularly common in hospitals where antimicrobial use is so prevalent, but some have emerged in the community including the rapid rise of antibiotic resistant and invasive clones of staphylococcus aureus. Likewise, there has been rapid spread of ciprofloxacin resistant gonococci around the globe, strongly suggesting spread by travelers from one region to the next. Past history has taught that resistant clones of bacteria may spread widely throughout the globe, including resistant pneumococci. It is quite possible that overuse of over the counter antibiotics in some regions of the world leads to emergence of resistant clones locally, with subsequent spread to others, eventually traveling the globe, analogous to transmission of SARS and other epidemic organisms. We are a global village.

The issue for our consideration is, what can we do about these problems? Without a more clear understanding of zoonotic vectors and reasons for occasional emergence of diseases such as ebola virus, we cannot institute measures to control emergence. We cannot prevent human travel easily, and therefore human transmission of emergent infections will be very difficult to prevent. It also is difficult to control the transfer of goods and foods that also contributes to the global spread of certain emerging infections,

and impossible to prevent the intercontinental flights of wild birds that act as vectors for influenza viruses. Even if we in the developed world were able control the use of antibiotics in hospitals and in outpatient practice, it is unlikely that this can be accomplished in underdeveloped and poor regions of the worlds where over the counter use without prescription or medical supervision is the rule. For all of these reasons, we can reliably anticipate continued problems with known infectious diseases and emergence of new ones not yet known.

### **The Institute of Medicine (IOM) Responses**

**Committees.** Recognition of the problems posed by reemergence of old diseases including tuberculosis and malaria, and the emergence of entirely novel diseases such as HIV/AIDS caused the IOM in 1990 to establish a committee to consider the nature of the problems and to recommend actions that might be taken to ameliorate them. This committee was chaired by Joshua Lederberg and the late Robert Shope, and it issued a report in 1992 *Emerging Infections: Microbial Threats to Health in the United States*<sup>17</sup> that had substantial impact in this country. The report called attention to the problem in a highly visible manner, and noted that former protections afforded by international surveillance centers had lost effectiveness as more of these centers were closed. Problems stemmed in part from decades old assumptions, now proven false, that advent of antimicrobials and certain highly effective vaccines would prevent any further serious problems with infectious diseases. The report called for renewed emphasis on surveillance, and a variety of other measures that led directly to new programs at the US Centers for Disease Control (CDC) and new funding through the National Institutes of Health (NIH).

Another decade passed with evidence for increasing problems of new disease emergence and resistance to antimicrobials, leading to a second IOM committee chaired by Lederberg and Margaret Hamburg. The second committee had commenced its deliberations when the bioterrorist anthrax attack occurred in several cities of the eastern United States in October 2001, shortly after the terrorist attacks on New York City and Washington D.C of 9/11/2001. Their report was in the process of completion when the SARS outbreak occurred in 2002. This committee issued a formal report in 2003 *Microbial Threats to Health Emergence Detection and Response*<sup>18</sup>. The second report was notable for its increased emphasis on the global nature of the problem, and for certain of its recommendations, including a call for centers of research that would bring together experts from diverse disciplines to consider effective responses to what was now seen as a continuing threat to global medical and fiscal health. This report also rather belatedly called on the United States to join much of the rest of the world in banning the use of human antimicrobials as growth supplements in animal husbandry, which has yet

to become policy in the United States. It was noteworthy that the main emphasis of the second report was not on planned bioterrorism, but rather on the natural emergence of new infectious threats and of increasing antimicrobial resistance. The cover of the 2003 report depicted the genetics of the influenza virus, a symbolic representation that this was more likely to be the next major problem facing the world. The response of the NIH leadership to a call for new interdisciplinary centers of infectious diseases analogous to the very successful cancer centers established in the United States for several decades was that such centers had just been created, in the form of centers for defense against bioterrorism. The 10 new regional centers of excellence for biodefense and emerging infections have to date focused almost entirely on perceived agents of bioterrorism, although it is possible that they will morph into centers for emerging infection.

Both of these reports are worth consulting for their careful analysis of the scope of the problems and the factors leading to continued emergence of infectious diseases. Global travel and commerce, poverty, wars and social unrest, the development of megacities, changing ecology and human invasion of territories inhabited by infectious agents and their vectors, global climate change, breakdowns in public health systems, developments of new technologies that paradoxically increase susceptibility to infection, microbial adaptation and change, and many other factors all contribute to a sort of continuing “perfect storm” that breeds problems with new and old infectious diseases. One of these problems is complacency, and another is lack of public will to do something about them. To this now can be added the problem of purposeful intent to harm by introduction of agents of bioterrorism, which has attracted major funding in the United States, in hopes of discovering and developing new treatments, diagnostics and vaccines for biodefense, limited to category 1 select agents for bioterrorism for the main part.

**Forums.** Another device also has been used by the IOM to try to bring public focus on the need to do something about the continued problems of emerging infectious diseases: the forums on microbial threats. Unlike committees, the forums do not have the power to issue formal reports with recommendations backed by the authority of the IOM. They do however have the power to issue publications summarizing the discussions, and are composed of members of industry, private foundations, public health communities, government, and academia in hopes of spurring collaborations and free exchange of ideas. Their financial support is derived from the membership, and they are an excellent example of an ongoing public-private partnership in search of solutions to very difficult problems. Recently, their scope has been broadened to include more international participation although much more might be done in this regard. Nevertheless, they are worth mentioning here because they serve as a model for what every nation or regional area might do in response to the same sorts of problems.

First formed in 1996, there have been one or two forums on microbial threats yearly. These have included reports on antimicrobial resistance<sup>19</sup>, emerging infections from an international perspective<sup>20</sup>, infectious diseases as a cause of chronic diseases<sup>21</sup>, SARS<sup>22</sup>, pandemic influenza<sup>23</sup>, bioterrorism<sup>24</sup>, emergence of zoonotic diseases<sup>25</sup>, eradication of viral diseases<sup>26</sup>, and others. Information about these reports and their availability is available from the National Academies at [www.nap.edu](http://www.nap.edu) and about the IOM at [www.iom.edu-information](http://www.iom.edu-information).

## **Conclusion**

How effective are these committees and forums? Do these deliberations make any difference? It is not easy to measure the impact, but certainly an important first step in any problem is to bring together people who are knowledgeable about it to consider responses that might be effective. In the United States, it is likely that these reports have influenced funding and therefore programs for action. In the increasingly small global village in which we all live, they serve as a model for our need to talk with each other across boundaries, and to work our solutions to problems that are global in scope. This meeting is exemplary of this need, and of our willingness to work together for the common understanding and good. I look forward eagerly to these discussions.

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## **It's All About Infrastructure**

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The material presented by Dr. Garrett in her address at the Trilateral Seminar on R&D Policies Related to Emerging and Re-emerging Infectious Diseases has been developed in more detail in the following two articles:

“The Lessons of HIV/AIDS” and “The Next Pandemic”.

Her articles appear in the July/August 2005 edition of *Foreign Affairs*, vol 84, No. 4, and may be accessed at <http://www.foreignaffairs.org/2005/4.html>.

# **Epidemiologic Transition of Communicable Diseases in the Republic of Korea: Academia's Contributions to the National Communicable Disease Prevention and Control Programs**

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## **I. Introduction**

Emerging/re-emerging infectious diseases have been the most important health problem threatening public health. Since 1973, 29 pathogenic microbes and infectious diseases have been newly recognized around the world, which have brought serious social and economic impacts.

Fatal new infectious diseases are expected to emerge more frequently in the future considering population growth and industrial development, which will induce vigorous competition for food, space and other limited resources, leading to more mutants, and resulting in the evolution of new, virulent pathogens.

The evolution of pathogens and hosts by natural selection process had been conclusively demonstrated. Many specific cases have been experienced over the centuries for example: cholera, plague (highly fatal pneumonic type to less fatal bubonic type), syphilis (generalized paralytic to local lesion), and many antibiotics-resistant strains.

At the beginning of the last century, Korea was politically unfortunate and economically underdeveloped country. However, during the past several decades, Korea has created and achieved drastic changes not only in politics but also in economics. Today, Korea is estimated to have become the world's 10th biggest economy in terms of gross domestic product (GDP).

Meanwhile, factors affecting the ecology of diseases, especially for communicable diseases, have been altered. The rise in population mobility and increases in food/animal commerce in Korea has created complexities in the dynamics of biological and ecological interactions thus creating or fostering the presence of new and old pathogens.

