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

B − Plenary Session I: *Surveillance*

Invited Presentations

Panelist Presentations

HIV/AIDS Surveillance System in China

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The Epidemiological Characteristics of HIV/AIDS in China

Since the introduction of HIV/AIDS to China in 1985, there have been an accumulative total of 141,241 infections, 32,244 AIDS incidences and 7,933 cases of death reported in the Mainland China until the end of November 2005. HIV infection has been reported in all thirty-one provinces, autonomous regions and municipalities, and all three modes of HIV transmission through sex, blood and mother-to-child channels have come to impact the spread of the epidemic. In China, the spread of HIV/AIDS has constituted serious public health and social issues. The following discussion will focus on the characteristics of the HIV/AIDS epidemic in China:

Chronological Characteristics. The chronology of the HIV/AIDS epidemic in China can be reviewed in terms of three historical phases:

The phase from 1985 to 1988 was characterized by imported and highly scattered HIV infections and AIDS incidences. Four infections were through the domestic use of imported HIV-infected viii gene by hemophiliac patients, and the rest HIV/AIDS cases were all imported infections.

The period from 1989 through 1994 is referred to as a period of regional pandemic, marked by the trend of assembling HIV infections amongst intravenous drug users (IDUs) in several areas such as Ruili of Dehong Prefecture of Yunnan Province. The HIV/AIDS epidemic mainly spread in the border areas.

The period starting from 1995 until the present is a period of expansive pandemic. The prevalence of HIV amongst IDUs in provinces, such as Yunnan, Guangxi, Xinjiang Sichuan, has continued to be expanded to most provinces, autonomous regions and municipalities. The epidemic resulted from the illegal unsafe blood collection and transfusion in the central provinces has spread to a larger region via the flow of migrant population as well as the trans-generational transmission. In addition, the prevalence amongst the sexually promiscuous population in urban centers and some coastal regions is gradually going up. The government has taken a series of measures to eliminate illegal blood collection and transfusion, and has therefore in the largest extent ensured blood use safety. However, the transmission of HIV via injection drug use and sexual channels has not been well contained. And the second-generation transmission through in-household

and mother-to-child channels has occurred in some areas, and has then contributed to the severity of the HIV/AIDS crisis nationwide.

The data collected from the national HIV/AIDS Case Reporting System showed in Figure 1 below may illustrate the basic trend of HIV/AIDS cases increase in the three historic stages from one perspective. What is necessary to mention is that more and more people living with HIV and AIDS patients have been discovered and reported along the effective enforcement of the government's comprehensive prevention and control policies and the improvement of the HIV surveillance capability; showing in the bar graph, the increase of the HIV/AIDS cases has occurred in a blowout shape.

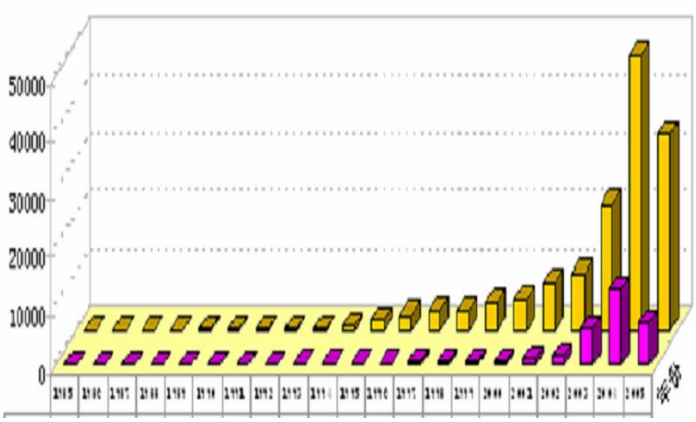

Figure 1 People living with HIV/AIDS and AIDS patients reported yearly according to *The PRC Infectious Disease Control & Prevention Law*

Illustrated in Figure 2, the serological sentinel surveillance data, the HIV infectious rate amongst IDUs has had an apparent increase since 1995. And that has reached around 7 percent in 1997, and fluctuated between 5.5 percent and 8.5 percent thereafter. Since 1995, the underground prostitutes' HIV infectious rate has been going up gradually each year, and has then been going between 0.8 percent and 1.5 percent HIV infection has been found amongst pregnant women often since 1998. To be noted, though underground prostitutes HIV infection detected at women education camp surveillance sites is several times that from hospital surveillance sites detection, the trends of the two are basically the same. When analyzing the national sentinel surveillance data, it will be noted that all the numbers describing the several categories of surveyed populations' HIV infectious rates are only the mean numbers of the nationwide sentinel surveillance data, therefore they cannot not accurately represent the situation of those regions of high prevalence, which is evened out by the data from the low prevalence regions.

It is necessary to clearly note that, when analyzing the trend of HIV/AIDS epidemic in China, the numbers of HIV/AIDS reported via the HIV/AIDS epidemic reporting system are merely reported case numbers. A certain portion of the newly reported HIV

infections and AIDS incidences were previous infections now flowing out of the water along the incidences of these infections; therefore, the new reporting rate does not represent the new incidence rate. Between the two, whereas the possibility of discovery and reporting of the former increases along there strengthening of work, increase in funding, increased in demand of the public for voluntary testing, and strengthening of control and prevention mentality of the medical personnel, the latter indicates the new infections each year, and it is the indicator which can accurately reflect the impact of the dangerous factors. And there would have been different conclusions made when forecast the HIV/AIDS epidemic trend in China, if these two concepts were not clearly differentiated.