In this paper, epidemiologic transitions of communicable diseases in Korea will be reviewed, and the significant factors that affected the emergence and reemergence of infectious diseases discussed.

## **I.1.General Information about Korea: Current situation**

**Geography.** The Korean Peninsula extends about 1,000 kilometers southward from the northeast Asian continental landmass. Roughly 300 kilometers in width, climate variations are more pronounced along the south-north axis. Differences in plant vegetation can be seen between the colder north and the warmer south.

The total area of the peninsula, including its islands, is 222,154 square kilometers of which about 45 percent (99,313 square kilometers), excluding the area in the Demilitarized Zone (DMZ), constitutes the territory of South Korea.

An ancient Korean artist featured the peninsula as a roaring tiger in Asia as shown in Figure 1.



**Figure 1. Korean peninsula featured by an ancient Korean artist as “roaring tiger in Asia”**

**Population.** The total population is 48,387 thousand with sex ratio 100.6 and age structure of bell shaped constituting 20.4 percent of under 14-year old children, 72.1 percent of 15-64 year old adult group, and 7.5 percent of older than 65-year old aged group.

**GDP/capita in 2004.** The GDP increased to 14,362 US\$ which appears to be the most outstanding achievement for Korea.

**Educational achievement.** Educational attainment in Korea for both male and female is considerably higher when compared with other countries; among the population above five-year of age, 64.5 percent completed above primary school education and 46.3 percent above high school education. Furthermore about 0.5 percent among the population hold doctorate and 2.0 percent masters degrees (Table 1).

**Table 1. Ten Leading Causes of Death in 1994 and 2004, ROK**

Rank	2004		1994		Changed percent
	cause of death	Mortality rate/10	Rank	Mortality rate/10	
1	Neoplasms	133.5	1	112.7	18.46
2	Cerebrovascular Dis.	70.3	2	84.4	-16.71
3	Heart Dis.	36.9	3	43.6	-15.37
4	Intentional self-harm	25.2	9	10.5	140.00
5	Diabetes mellitus	24.3	7	17.0	42.94
6	Diseases of liver	19.1	5	29.2	-34.59
7	Chronic lower respiratory Dis.	17.3	8	15.7	10.19
8	Transport accidents	17.2	4	35.9	-51.27
9	Hypertensive Dis.	10.4	6	25.8	-59.69
10	Pneumonia	7.2	17	4.6	56.52
<b>Subtotal</b>		<b>361.4 (76.3 percent of the total death)</b>			
<b>Total Mortality rate/10</b>		<b>506.9</b>	<b>530.2</b>		

**Health indicators.** Crude birth rate in 2003 was 10.2 with sex ratio of 106.7 and total fertility rate of 1.19.

Crude death rate in 2003 was 5.3, and infant mortality rate in 1999 was 6.2 in which the neonatal mortality was 3.8, implying over the half of the infant mortality was almost inevitable.

Ten leading cause of death that comprises 68.8 percent of the total deaths constitute 62.6 percent from chronic degenerative diseases and 6.2 percent from external causes. The death from infectious diseases was 2.1 percent among all deaths. Table 2 presents ten leading cause of deaths by sex in 2004.

**Table 2. Educational attainment among the population older than 5 years of age (2004)**

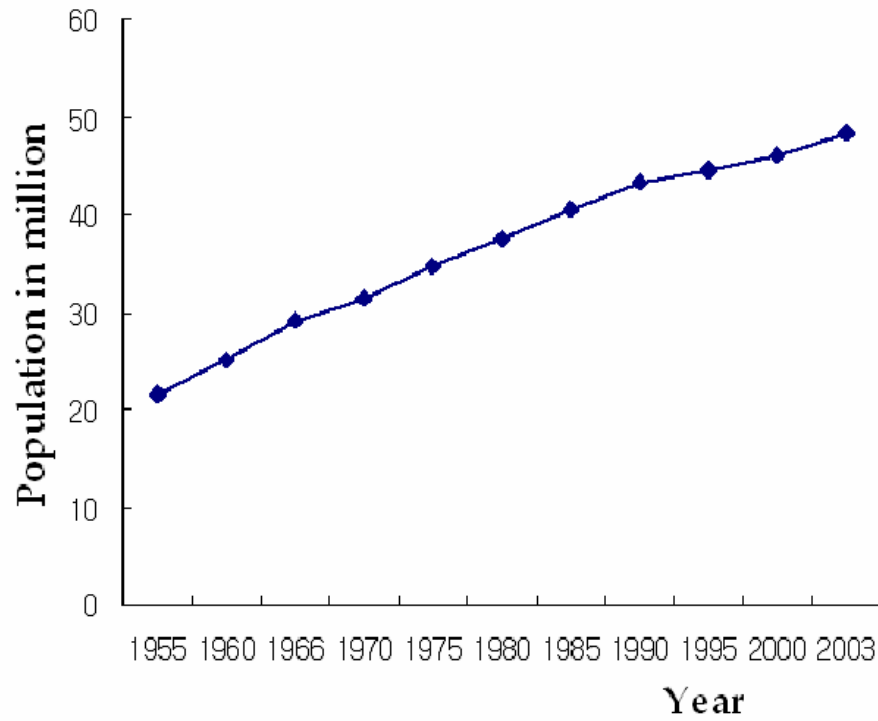
Status of Education	Male (21,062,752)*	Female (21,106,059)*
In Schooling	28.9	22.8
Dropped out	3.3	2.3
Graduated	63.7	65.5
Primary school;	7.0	12.1
Middle school	7.8	9.8
High School	28.7	29.2
Junior College (2yrs)	6.3	9.8
University (4 yrs)	12.0	7.8
Masters Degree	1.5	0.5
Doctorate Degree	0.4	0.1
No schooling	3.5	9.1
Total	100.0	100.0

\* Korean population older than 5 years of age

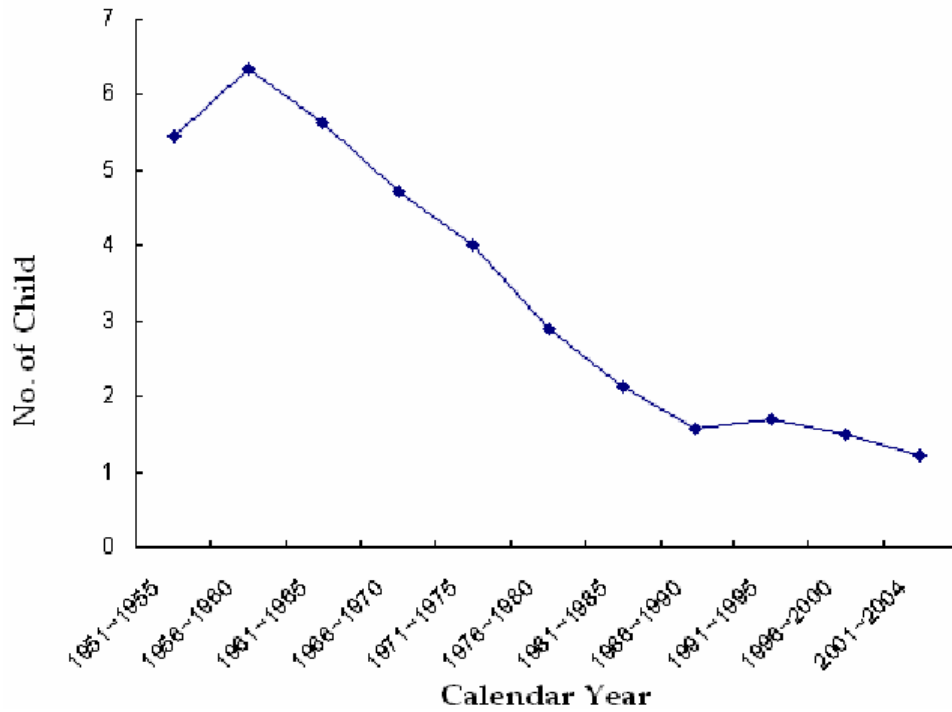
Life expectancy at birth in 2001 was 72.8 years for male and 80.0 years for female making the average life expectancy 76.5 year for both sexes. Accordingly natural increase rate of the population in 2003 was 5.1.

### **I.1.ii. Changes of Some Indicators Associated with the Transition of Disease during the Past Several Decades**

**Population growth.** The population growth from 1955 to 2003 is shown in Fig.2. The Republic of Korea has undergone demographic changes at a pace that has dazzled many population scientists. Fertility has declined to a level far below the replacement level within a short span of two and half decades by concerted government policies and family planning programs achieving this momentous transition. The total fertility rate in Korea rapidly decreased from 6.0 in 1960 to 1.6 in 1987. Thereafter, the total fertility rate fluctuated between 1.7 and 1.8, nevertheless it has recently decreased further to 1.19 in 2003 as shown in Fig.3. (NSO, 2004). It is estimated that if the current low fertility continues, the population in Korea will stabilize at around 52.8 million people by the year 2028, and will begin to decrease thereafter.



**Figure 2. Population growth of Korea (1955-2003)**



**Figure 3. Total Fertility Rates by 5-Year period**

Socio-economic developments which have resulted in the decline in fertility include rapid urbanization, increase in educational and economic participation of females, increase in educational attainment of both males and females, and reduction in infant and child mortality rates. Other factors include changes in the value placed on, or preference for, the number of children, family structure, marriage behavior, role and function of the family, especially in support for the elderly. In addition, improvements in nutrition, general health status, and change in life style that often go along with socio-economic development, have played a role in reducing mortality. Life expectancy at birth was 52.4 years for both sexes in 1960 but increased to 74.4 years in 1997 and 76.5 years in 2001(NSO, 2003b).

The decline in fertility in Korea has been attributed to the increase in the proportion of single women and the changing attitude of women concerning childbirth. The proportion of women, who have never married, increased from 57.3 percent for the 20-24 year age group in 1970, to 83.3 percent in 1995. There has also been an increase in the proportion of women never married in the 25-29 (from 9.7 percent to 29.6 percent) and 30-34 (from 1.4 percent to 9.7 percent) age groups. The proportion of single women is expected to increase continuously in the immediate future (NSO, 1996).

Major consequences resulting from the rapid fertility decline include the shrinking of the labor force and the growth of the elderly population (Fig.4), for which a population specialist (N.H. Cho) has proposed various policy options.

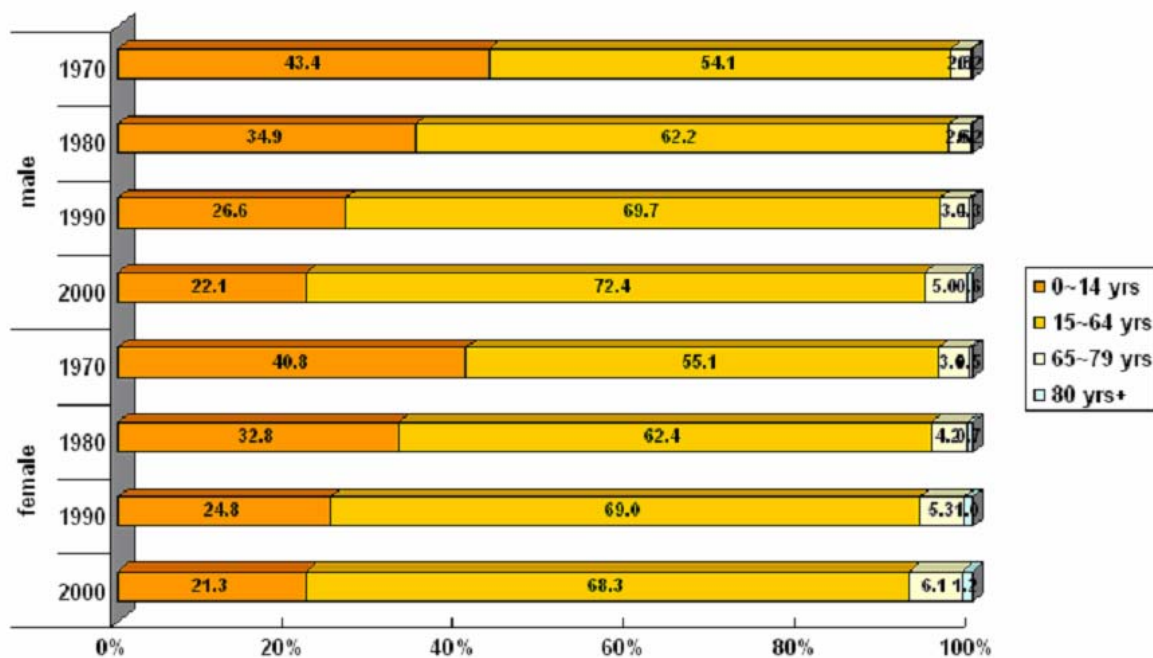
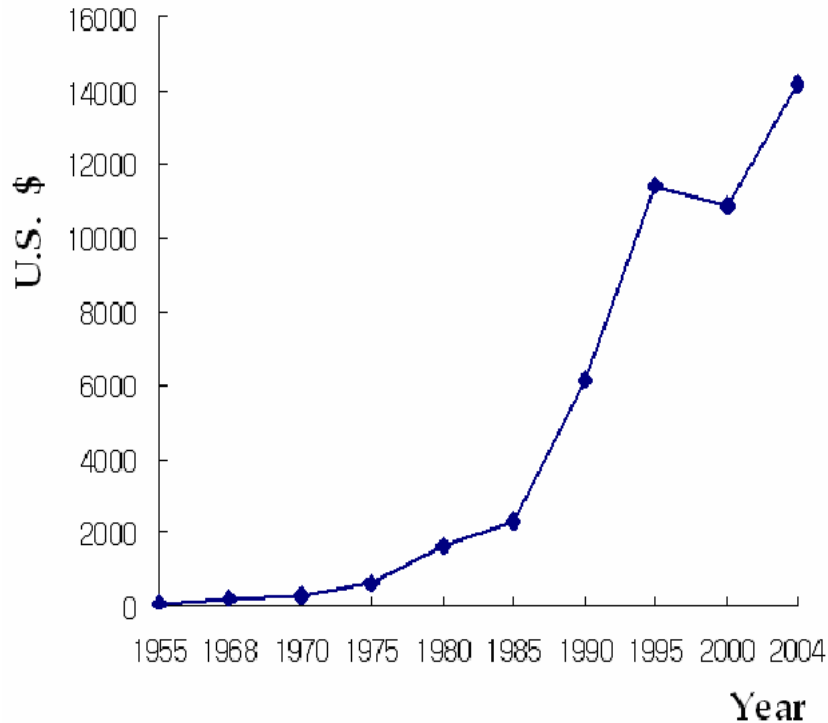


Figure 4. Age structure by year and sex in Korea

**GDP Growth.** The growth of the South Korean economy has been extremely rapid, recording between 5 percent and 11 percent annual increase in GDP since 1980 (with the exception of the 1997 financial crisis), and a doubling of GDP between 1985 and 1995. South Korea joined the Organization for Economic Co-operation and Development (OECD) in 1996, and currently ranks tenth in GDP among the thirty member countries. Fig.5 shows the increase of GDP for every five-year period.



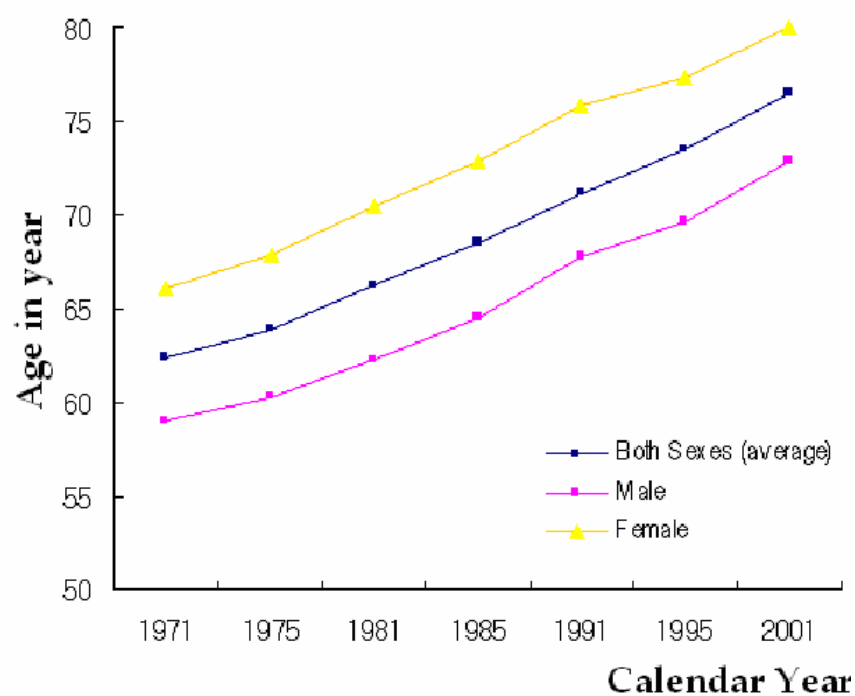
**Figure 5. GDP/capita growth by year in Korea**

**Life expectancy by sex.** South Korea has the highest rise in average life expectancy among the 30 members of the OECD, the National statistics office stated.