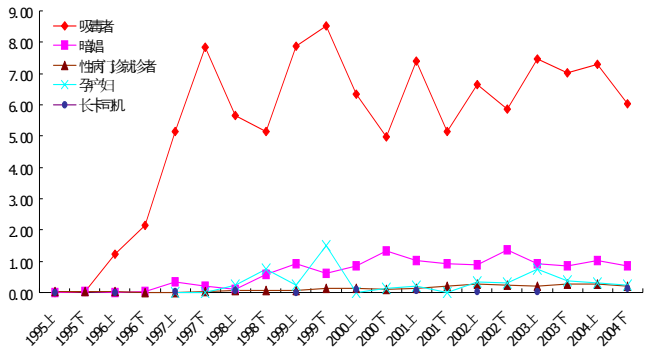

Figure 2 Serologic Surveillance Data of Sentinel Sites by Groups, 1995 - 2004

Geographic Characteristics. By the end of June 2005, the five provinces with the largest accumulative of reported HIV infected populations are Yunnan, Henan, Guangxi, Xinjiang (autonomous region) and Guangdong, seriatim. (See Figure 3). The total reported infections per above counted for 85% of the national total, mostly due to the concentration of intravenous drug use. For the same time being, the five provinces with the largest accumulative of reported AIDS patients are Henan, Yunnan, Anhui, Hubei and Guangxi, counting for 90 percent of the national total. And those of the largest accumulative of reported AIDS deaths are Henan, Yunnan, Anhui, Hubei and Shanxi, counting for 80 percent of the national total, mainly as a result of the previous unsafe blood and plasma donation. Those with the highest accumulative of infectious rates are Yunnan, Xinjiang, Guangxi, Henan and Beijing (municipality). Qinghai was the last resort of HIV infection identification until one infection was reported in June 1998. The HIV infected populations in southwestern and northwestern China are mainly comprised of the drug using population. Those in central China are mainly from the migrating population and the former blood and plasma donors. And those in the southeastern coastal region, especially the big cities, are mainly from STD patients and underground sex workers.

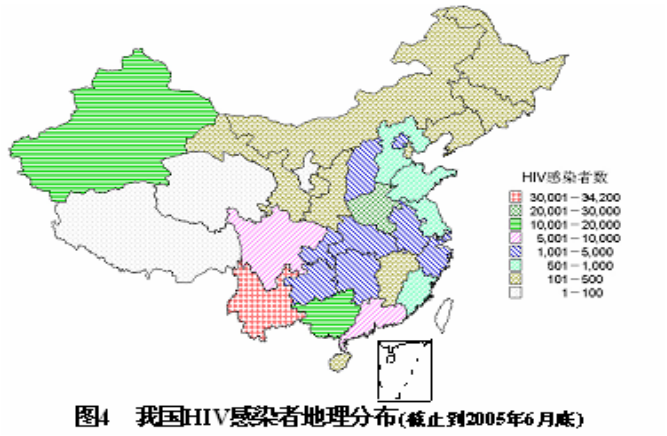

图4　我国HIV感染者地理分布(截止到2005年6月底)

Figure 3 the Geographic Distribution of HIV Infected Populations, by the end of June 2005

The geographic distribution of the HIV/AIDS epidemic is fairly imbalanced from one region to another at all of the provincial, municipal, prefecture, district and village levels, appearing as grouped spots. In Yunnan Province, for instance, the HIV/AIDS epidemic expanded to four new prefectures, which added the provincial total up to sixteen states and municipalities, and 125 prefectures. By regions, three are categorized as those of high prevalence, eleven are of medium prevalence, and two are of low prevalence. (See Figure 4.)

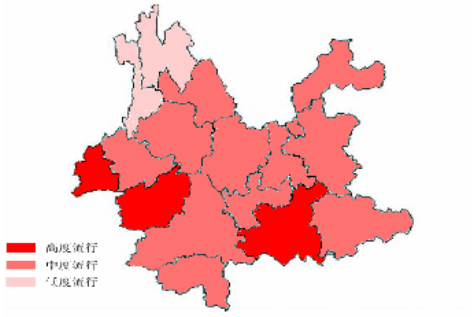
图5　云南省艾滋病流行地区分布（截至2004年底）

Figure 4 Distribution of the HIV/AIDS Epidemic in Yunnan, by the end of 2004

In terms of Henan Province as another example, there are 220 villages with more than twenty HIV infections amongst the 5300 villages with HIV infected populations reported in this province by the end of 2004. There accumulatively 13,974 HIV infections reported in the villages mentioned above, counting for 52.35 percent of the provincial total, with currently 8,609 AIDS patients, counting for 66.18 percent of the provincial total. In the forty high prevalence villages, there are 7,059 HIV infections reported accumulatively, counting for 26.45% of the national total. Over one third of the HIV infected population and AIDS patients are concentrated in Zhumadian area, and 90% of the provincial of those are in the five areas of Zhumadian, Zhoukou, Kaifeng, Nanyang and Shangqiu. (See Figure 5.)

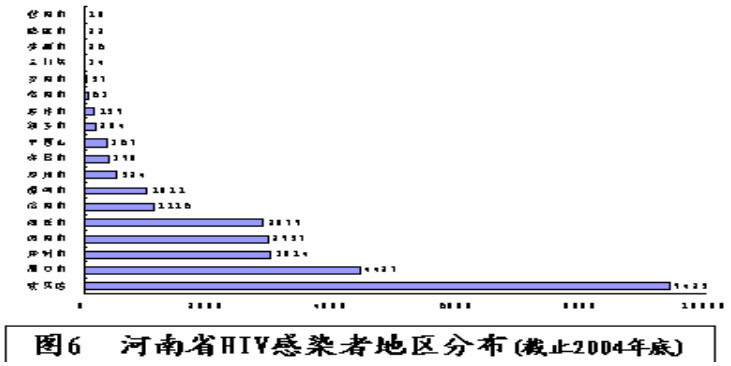

Figure 5 The Regional Distribution of HIV Infections in Henan, by the end of 2004

From a national perspective, the HIV/AIDS epidemic is mainly concentrated in rural and less economically developed areas. The senior support in these areas mainly relies upon their children with laboring ability. That said, each HIV infected individual increased would result in the decrease of transfer payment to support the seniors, which is a situation that brings more severity to the already fragile senior support system of the country. Further, each HIV infected adult increased would result in the decrease in transfer payment to raise the children, therefore would tremendously increase the burden of the government, the society and the families.

The HIV-1 molecular epidemiological survey data indicates that, of all the HIV-1 infections in China, the percentages of the subtypes A, B, B, C, CRF-BC, CRF01-AE, and the total of other unusual subtypes mare 1.24 percent, 36.16 percent, 1.65 percent, 1.45 percent, 43.90 percent, 15.08 percent and less than 0.5 percent. And the distribution of the subtypes has a feature of geographic singularity at most places. Yet, regions of infections due to sexual transmission may have multiple subtypes. (See Figure 6.)