In recent years, the health and quality of life for Koreans have improved steadily. There has been a significant rise in life expectancy by markedly improved living standards, and in part due to achievement of the national medical insurance plan and progress in medical services accompanied by increases in the number of medical facilities and medical staff. These improvements have greatly contributed to reductions in the infant mortality rate and the maternal mortality ratio also.

Average life expectancy in the Republic of Korea for males rose from 51.1 years in the 1960s to 76.5 years in 2001 and for females from 53.7 to 80.00 over the same period (Fig. 6). However, the disparity between males and females appears to have resulted in the improved allocation of resources for women, who had been the major victims the lack of basic resources. It also reflects in part a relatively high mortality rate for males in their forties and fifties. The infant mortality rate fell from 61.0 per 1000 live births in the

1960s to only 6.2 in 1999, while the maternal mortality ratio stood at 15 per 100 000 live births in 2000.



**Figure 6. Life expectancy by sex and year in Korea**

**Percent of death by infectious disease by year.** Percentage of deaths from infectious diseases among all death has decreased gradually from 18.2 percent in 1950s to 2.1 percent in 2002 (Fig. 7). The decreased deaths from the infectious diseases are attributable to the declines of occurrences and mortality from infectious diseases, which largely were influenced by improved living standard in general accompanied by improved nutrition, educational level, sanitary living environments (modern kitchen and bathroom facilities), and working conditions. Enforced government policies on prevention and control of communicable diseases have been the most powerful factor influencing the declining the occurrence of, and deaths from, communicable diseases.

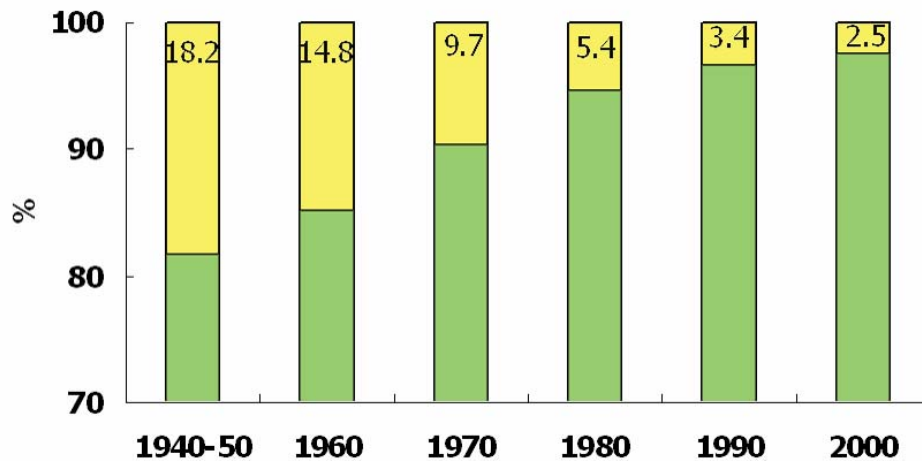


Figure 7. Percentage of death from infectious diseases in Korea among total death by year

**Sanitary water supply facilities.** Until the 1970s, there had been frequent outbreaks of water and food-borne communicable diseases such as typhoid fever, paratyphoid fever, dysentery and food poisonings by various pathogens, mainly from unsanitary living environments along with poor nutrition. These diseases have shown a remarkable decline of occurrence closely associated with increased proportion of the population supplied by sanitary water. Fig.8 shows the increased proportion of the population supplied by sanitary water and the amount spent by one person.

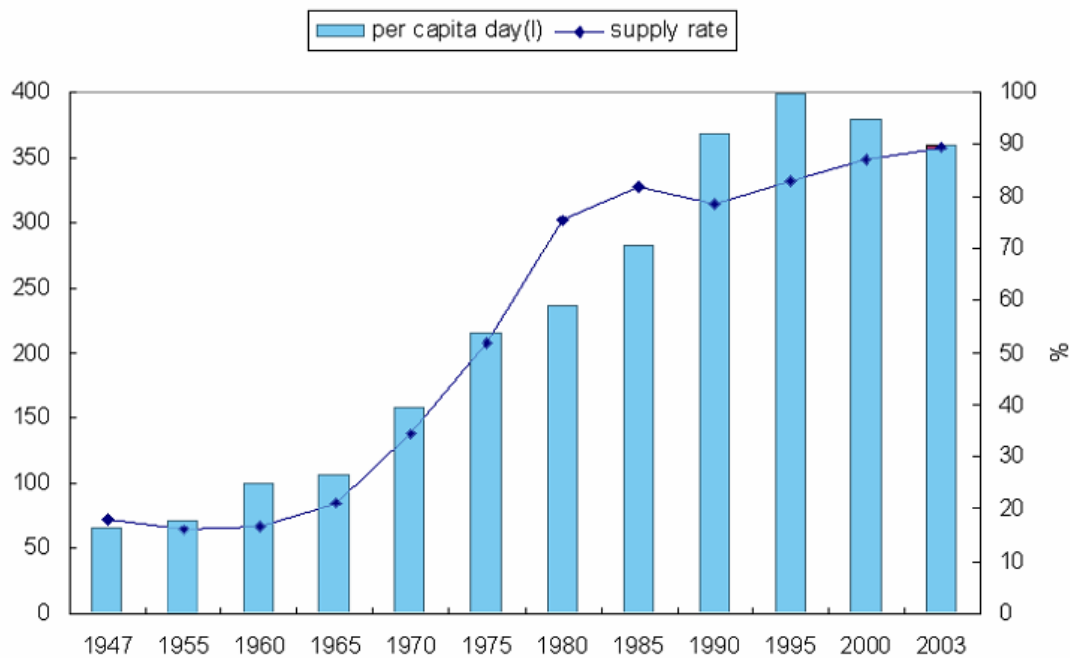
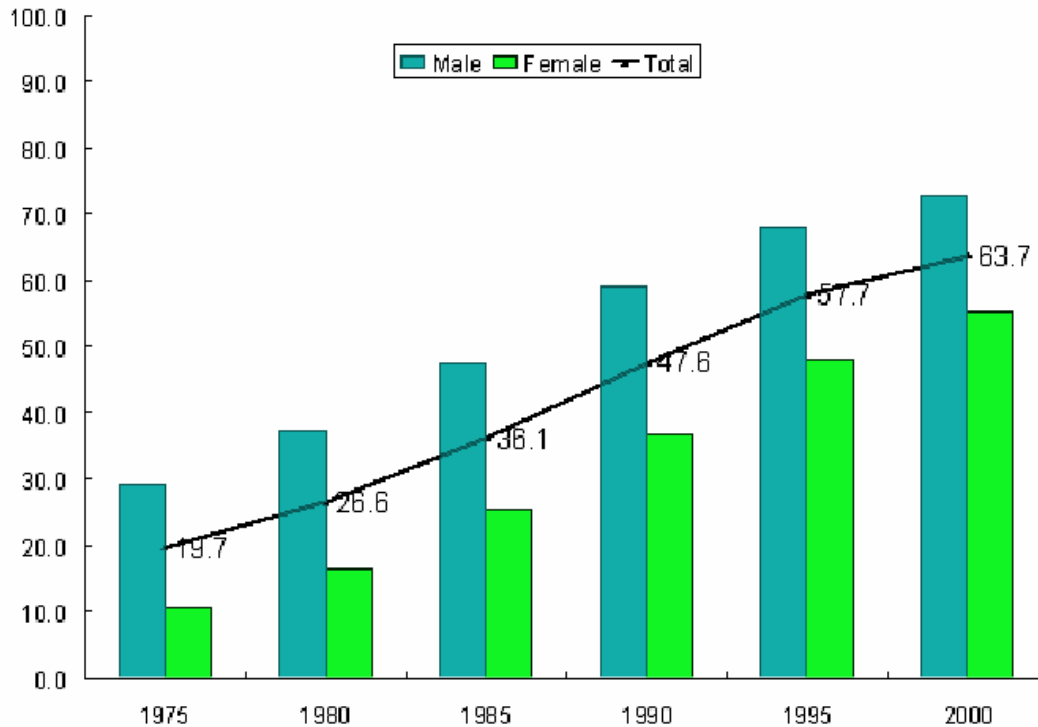


Figure 8. Proportion of the population supplied by sanitary water with the amount of water spent/ person by year in Korea

**Educational attainment.** Educational attainment also improved remarkably as shown in Fig.9; the proportion of high school graduates among the population above 25 year of age was only 19.7 percent in 1975 whereas it reached to 63.7 percent in 2000.



**Figure 9. Proportion of high school graduates among 25 years old and over in Korea**

The Korean population's enthusiasm to educate children is so strong that most of the household budget, over 60 percent, is used up for paying children's education.

## **II. Occurrence of Communicable Diseases**

### **II.1. Current Status of Communicable Disease Occurrences**

The incidence rate of reportable diseases in 2004 by group is presented in Table 3 showing the incidence rate/1 million population for the group 1, 2, 3, and 4 communicable diseases. Group 1 diseases are those which need immediate attention for control measure because of the greatest public health impacts resulting from their outbreak. Despite the strong efforts of the regional and central governments, shigellosis and typhoid fever are still major troublesome diseases.

**Table 3. Incidence rate of notifiable communicable diseases by group, 2004**

<b>Group 1</b>	<b>cases</b>	<b>Incidence/1 mil.</b>
Shigellosis	487	10.1
Typhoid fever	174	3.6
Enteropathogenic Escherichia coli infection	118	2.5
Paratyphoid fever	45	0.9
Cholera	10	0.2
Plague	0	0.0
<b>Group 2</b>		
Mumps	17443	6.3
Measles	16	0.3
Rubella	15	0.3
Tetanus	11	0.2
Pertussis	6	0.1
Diphtheria	0	0.0
Polio	0	0.0
Japanese Encephalitis	0	0.0
<b>Group 3</b>		
Tuberculosis*	306876	38.2
Leprosy*	41	0.9
Typhus fever due to <i>Rickettsia tsutsugamushi</i>	46999	7.7
Malaria (re-emerged 1994)	8641	8.0
Hemorrhagic fever with renal syndrome	427	8.9
Leptospirosis	141	2.9
Scarlet fever	80	1.7
Vibrio parahemolyticus	57	1.2
Brucellosis	47	1.0
Typhus fever due to <i>Rickettsia typhi</i>	19	0.4
Legionellosis	10	0.2
Meningococcal meningitis	8	0.2
Rabies	1	0.0
Q fever	0	0.0
Anthrax	0	0.0
HIV/AIDS	612	12.7
<b>Group 4</b>		
Dengue fever	16	0.3
Leishmaniasis	1	0.0
Yellow fever	0	0.0
Marburg virus disease	0	0.0
Ebola virus disease	0	0.0
Lassa fever	0	0.0
Babesiosis	0	0.0
African trypanosomiasis	0	0.0
Cryptosporidiosis	0	0.0
Schistosomiasis	0	0.0
Yaws	0	0.0
Pinta	0	0.0
Small pox	0	0.0
Botulism	0	0.0

Enteropathogenic *E. coli* infection, originally thought to have been imported, may have been endemic in Korea already; the cases appear to be too numerous to be imported. The group 2 diseases are infectious diseases preventable by immunization. Since the measles elimination campaign in the year 2001, in which 5.8 million school children have been immunized, mumps became the major disease to be concerned about among these. The Korea Center for Disease Control (KCDC) is in the process of planning that mumps be the second one eliminated. The group 3 diseases are those that need close monitoring/surveillance in order to prevent outbreaks; tuberculosis still is a big health problem, showing an increase of incidence recently owing to the HIV infections despite the intensive national control program for many years.

Scrub typhus due to the infection of *R. tsutsugamushi* that had been newly identified in 1980s has been occurring sporadically from place to place since then. Hemorrhagic fever with renal syndrome has never been decreased even with vaccine developed by the person who isolated the agent, whereas leptospirosis identified newly in mid 1980s has decreased considerably since the pathogen and epidemiologic characteristics including the mode of transmission were clearly identified. The incidence of HIV infection is increasing though very slowly compared with the other countries.

Newly identified diseases and re-emerged diseases will be discussed more in detail in a separate section.

Among the group 4 diseases that are imported infectious diseases from outside Korea, 16 cases of dengue fever and one case of leishmaniasis have occurred. These diseases could not be naturalized due to lack of their vectors in Korea.

## **II.2. Newly Identified Diseases in Korea**

**HFRS** that had been identified as a clinically new disease among UN troops located along the DMZ line during the Korean War, and **hantaan virus** identified as an etiologic agent in the 1970s by Lee, is still occurring sporadically despite an immunization program supported by the government. **Legionnaires's disease** was identified in 1984 as a new entity with clinical characteristics of pneumonia among the 10 ICU patients resulting in four deaths within one day. 95 percent incidence rate among medical staff exposed with clinical characteristics of **Pontiac fever**, has been occurring in only a few cases with fewer death owing to intensive surveillance, periodical disinfections of circulating water of cooling systems, and appropriate treatment.

**Leptospirosis**, which had remained as a queer mysterious disease of unknown etiology killing numerous healthy young farmers for almost 10 years, was investigated by an epidemiologist in 1984, who identified the cause and mode of transmission. Since then the massive occurrence, particularly in the year when there was flood during fruit bearing

season, declined considerably due to health education and an operational warning system for the farmers at risk on how to avoid the infection (wearing gloves, long sleeve shirt, and rubber boots, clean mud with soap right after the work in rice field), and immediate treatment whenever they sense prodromal symptoms.

**The scrub typhus** by *R. tsutsugamushi* transmitted by bite of nymphs of mite was also identified newly in the 1980s among farmers working in vegetable cultivating dry fields. It has been occurring sporadically without much effects of preventive measures (health education to use repellent, take shower right after the exposure, spray insecticide on the field suspicious of mite infestation). Nevertheless the fatality rate appears to have decreased to the minimum because of immediate treatment when they notice eschar. The effect of education for medical clinicians through professional societies rendered a great contribution to the skills of diagnosis and treatment of scrub typhus for all physicians in Korea wherever they practice regardless of whether in urban or rural areas.

**Vibrio vulnificus** infection, causing fetal septicemia to the patients with chronic liver diseases, in 1980s and **Tularemia** in 1990s, **Rota virus** infection causing infantile diarrhea epidemics in pediatric wards in 1980s were all newly identified and are still occurring from time to time.

It has been speculated that all these newly identified diseases during 1980s and 1990s existed in Korea for quite a long time without being recognized before their identification. It seems that only a few cases occurring from time to time could not be recognized by clinicians as a new disease until a sufficient number of cases and deaths occurred to call the attention of mass media, which in turn led the government and scientists to become involved in their investigation.

### **II.3. Emerging Disease, HIV/AIDS and EHEC (imported), and Re-Emerging Disease - Malaria**

The first case of HIV infection was identified in December 1985 and involved a deported Korean worker of a building company from Saudi Arabia, who was identified being HIV infected in a screening examination for foreign workers by Saudi Arabian government. Soon after the first case was confirmed, an American English teacher, who was admitted to a local hospital because of pneumonia, was found to be the first case of AIDS. He was eventually sent back to the United States. The Korean government strengthened its surveillance system thereafter and many cases of HIV positives have been identified among whom many have experienced clinical symptoms. Some of them died from AIDS. In the first phase of the epidemic, the end of 1990s, the major route of transmission appeared to be homosexual contact, specially clustered among international cargo ship crews and known male homosexuals. It then gradually spread to females, mostly the wives of cargo ship crews and bisexual husbands. There were about ten cases

transmitted by blood or blood products (mainly for homophiles) that disappeared right after the introduction of heat treatment of blood products and intensified screening of donated blood. In Korea, no case transmitted by IV drug users syringes has been reported.

Even now HIV transmission seems to occur more frequently among male homosexuals because the sex ratio among HIV positives remains at 1(F): 9(M).

Fortunately, commercial female sex workers do not have a prominently higher HIV positive rate than the average, according to the regular check-up examination results. Fig. 12 shows the number of new cases, cumulative number, and number of person with HIV/AIDS by year from 1995 to 2005. Compared with other countries the HIV/AIDS epidemic in Korea has a rather slow pace.

Imported **EHEC** that was identified first in Korea in the middle of 1990s, has been occurring quite frequently, causing a few infantile deaths.