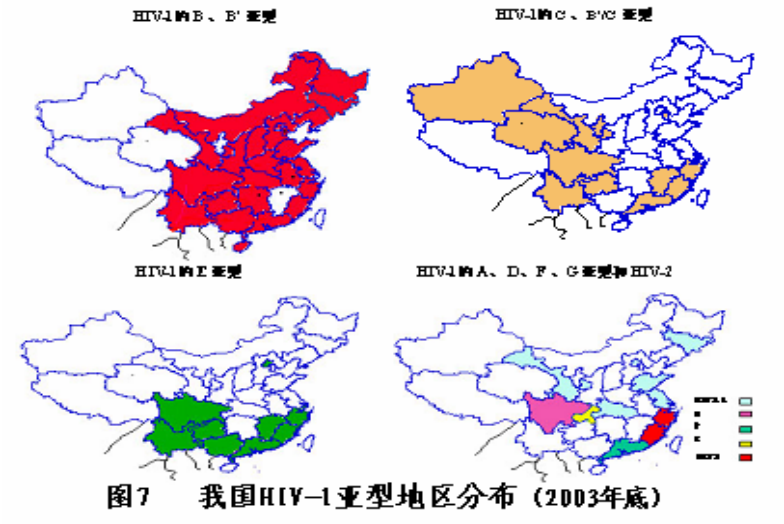

Figure 6 The distribution of HIV-1 Subtypes, by the end of 2003

According to the HIV-1 molecular evolution analysis, associated with the local epidemiological data, scientists in China drew a roadmap of the transmission of the strains of multiple HIV-1 subtypes in China, shown below.

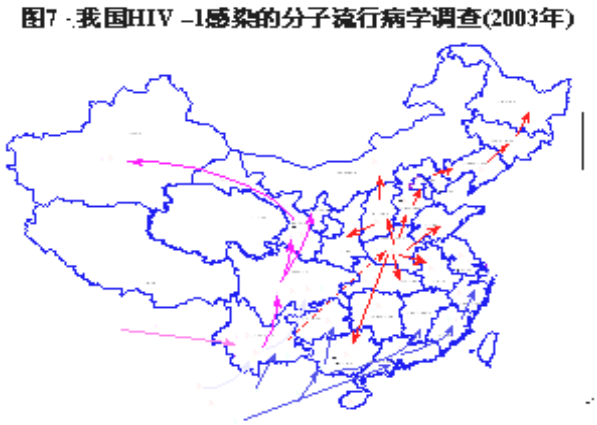

Figure 7 The Molecular Epidemiological Survey of HIV-1 Infections, 2003

Demographic Groups. In terms of gender, males dominated the HIV infected population in China. According to the accumulative total of HIV infections infected reported till June 2005, the male to female ratio is 2.6:1, and that of the accumulative total of AIDS patients is 1.3:1. It is necessary to notice that the percentages of females in the infections reported and found in recent years have increased, from 15.3 percent in 1998 up to 39 percent in 2004. Since the majority of these infected women are in the age of pregnancy, the HIV epidemic has been threatening under the shadow of the increasing mother to child transmission. The data collected from several pregnant women sentinel sites indicate that the HIV infectious rate of pregnant women has raised from 0.3 percent in 1998 to over 1 percent in 2005.

For those who have high risk backgrounds, such as the history of intravenous drug use, prostitution, and HIV infected spouses, the HIV infectious rate has reached as high as 2-3 percent.

In terms of age groups, the young and middle age populations are still those most heavily influenced by the HIV/AIDS epidemic. According to both the reporting data and those collected from sentinel surveillance, most of the infected, about 50 percent, populations are between 20 and 29. The next largest age groups are 30 to 39, counting for 30 percent, and 40 to 49, counting for 10 percent. The percentage of HIV infected children under 15 has increased from 2000 to 2004. Till the end of June 2005, the accumulative total of HIV infected children under 15 reported is 2,091, that of AIDS pediatric patients reported is 773, mostly in high prevalence provinces such as Henan and Yunnan. For instance, amongst the 991 children surveyed in four high prevalence townships in some province, there are 31 HIV infected, and the infectious rate is 3.13 percent.

As for the ethnical composition, counting for 67 percent of the total, Han people dominated the HIV/AIDS population reported nationwide; the minorities take up a portion that is about 30 percent, and the rest include the expatriates and those whose ethnicities are unidentifiable. Yet, considering the fact that the percentage of minorities is only 8 percent of the total population in China, it is quite significant that over 85 percent of all accumulative reported total of the HIV/AIDS population in Xinjiang are Uigur, about 40 percent of that reported in Sichuan are Yi, 13 and of that reported in Yunnan are Thai, which is an ethnicity which only makes up of less than 3 percent of the total population in Yunnan Province. The prevalence of HIV/AIDS in the ethnical minority groups is due to particular reasons; and as for the same risk burden, different ethnical groups may bear different means of threats, which may include:

1) living in the bordering areas where the drug production and transportation routes are located;
2) some traditions, such as sharing, is transformed to compose the dangerous behaviors, indicated in the statistics that the average term between the first time of drug use and the start of needle-sharing is 471 days amongst the Han people, 168 days for the Yi people, and 98 days for the Uigur;
3) the low level of education. Discovered in the surveys conducted in Dehong State of Yunnan and Liangshan State of Sichuan, over 50 percent of the drug related population are illiterate, 82 percent are below elementary school level; and
4) disadvantaged medical & health infrastructure, low awareness of HIV/AIDS prevention, high second generation infectious rate.

In summary, more significant attention should be paid to the status quo of the HIV/AIDS epidemic in the ethnic minority population.

In addition, the number of infections detected at the custom and other bordering ports is going up rapidly with an accumulative total of more than 2,550, amongst of which the infections detected in 2002-2004 count for over 51 percent, mostly age between 20 and 50, of that during the past two decades. The infected expatriates are mainly from Southeast Asia and Africa, and mostly are those who come to China for tourism, business, study and border trade. The infected Chinese detected are mostly people who returned from working, doing business abroad, sailors, people who served in border area business. The molecular epidemiological surveys conducted amongst the HIV-1 infected populations living in the border areas in Guangxi and Yunnan have evidenced the high relevance between the epidemic in these areas and the foreign HIV-1 subtypes. Nearly half of the 20 HIV/AIDS cases reported in Tibet are from the marital exchanges with the China's neighboring countries that share borders with the autonomous region. The epidemic has spread from part of the HIV infected foreign population in China and those returning from abroad through the second-generation transmission at their resident locations. And there have been HIV-2 cases detected at some places.