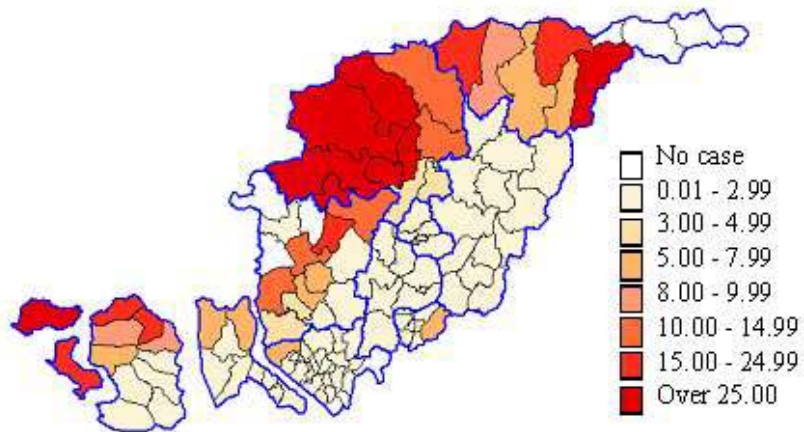
**Malaria** had been absent in South Korea for more than twenty years since 1976 when the last case was reported. It re-appeared in 1993 among Korean soldiers stationed along the DMZ line and gradually spread to civilians. The Korean government held multiple symposia and conferences with parasitologists, entomologist, epidemiologists, animal ecologists, and veterinarians to set control strategies. Additionally, an epidemiologic investigation was carried out in the areas where the cases had been reported.

As the results of investigation, it was concluded that most likely the malaria had originated from North Korea by infected vector mosquitoes flying south from the malaria endemic North Korean villages.

Fig. 10 shows the areas affected along the DMZ. The nearer the DMZ, the denser the incidence. Fig. 11 illustrates the distinct feature that the malaria spread from soldiers actively engaged in duty along DMZ line to civilians. Particularly soldiers discharged from the service after the infection were the major sources for infecting civilians throughout the country.

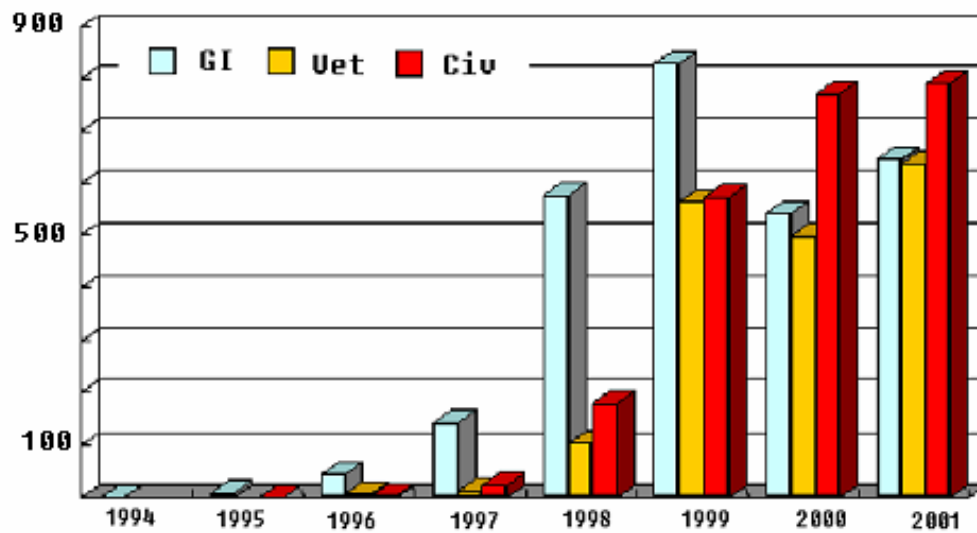
The Korean government proposed to the North Korean government through the Red Cross Organization to work with it for the control of malaria. They hey denied having a malaria problem, although they accepted free anti-malarial drug donated by the World Health Organization (WHO).

New malaria cases have been decreasing slowly after the intervention, control program. Enforced surveillance, prophylactic anti-malarial drug administration to the risk groups, and thorough treatment of all patients detected have also been instituted.

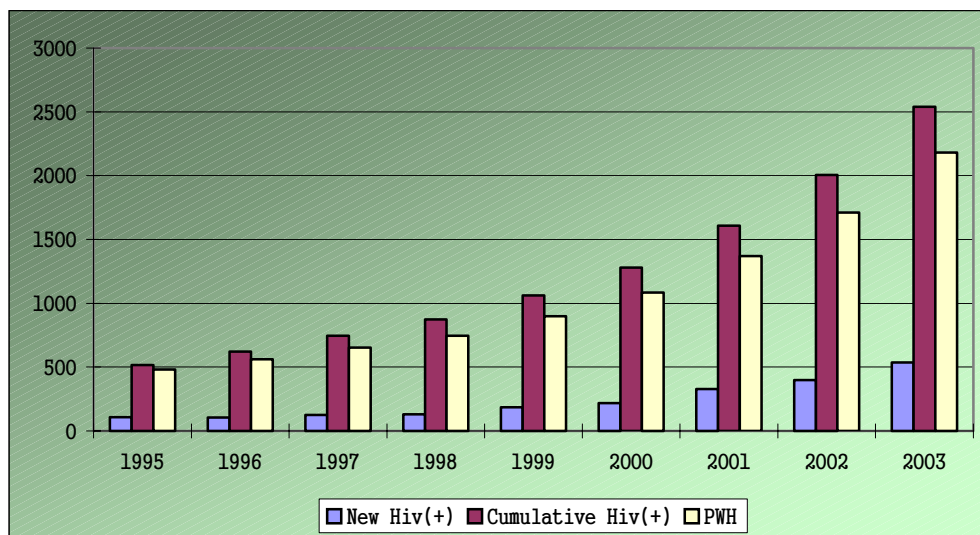


The areas colored are the affected ones along the DMZ, nearer the DMZ, denser the incidence.

**Figure 10. Geographic distribution (1995~2001) of re-emerging malaria in Korea.**



**Figure 11. Annual trends of malaria cases by occupation in Korea**



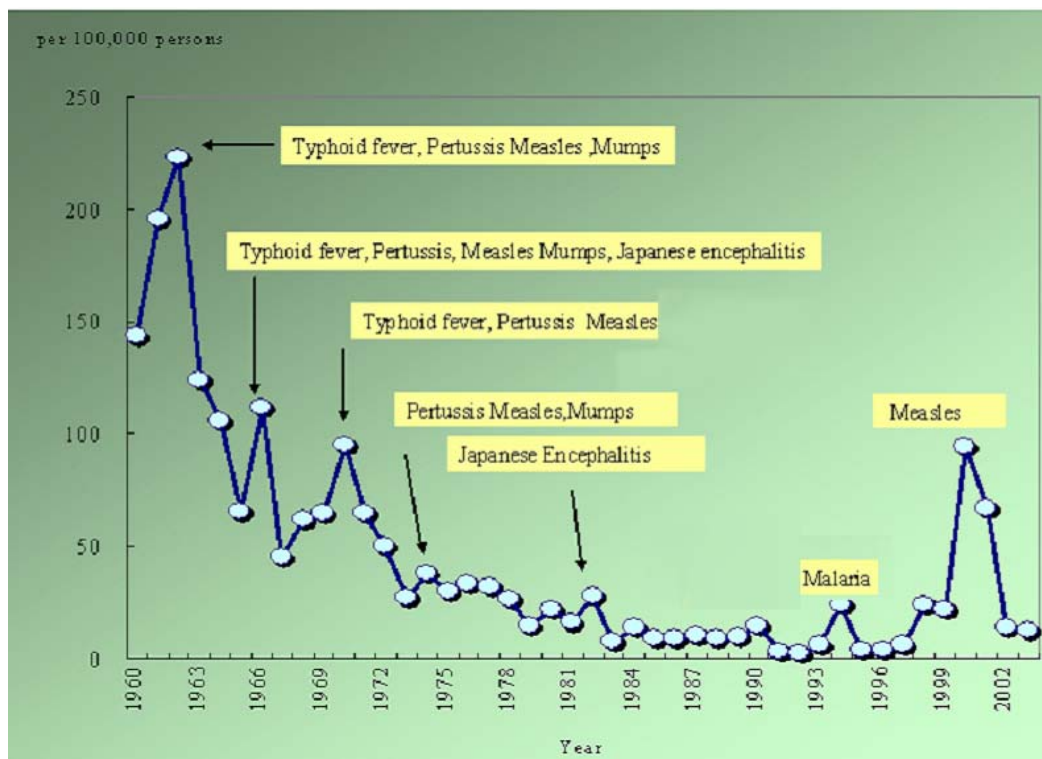
**Figure 12. Number of new cases, cumulative number, and number of person with HIV/AIDS by year from 1995 to 2003 in Korea**

### II.3. Transition of Communicable Diseases (1960-2002)

The incidence of all notifiable communicable diseases has been decreasing remarkably from the beginning of the 1970s as shown in the Fig. 13. This shows the total incidence rate, number of new cases/10 thousands population of all notifiable communicable diseases excluding chronic, long lasting diseases, such as tuberculosis, leprosy, and HIV/AIDS. The incidence of typhoid fever which had been a major plague in Korea has decreased, yet outbreaks of smaller magnitude still occur. Japanese encephalitis that used to occur periodically with four to six year intervals is down to a negligible level by thorough immunization since the 1882 epidemic when over 3000 people were infected and tens of patients died. In 1995 a few thousands of malaria cases occurred as described in the previous section. This disease seems to be under control.