Key Epidemic Factors and the Trend

The Key Epidemic Factors of HIV/AIDS in China. Intravenous drug use (IDU) – the drug using population constitutes a major portion of the HIV infected population; about 42 percent of the accumulative HIV/AIDS cases reported are drug users. (See Figure 7.) The Ministry of Public Security has enrolled about 1,000,000 drug users in its record. And the drug crisis has extended to 2,084 counties, 72.7 percent of the total, in China. In recently years, the expansion of the drug using population has been put under control within a certain extent, but the percentage of intravenous drug users still takes up about 50 percent. Amongst these IDUs, the average frequency of needle-sharing is 50 percent, with the peak at 98 percent. The HIV infectious rate in the injecting drug users is as high as 30-60 percent in general, and even above 85 percent at certain places. According to the national level sentinel surveillance data, the HIV infectious rate in the entire drug using population has raised from 0.02 percent in 1995 to 6.6 percent in 2004, which was a 330-time increase. (See Figure 2.) The base numbers of the drug using population differ greatly from place to place, and so are the percentages of intravenous drug use and needle-sharing behavior. For instance, the base number of the drug using population counts for 5-8 percent of the total population in some regions in Yunnan and Xinjiang; around 80 percent of them are IDUs, and most of them share needles. Another example is that, according to a local survey in Beijing, fewer than 0.5 percent of the local residents are drug users; amongst them, no more than 50 percent are IDUs, the average term to move from oral/nasal use to injecting use is 2.5 years, and needle-sharing is rare. It is also discovered that more and more young females, from the very beginning of drug use, have become intravenous drug users.

Unsafe sexual behavior – the percentage of HIV infections via sexual means has been increasing in China. 8 percent of the national accumulative total HIV/AIDS cases reported are through sexual transmission of the virus. (See Figure 7.) And according to the experts, most of the transmission identified as due to unknown reasons are as a matter of fact due to the sexual route. According to the PRC Ministry of Health, WHO and UNAIDS joint assessment report on the HIV/AIDS control and prevention in China, it is estimated that nearly 30 percent of the alive HIV infected population are infected via sexual behaviors. The effectiveness of sexual transmission in spreading HIV is by far lower that of the needle-sharing based IDU, the size of the population affected by the former, however, has tremendously exceeded that of the latter. And the transmission through unsafe sexual behavior has still not been put under control.

The transmission of HIV through heterosexual sex is going up by percentage each year. The promiscuous population has gradually become a key population for the transmission of HIV. Sentinel surveillance data indicates that, from 1995 to 2004, the infectious rate amongst the under ground sex works rose from 0.02 percent to 1.2 percent, which is a 60

time increase, and that amongst STD patients has increased by 25 times, from 0.02 percent to 0.5 percent. (See Figure 2.)

The infections of HIV positive people's spouses via unprotected in-marriage sex – 18.553 spouses of HIV/AIDS patients were surveyed in Henan, and 16,089 were tested for plasma, and 3,890, 24.2 percent, were found HIV positive. The mutual unsafe blood/plasma donation and transmission history of the couples excluded, the in-household infectious rate estimated in Henan is 12.5 percent. The same was done in Yunnan in 2004 for 808 spouses of HIV positive people, and 151, 17.8 percent, were found HIV positive. Observations on the family cohort of HIV infected people with HIV-spouses indicate that the average annual in-household sexual transmission rate is 12-38 percent. With effective intervention measures such as health education and condom use, the possibility of infection in these families can be decreased by 50 percent. To analyze the term and factors of the in-household transmission with the risk ratio model, the average term for the efficacy of infection is 2.43 years, and the frequency of sex between spouses, the ratio of CD4 and CD8 are the key influencing factors.

The entry of HIV infection to the men who have sex with men (MSM) population – the estimated homosexual population according to experts is about 15 million, of which about one third are sexually active in term of the high frequency of changing sex partners; and at the same time, their rate of condom use is low. Discovered by the ten large-scaled surveys, of which some are conducted by the people in the homosexual community, from 1998 to 2005, the infectious rate in this population is between 2.5-6.5 percent. Particularly in the areas there male prostitution exists, the highest infectious rate has reached to 17.7 percent.

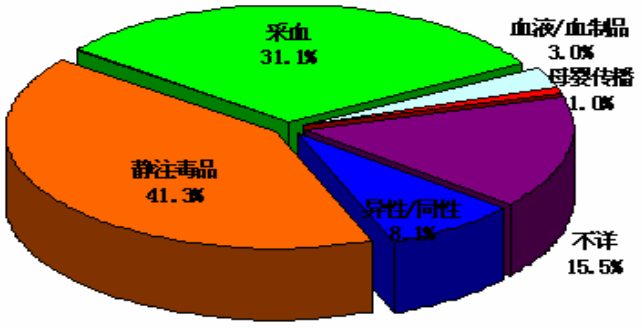

图8 全国报告的HIV/AIDS传播途径构成（截至2004年底）

Figure 7 The reported composition of HIV/AIDS transmission routes nationwide, end of 2004

The Altered HIV/AIDS Epidemic Due to the Frequent Flow of Population. The national census indicates that the total size of the migrating population in China is 220 million, mainly from the rural areas to the urban centers, and from the less developed regions to the economically advanced regions. Age group wise, the migrating population are dominated by young and middle aged people. And the tendency of the moving of the entire core-family has become obvious in recent years. The improvement of the healthcare provided for the migrating population is far behind the increase of these people, and the employment and education opportunities cannot meet their need either. If not managed effectively, the numerous single migrating workers can bed for a market of underground commercial sex and drug trade. According to the public safety authority, above 95 percent of those at the women detention facilities are non-residents, and more than 77 percent of those at the city drug abstaining facilities are non-residents, and most of them are IDUs. According to the national accumulative HIV/AIDS case reporting, 31 percent of the infected populations who moved across the provincial borders. And the non-residents' infectious rates reported are much higher in the more economically advanced urban centers.

Moreover, women from some HIV/AIDS epidemically severe countries and regions are organized to some rural areas in Northern and Eastern China. In 2005, for instance, a study conducted in a certain county in Shanxi surveyed 113 foreign wives, and found an HIV infectious rate at 18.6 percent. 72.2 percent of these HIV infected wives are from Burma, and the rest are from the Sino-Burmese bordering areas. Amongst their spouses surveyed, one third are already infected with HIV via sexual means. Amongst them there are also underground sex workers, and those who formed families when returning to hometown or traveling elsewhere. It is surveyed that the HIV infectious rates of these two groups are both above 2 percent, which therefore has brought to the receiving regions the threats of in-household transmission and mother-to-child transmission.

In addition, there are millions of Chinese citizens traveling abroad each year, and about 260 million domestically for the same time duration, and there are also about 20 million foreign tourists traveling to China annually. With the large size of the tourist population, associated with the high risk behaviors when traveling, the HIV/AIDS epidemic has become more severe, and the potential of in-household second-generation transmission has also grown.

Lack of Public Awareness of HIV/AIDS. The society in general, including many local government officials, has neglected the HIV/AIDS crisis and those related social problems. The awareness of HIV/AIDS prevention amongst the general public is still fairly low. China's Center for Disease Control (CDC) conducted sampling surveys in thirteen provinces in 2002, and found that the average awareness rate of HIV/AIDS transmission and prevention was only between 32.8-40.3 percent.

Many surveys have indicated that the rate of accurate knowledge amongst many medical personnel is only 70 percent, and the accurate knowledge of behavioral intervention to the high-risk behaviors is not very satisfactory amongst the medical staff. For examples, 80 percent of the surveyed drug using individuals, who understand HIV prevention, are not willing to alter their intravenous drug use and needle-sharing behavior.

In addition, the social stigma and discrimination against HIV/AIDS are still common today, and are good for the HIV/AIDS control & prevention. Strong discriminatory attitude against the HIV/AIDS population can possible result in the anti-social sentiment amongst this group.

The Epidemic Trend of HIV/AIDS in China and the Analysis. The HIV/AIDS epidemic in China is characterized with the several key dimensions below: the existence of three routes of transmission, with the apparent increase of the transmission of the sexual means; expansive prevalence geographically, with low national prevalence and high prevalence at certain regions and the sharp differences regionally; the increasing trend of AIDS incidences and deaths have been down-sloped since the implementation of the government's free antiretroviral policy; the routes of transmission is in the changing, with the epidemic spreading for the high risk populations to the general public.

Analysis. Former Commercial Blood Donors. The transmission of HIV via blood donation/injection has been basically put under control, therefore will not cause future large-scale transmission. The major task at present is to provide medical services and social support.

Intravenous Drug Use. In the few years yet to come, the transmission of HIV by intravenous drug use will remain the primary mode of the spread of the epidemic in China.
Heterosexual Sex. The cases of HIV-infection via this mode will keep increasing in the next a few years, and will gradually become the primary mode of HIV transmission in China.

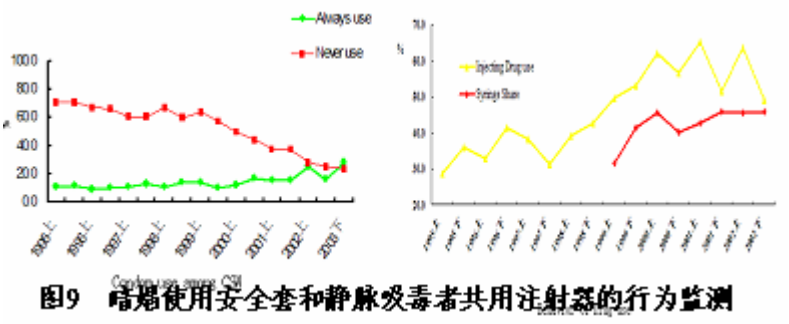

Figure 8 Behavioral surveillance data of the condom use by underground sex workers, and needle sharing of IDUs

Homosexual sex. The size of the population involved in homosexual activities is fairly large. HIV/AIDS has made impact to this population. Since most homosexual and bisexual males in China make families with females via marriage, they have been threats to the health of these females.
Mother-to-Child Transmission. The size of HIV infected female population increases while more people are infected through sexual means. Consequently, more infections are caused via mother-to-child channels.

Major Achievements of China in HIV/AIDS Epidemiology

HIV/AIDS surveillance in China grew out through three phases: 1986-1994/passive surveillance, during which hospitals and disease prevention stations reported, by law, HIV infected individuals and AIDS patients. 1995-2000/Active Surveillance, during which the disease prevention system set up sentinel sites to enforce active serological surveillance on the high-risk groups including drug using population, underground sex workers and STD patients, and vulnerable groups such as the long distance truck drivers in order to monitor the trend and changes of HIV infection amongst high-risk groups at different places.

The phase of comprehensive surveillance has been carried out since 2000. By adopting the WHO/UNAIDS recommended Second Generation Surveillance, where plasma antibody is continually surveyed, high risk behaviors, such as the intravenous drug use rate, needle-sharing rate, condom use rate, etc., amongst the relevant groups, are also monitored. There have been 329 HIV serological sentinel sites established at the national level until 2005. (See Table 1.) Including the sentinel sites for behavioral surveillance, there have been over 500 national level HIV sentinel sites installed.

表2 1995-2005年各类人群国家级HIV血清学监测哨点数

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
性病门诊就诊者	17	17	22	37	36	39	39	63	72	91	120
暗娼	13	13	17	22	21	25	25	35	43	52	66
吸毒者	8	8	13	19	19	25	25	37	49	62	77
长卡	4	4	7	7	7	8	8	9	11	21	25
孕产妇			1	1	1	4	4	13	18	26	37
有偿采集血员				12	12						
男性同性恋者								1	1	1	1
其他											1
合计	42	42	60	98	96	101	101	158	194	253	329

Table 1 Numbers of the national level HIV serological sentinel sites by groups from 1995 to 2005*

* The category in each row is STD clinic attendees, underground sex workers, drug users, long distance truck drivers, pregnant women, commercial blood donors, homosexual males, others and the total, seriatim.

To assure the nationwide HIV diagnosis, to strengthen the management and standardization of the diagnostic techniques, there have been 3,209 HIV screening laboratories and 58 confirmatory laboratories certified to implement HIV clinical diagnosis and group-based VCT nationwide. These laboratories are installed within the disease control and prevention, hospitals, immunizations, maternal and child care, blood station, STDs control and prevention, birth control and military systems. In 2004, the diagnostic network was added with CD T test, HIV viral load test, and HIV drug resistance surveillance, all of which are crucial to guide the antiretroviral therapy planning, to monitor the prevalence of drug resistant strains, and to forecast the HIV prevalence. Currently, a nearly accomplished national HIV/AIDS comprehensive control and prevention network for surveillance and diagnosis is basically formulated; China has thereby become one of the countries with nearly complete diagnosis and surveillance systems.