In 2001 there was a big epidemic of measles affecting a few tens of thousands of children. Measles has been brought down to an endemic level by measles elimination project.

This transition can be explained by several factors: (1) improved living standard owing to economic development; (2) improved nutrition conferring general resistance to infections; (3) improved living environment including sanitary water supply, modernized sanitary kitchen and sanitary bathrooms; (4) changed attitude and practice of the people for healthy living by elevated educational attainment; and (5) strong policies operated by the government - enforced surveillance system, thorough immunization, cooperation with professional groups, health education through mass media, and completion of the medical insurance system.



**Figure 13. Incidence Rate/10<sup>5</sup> of notifiable Communicable Diseases from 1960 to 2003 in Korea**

### III. Responses of the Government to Public Health Threats

#### III.1. Amendment of Communicable Disease Prevention and Control Laws

The Korean government has expended an enormous effort in the prevention and control of communicable diseases, including emerging and re-emerging infectious diseases, working with specialists from various fields and discipline. The government amended the communicable disease prevention and control acts, through which notifiable diseases were re-classified from three groups to five groups adding many new diseases. These amendments enforced the surveillance system (i.e., expanded the scope of statutory notifiable diseases), strengthened epidemiologic investigation activities and public health laboratories; and expanded the numbers of relevant professional personnel by establishing a field epidemiology training program (FETP) for military drafted medical doctors dispatched to the ministry of health and welfare, and field management training program (FMTP) for senior health workers of health centers throughout the country. On the basis of this amended legal framework, the overall organizational structure of communicable disease prevention and control system has been redesigned; e.g., clarification of case definition, criteria of report and the intervals of reporting, and

stipulation on use of an emerging infectious diseases reporting system. The surveillance system is described in great detail in Dr. Ok Park's paper.

The Korea Center for Disease Prevention and Control (KCDC) was established in 2004 to cope with the tremendous numbers of anticipated public health threats.

### III.2. Response to the Measles Epidemic

The government responded to the 2001 measles epidemic quickly by implementing a measles elimination project through a catch up vaccination campaign, through which 5.8 million school children were vaccinated. This was combined with a new system requiring immunization certificates, as well as post campaign surveillance.

Fig. 14 shows the reason why the measles epidemic occurred and catch up vaccination was indispensable. Fig 15 shows the outcome of the catch up project. The incidence of measles dropped down to the negligible level when the vaccination rate among risk group reached 95 percent.

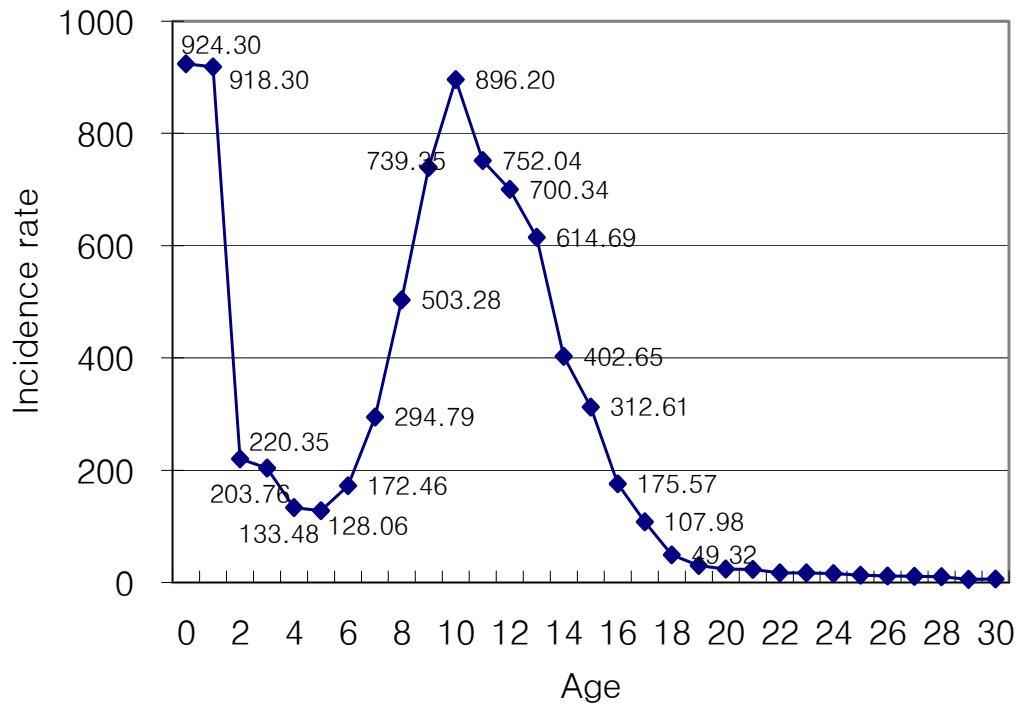


Figure 14. Catch up vaccination campaign for school children in Korea in 2001

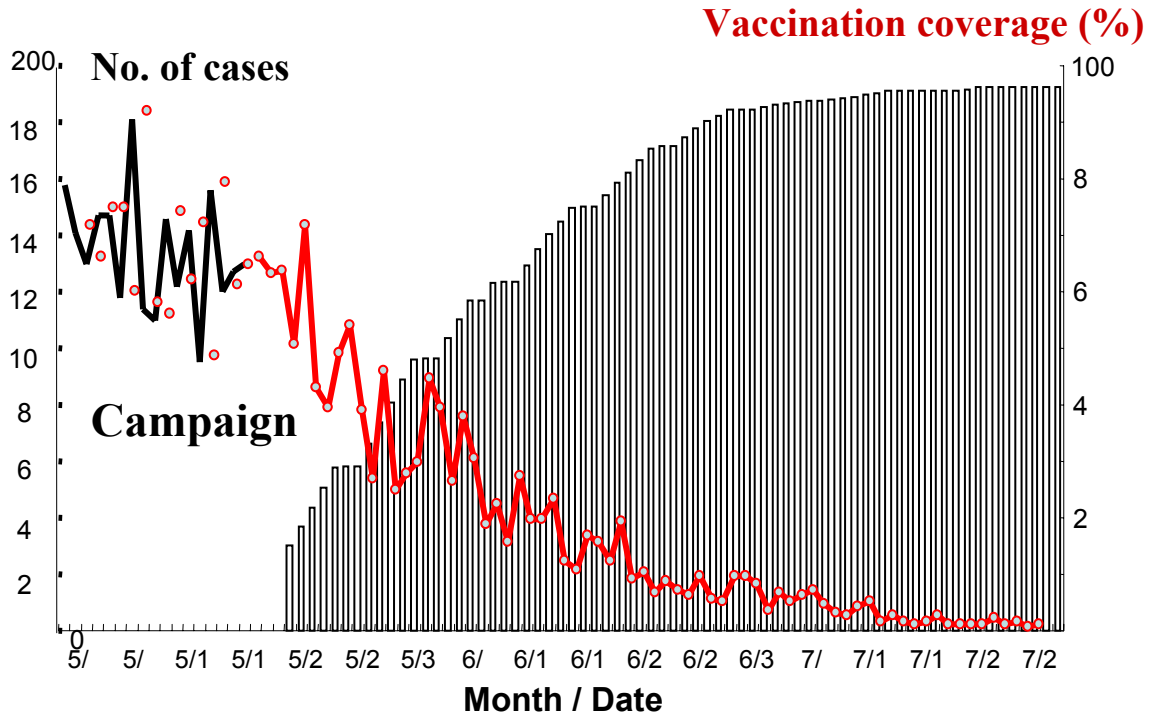


Figure 15. The outcome of the catch up project in 2001 in Korea

### III.3. Response to SARS and Avian Influenza

When SARS was prevailing among neighbor countries, Korea became very much embarrassed by the event because Korea was a country visited most frequently by short-term Chinese and Southeast Asian travelers. The Korean government immediately responded to this serious situation by enforcing and fully activating quarantine activities in every port of entry, particularly for those entering from the epidemic areas. As the result of vigorous quarantine activities, only three suspects were identified at ports and isolated instantly; thus neither secondary infection nor indigenous case was found, implying no transmission of SARS whatsoever has occurred in Korea.