Having understood more accurately the rationale of HIV/AIDS epidemic with the molecular epidemiological method, along with the increasingly fast implementation of the "Four Frees and One Care" policy, there will be more HIV infected individuals diagnosed. With the advanced molecular epidemiology and serological epidemiology laboratory technologies, new infections and newly diagnosed long-term infections can be correctly differentiated, whereas they could not be so by the traditional epidemiology. These are all meaningful to subjectively assess the status quo of the HIV/AIDS epidemic in China.

Through the years of continuous HIV molecular epidemiological research, China has obtained more accurate genetic dispersion rate data of the unsafe blood/plasma donors and drug users, of which the HIV-B strains of the former has an annual GDR at around 0.8 percent; and the HIV-CRF07-BC combinative strain of the latter has a GDR with an annual deviation rate at around 0.5 percent. To analyze the genetic cohorts of the newly diagnosed former blood/plasma donors, and their spouses and children in Henan and Chongqing in 2004 with system tree evolution, it is discovered that the general GDRs of these populations are 8.11±2.4 percent, 7.77±2.2 percent, and 7.66±5.3 percent, seriatim. The terms of infection calculated accordingly are 10 years, 9-10 years and 9-10 years, respectively, instead of the new infections in recent years. The conclusion thereby is that the key factors of transmission have been thoroughly put under control. The multi-subtypes (A-E) HIV-1 new infection diagnostic methods, the BED-EIA technique, adopted in 2005, are able to identify the infections that occurred within half a year; it can therefore assess sensitively the strength of risk factors amongst a certain population group and in a certain region in the near term

Crucial information has been collected on the high-risk groups, especially the intravenous drug using population, through very high quality on-site cohort research.

These researches have helped formulate the technical mechanism to recruit and maintain cohorts in IDU communities. In particular, the maintaining rate of cohort at the Xinjiang project site has remained amongst the top ones globally. The implementation and promotion of these techniques and methods will bring practical values to the work of remaining the IDUs in intervention programs such as methadone treatment and needle exchanges.

Surveillance System for Emerging Infectious Disease in Korea

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Current Situation of Emerging and Reemerging Infectious Disease in Korea

Korea has experienced sporadic cases or outbreaks of emerging and reemerging infectious diseases since the 1980s. Beginning with the first confirmed outbreaks of leptospirosis and legionellosis in 1984, HIV infection in 1985, enterohemorrhagic *E-coli* infection in 1998, *staphylococcus aureus* infection with decreased vancomycin susceptibility in 1999, brucellosis in 2002, and botulism in 2003 were confirmed in Korea for the first time. Also Korea has suffered from reemerging diseases such as vivax malaria along Demilitarized Zone (DMZ) since 1993. Owing to globalization, imported cases of diarrheal diseases, malaria, and dengue have been increasing. In addition, the overall incidence of acute infectious diseases such as shigellosis, scrub typhus, and mumps, once it had been decreasing since 1970 until late 1990s, increased after late 1990s. The range of emerging and reemerging diseases posed serious public health threats to the public.

The Korean government has been striving to build capacity to detect and respond to these infectious disease threats in a timely manner since late 1990s. For this, the government revised the Communicable Disease Prevention Law, reorganized the government structure for communicable disease control, and developed human resources through field epidemiology and various other training programs. SARS and highly pathogenic avian influenza accelerated and provided momentum to these endeavors.

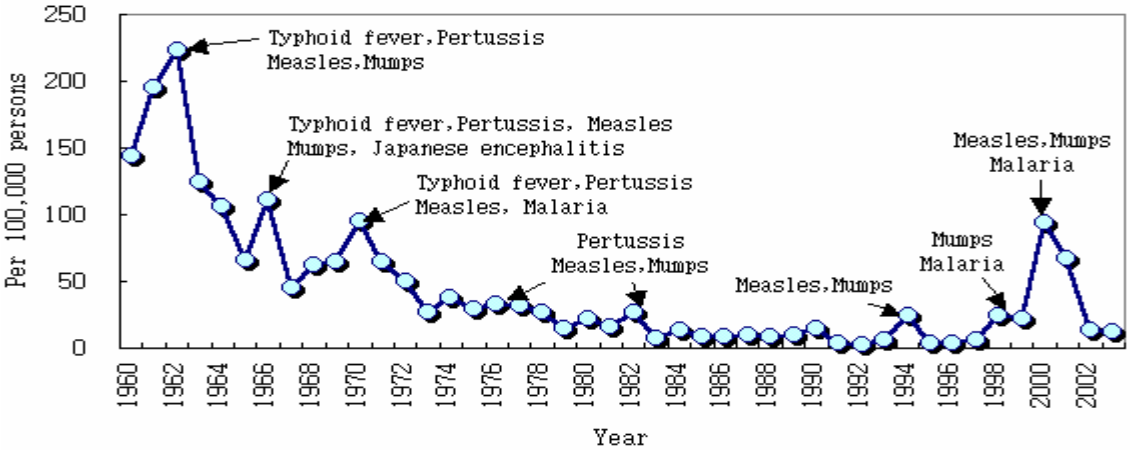

Figure 1. The overall incidence of acute notifiable infectious diseases by year

Enhancement of Infectious Disease Surveillance

Revision of Communicable Disease Prevention Law. The Communicable Disease Prevention Law was revised in order to reclassify notifiable communicable diseases, change notification criteria, and shorten the intervals between periodic notification reports in response to emerging and reemerging infectious diseases in 2000. The law stipulated the reporting form, reporting process, and the article for punishment for delinquent and missing-report.

Reclassification of Notifialbe Diseases. Notifiable diseases were reclassified from three groups to the following five new groups reflecting the new trends of infectious diseases in Korea. Also the number of notifiable diseases extended from 29 to 64 diseases. Including new emerging infectious disease provided high level flexibility to our surveillance system. New emerging diseases such as SARS could be easily incorporated to our surveillance system without changing the reporting form and electronic reporting system.