**Avian influenza** has also been well managed by the government facilitating prompt notification of outbreaks among ducks and chicken. Although a few outbreaks among herds of ducks and chickens (which had been all culled and buried) have been reported, no single human case has ever been identified.

For an anticipated pandemic of avian influenza, the government has appropriated a budget to buy necessary anti-viral agents and control activities. It has carried out a table top exercise based on the estimated number of patients and deaths by mathematical modeling under the assumption that anticipated a pandemic might be the similar epidemiologic and clinical characteristics of Spanish flu occurred in 1917-18.

This exercise rendered a significant meaning to many governmental high officials and even to medical professionals who participated to the exercise in terms of realization of its importance and urgency; it has given them new insights into a situation about which they were ignorant. They now understand how many shortcomings and frustration they would experience, how difficult it would be to get the interdisciplinary cooperation and understanding that are indispensable in case a real situation comes along.

#### **III.4. Response to Emerging, Re-emerging Diseases, Imported Diseases, and Bio-terrorism**

In response to emerging, re-emerging diseases, imported diseases, and bio-terrorism the government has organized advisory committees, enforced a surveillance system, educated medical practitioners on the process of recognizing new diseases by system of the body and reporting process to the KCDC. For bio-terrorism KCDC established an independent section for preparedness against bio-terrorism, and the section got specialists to make scenarios on the most probable agents to be used, had table top exercise in cooperation with responsible governmental organizations. The Ministry of defense, police departments, fire department, emergency medical care departments, KCIC, and all health centers belong to this network.

In summary the Korean government has responded effectively so far against the public health threats with prompt actions, utilizing professional specialists properly.

#### **IV. Academia's Contributions to the National Control Programs of Communicable Diseases**

In Korea, epidemiology had been nominal in theory and practice since the 1970s when a few epidemiologists trained and educated abroad returned to academia to teach epidemiology in graduate schools of public health and medical school.

The Korean Society of Epidemiology was established in 1978, when a sufficiently well qualified number of members who were interested in epidemiology become available. Members are mainly professors teaching epidemiology, statistics, demography, genetics, and preventive medicine in graduate schools of public health, medical schools, nursing schools, colleges of nursing, and colleges of public health.

The society has played an important role in stipulating the concept and practice of epidemiology suitable to the Korean situation by carrying out the following activities:

#### **IV.1. Epidemiology Teachers Workshop Sponsored by WHO**

This workshop refined the concept of epidemiology, discussed the scope and domain of epidemiology, and the areas of shortcomings, with a strong emphasis on developing epidemiology for teaching and research. The workshop was organized into plenary sessions and in four breakout groups (grouped teachers with the same interests) and determined various levels and contents of epidemiology teaching at different educational institutes.

The workshop was productive in many ways in terms of forming common interests and common language of epidemiology relevant concepts. Moreover, all teachers gained a strong feeling of professional partnership.

#### **IV.2. Biannual Symposium and Special Edition**

The society has had biannual symposia every year, in which current issues on the most threatening diseases or that of public health importance are discussed and published as a special edition of the society's journal. Also, invited epidemiologists and society members presented epidemiology-related research papers, some of which have been published in the journal.

These activities are directly connected to the governmental policies. Thus the government had taken up most of them to implement.

#### **IV.3. Education and Training of Competent Epidemiologists**

Schools of public health are producing sizable numbers of epidemiologists who have become core members of central and regional government public health organizations, and epidemiology teaching professors in various professional schools.

Many professors also have participated actively in government training programs for military doctor draftees and health workers of health centers (FETP and FMTP) beginning in the late 1990s, building up enormous competent manpower in field epidemiology.

#### **IV.4. Epidemiological Field Investigations**

While the government was suffering from the shortage of professional epidemiologists, epidemiologists in academia had to conduct most of the investigations till the government had its own manpower (middle 1990's). The government used to call epidemiologist in academia to investigate outbreaks of known or unknown causes of diseases. Although these frequent inquiries rendered a lot of tension and anxiety to the responsible

epidemiologists, they provided excellent chances to familiarize various communities with one another, and those experiences taken from all the different situations became good teaching materials.

Also many new diseases were identified: for instance, **legionellosis** in 1986 among the hospitalized patients (Kim), **leptospirosis** epidemic in 1986 (Kim), **anthrax** epidemic in an isolated small islet in 1988 (Kim) that was very suspicious of intentional induction, and **tularemia** occurrence in 1994 (Lim) were all newly identified in Korea. Identification of new diseases with unknown causes, for which the mass media blamed the government publicly for doing nothing despite the serious health impact to the people, conferred strong pride to all epidemiologists making epidemiology popular among medical/public health disciplines.

#### **IV. 5. Advisory Activities to the Government**

Academics are actively participating on various committees that are the major resources for government policies. They participated in various policy decision-making activities such as the amendments to the communicable disease act, the establishment of KCDC, immunization policies, the measles elimination campaign, quarantine enforcement which resulted in the successful quarantine for SARS. Academics are also involved in programs related to avian influenza, cholera, tropical diseases, and the successful control of endemic epidemics of communicable and newly identified diseases.

# **What Lessons We Have Learned from the SARS Epidemic in China**

**Zeng Yi**  
**China Center for Disease Control**  
**Beijing**

After the founding of the new China in 1949, the Chinese government emphasized the prevention and control severe epidemics diseases and developed policies putting prevention first. During this period many severe epidemic became well controlled, including schistosomiasis, malaria, filariasis, smallpox, measles, tuberculosis, and other bacterial related disease. But after the Culture Revolution, the government concentrated on economic development and markedly neglected public health preventive medicine.

Since smallpox had been eradicated, poliomyelitis has also been eradicated in many countries, and efficacious vaccines for the common childhood infections became available and widely used. So three decades ago many international experts predicted that epidemics of infections disease were soon to be relics of past. Soon after health experts had to rethink and retrench as the era of newly emerging and reemerging infection began, such as drug resistant variants of tuberculosis, and malaria, rapidly spread around the globe. New infectious disease appeared. HIV/AIDS spread rapidly in the world and has already killed tens of millions and infected more than 400 million. In some countries it has severely damage economies, posed a threat to national security, and disrupted the structure of family life. Additionally, life expectancy has fallen by decades.

SARS originated in November 2002 in China and subsequently spread to more than 30 countries, infected 8000 individuals with a fatality rate about 10 percent. SARS severely influenced economic development. Soon the Chinese government realized that SARS was not only a severe infectious disease, but also a severe social and economic problem. The SARS epidemic presented a significant challenge to the Chinese public health system. The Chinese government has learned a lot of lessons from the SARS epidemic: 1) emerging and reemerging infectious diseases are not over, they can happen anytime and cause severe damage; 2) the leadership of the Chinese government at different level, especially the central government level, along with their responsibilities, should be strengthened; 3) multiple sectors of government and different NGOs should be mobilized and their cooperation improved; 4) the public health system, including the surveillance system, should be strengthened; and 6) financial support for public health should be markedly increased. The Chinese government has strongly responded by establishing

and strengthening a public health system to ensure an effective and rapid response to any future epidemic.

Avian Influenza is spreading rapidly in many countries including in China. It has killed millions of chicken and severely damage regional and national economies. Over 100 individuals have been infected with avian flu. Public health experts fear that the Avian Influenza virus currently circulating among birds has the potential to mutate into a transmitter from human to human and if so could cause a human pandemic. So we have to prepare in case of a possible outbreak of avian flu. It is a global disease, so all countries should unit together in fighting against avian flu. Therefore, this trilateral seminar on R&D polices related to emerging and re-emerging infections disease has become more important than when planning began more than a year ago. Through our discussion and exchanging experiences it will help us to fight against avian flu and other emerging and reemerging infectious diseases.