Table 1. Criteria and reporting time for notifiable communicable diseases

Category	Criteria	Diseases	Reporting time
Group I1	Communicable diseases that spread rapidly and pose a high level of health risk to national health, requiring immediate control measures at the development or onset of an outbreak	Cholera, Plague, Typhoid fever, Paratyphoid fever, Shigellosis, bacillary dysentery, Enterohemorrhagic *E. Coli*	Immediate
Group II2	Vaccine preventable communicable diseases that are subject to the national immunization program	Diphtheria, Pertussis, Tetanus, Measles, Mumps, Rubella, Poliomyelitis, Viral hepatitis B, Japanese encephalitis, Chickenpox	Immediate
Group III3	Communicable diseases that require continuous monitoring and establishment of preventive measures because of the potential for an outbreak	Malaria, Tuberculosis, Hansen's disease, Leprosy, Scarlet fever, Meningococcal meningitis, Legionellosis, Vibrio vulnificus, Sepsis Epidemic typhus, Murine typhus, Scrub typhus, Leptospirosis, Brucellosis, Anthrax, Rabies Hemorrhagic fever with renal syndrome, Influenza, AIDS	Within seven days

Group IV4	Newly emerging diseases within Korea, reemerging in Korea or importable from overseas that require urgent prevention measures, as designated by the directive of the Ministry of Health and Social Welfare	Yellow fever, Dengue fever Marburg fever, Ebola fever Lassa Fever, Leishmaniasis Babesiosis, African Trypanosomiasis Cryptosporidiosis, Schistosomiasis, Yaws, Pinta, Smallpox, Botulism Emerging infectious Disease	Immediate
Appointed	Communicable diseases not included in Groups 1 and 4, that require surveillance monitoring to detect outbreaks, as designated by the Minister of Health and Social Welfare	Viral hepatitis A, Viral hepatitis C, VRSA, Chagas' disease, Angiostrongyliasis, Gnathostomiasis Filariasis, Hydatidosis Creutzfeldt-Jakob Disease	Within seven days

* Sentinel Surveillance System conditions (Hep B, Influenza, and sexually transmitted diseases) will be notified by Sentinel Surveillance Agencies.
* Sexually transmitted diseases: syphilis; gonorrhea; chancroid; arthritis, non-gonococci; chlamydia; condyloma acuminate.
* Anthrax reporting time frame changed from reporting within seven days to immediate reporting

Case Classification Criteria for Notifiable Communicable Diseases. The Communicable Disease Prevention Law defines the scope of case classification for notification of each notifiable communicable disease based on the natural history of the disease, need for isolation or control measures, and availability of diagnostic tests.

Confirmed case: A person presenting with symptoms due to infection with a pathogen that meets the clinical case definition by a physician's examination or is confirmed by a laboratory designated by the Ministry of Health and Welfare (MOHW).

Suspect case: A person suspected to have been infected with a pathogen but not yet confirmed by physician's examination or examination by a laboratory designated by the MOHW

Carrier: Carrier of pathogen without clinical symptoms.

Reporting Process for Notifiable Diseases. The physician who diagnoses the patient is responsible for reporting to the district health authority where the patient or corpse is located. The physician can report in writing, verbally, via telephone, fax, or email, which ever is most convenient for the reporter. For the group 1, 2 and 4 diseases, the physicians should report immediately after diagnosis, for the group 3 and appointed diseases, the

physicians should report within seven days after diagnosis. After receiving the report, the chief of the district health authority should report the case to the provincial health authority via an electronic reporting system, the so called Electronic Data Interchange (EDI) System, and then the provincial health authority should report to the national health authority, the Korea Center for Disease Control (KCDC) via EDI.

Introduction of electronic data interchange system, data management program, and statistical program. To improve surveillance, EDI was established in 2000. After this, every health authority has its own database for reported cases of communicable diseases and KCDC has a national database for reported cases of communicable diseases. Also for managing the data of reported cases, data management systems for the district, provincial, and national levels were developed. Using the data management program, each health authority and KCDC can review the each reported cases and approve or reject it when it doesn't meet the criteria or is not completed. For rapid analysis, a statistical program was developed in 2000 and posted on a website named *Disweb*. The public can see the status of reported communicable diseases after downloading the program and database in a tablular or graphical form.

Development of website (Disweb) for information sharing and communication. KCDC developed *Disweb* to provide all relevant information on infectious diseases including guidelines, statistics and press releases. It has been a portal site since 1999 for information on infectious diseases. Also *Disweb* has been a communication channel for health care workers who are responsible for communicable disease surveillance and response. A less complete English version of *Disweb* has been established and provides statistics on infectious diseases, and a brief English version of communicable diseases weekly reports.

Establishment of various surveillance systems. Since the late 1990s, the Korean government has established various surveillance systems. Sentinel surveillance systems for influenza and school absenteeism for communicable disease were established in 1997. Sentinel Surveillance systems for viral hepatitis A and C, sexually transmitted diseases, Creutzfeldt-Jacob diseases, vancomycin resistant *staphylococcus aureus* infection, and imported parasitic diseases were established in 2000. A rumor surveillance system, so called *K-Promed*, infection specialists' network, and syndromic surveillance systems were established in 2002. After the SARS outbreak, a network, so called *EpiNet* among the health care workers in the public health sector and infection control doctors in hospitals nation-wide was established for information sharing and surveillance for unusual respiratory diseases clusters.

Enhancement of analysis and feedback and collaboration with the private sector. Analysis of the reported communicable diseases can be done continuously, on a daily, weekly, monthly, and annual basis because we have a database for all notifiable diseases

after establishing the EDI. Also feedback can be provided to public, health care workers, and physicians through a website, email, and as printed material. The *Communicable Disease Weekly Report*, *Communicable Disease Monthly Report*, *Newsletter for Sentinel Surveillance*, and *Communicable Disease Statistics Year Book* have been issued on *Disweb*, and printed versions have been sent to physicians' offices. The Korean government has enhanced collaboration with the private sector to develop surveillance systems and conduct surveillance.

Training of health care workers at the local government levels. After the establishment of sophisticated surveillance systems, some local governments experienced problems in reporting cases through EDI, maintaining databases, and using data management systems because of lack of trained health care workers. To solve this problem, we have conducted regular training courses for surveillance based on needs assessment, three to four times a year. Also a field epidemiology training program at the provincial government level provides technical support for health care workers at both the district and provincial levels. We also launched a field management training program for the health care workers at the local government level in 2002.

Gaps

Insufficient capacity for disease surveillance and response for emerging infectious disease at the local government level. New international health regulations require member states to build their core capacity to detect and respond to public health events of international concern. In this context, Korea has a relatively strong public health infrastructure to detect and respond to such events because public concern about public health events is quite high and the central and provincial governments can respond within several hours after notification. For example, when an avian influenza outbreak in poultry occurred in 2004, a response team from KCDC reached the outbreak site and mobilized all the resources including antivirals and personal protective equipment within five hours. However the capacity of local governments to respond to emerging infectious diseases is not strong enough even though the capacity to respond to outbreaks of food-borne disease or established diseases is quite high.

Inadequate operation of various surveillance systems. Various surveillance systems including different sentinel surveillance systems, a rumor surveillance system (*K-ProMed*), and syndromic surveillance systems have been developed. Generally, routine notifiable communicable disease surveillance systems are limited in their ability to serve as early warning systems. Usually information of outbreaks can be gathered from the media or through personal channels. Rumor surveillance systems and other various surveillance systems can play an important role for detection of outbreaks and as an early warning system. However the operation of these systems is inadequate mainly because of a lack of human resources.

Insufficient integration among surveillance systems. Because of EDI, the national database for notifiable infectious diseases is now well established. Korea also has well established public health laboratory networks. Korea has adopted a strategy for the elimination of measles and malaria. Integration of the data on measles and malaria has been accomplished to enhance surveillance. Sometimes merging data of other selected diseases from EDI and laboratory networks has been done, and some missing reports of communicable diseases have been detected. Integration of data for other infectious diseases from EDI and laboratory networks should also be carried out to enhance surveillance.

Low participation rate for notification among physicians. There is a low participation rate among physicians for the communicable disease notification. One survey conducted in one of the metropolitan areas in 2002 showed the proportion of the physician who replied that they always reported was 28 percent, to report usually was 37 percent, to report sometimes was 18 percent, to report rarely was 9 percent, and no experience of infectious disease was 8 percent.

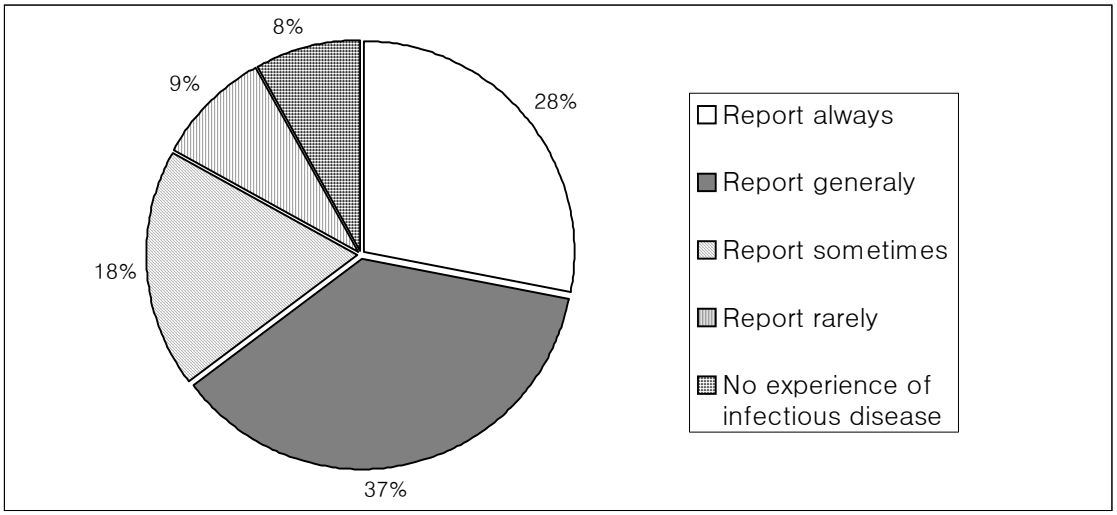

Fig 3. The proportion of physicians by the attitude for notification of notifiable diseases (N=727)

Future Plans

Establishment of web-based reporting system. The current EDI system was developed as a client server system because we had some technical limitations to maintain security of the confidential data and speed of Internet reporting in 2000. However it's not convenient to maintain the EDI system as a client server system. So the government plans to switch to an online web-based reporting system for real-time reporting and analysis of communicable disease information by 2006.

Integration of EDI and laboratory surveillance systems. The efforts to find missing reports by merging EDI data and laboratory surveillance data manually have been done for the selected diseases and then KCDC has asked local government to report the missing cases. So for the comprehensive communicable disease surveillance, we have a plan to integrate the EDI system and laboratory surveillance system of the laboratories in the public health sector.

Extension of the electronic reporting system to the private sectors. The current EDI system involves the public health sector only. However almost all the clinics and hospitals use electronic patient management system − the so called Order Communication System or 'Non-chart System. So EDI can be integrated easily with the electronic management systems of hospitals and clinics. This will increase notification rates automatically and provide convenience to physicians.

Continuous human resources development to build capacity. Field epidemiology training programs at the central and provincial levels have been conducted since 2000, and field management training programs to develop human resources at the district level since 2002. Other programs to provide training for persons responsible for surveillance, epidemiologic investigations, and laboratory diagnosis have been conducted continuously. These efforts to develop human resources and training at all administrative levels should be enhanced continuously to build capacity to respond to emerging infectious diseases.

Enhancement of collaboration with the private sector. To increase participation from the private sector for communicable disease surveillance and response, more collaboration should be ensured, particularly in the areas of research and development, and the development and operation of communicable disease surveillance systems.

Public Health Surveillance for Respiratory Diseases: United States

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With the world's attention focused recently on SARS and today on the threat of pandemic influenza, I was asked to focus especially on respiratory disease surveillance. My remarks are focused predominantly on domestic public health surveillance, with some attention to systems supported by the United States in other countries.

Surveillance is among the most powerful tools we have in infectious disease control programs. As DA Henderson articulately stated almost 30 years ago, surveillance "represents organically the brain and the nervous system in a management process" (Henderson, 1976). One must get information from the periphery on when, where, and who is getting ill, and it is by analyzing this information that the appropriate response measures can be developed and implemented. Also, one can recognize an emerging or previously unknown agent only against a background of what is known (Berkelman, 1997). Thus, routine diagnosis and surveillance for traditional infectious diseases is critical to address those that are emerging.

Surveillance systems in the United States are a mosaic and infectious disease surveillance is accomplished by multiple systems. They may overlap, and this makes the surveillance more robust. Even surveillance for a single disease such as HIV infection or influenza may consist of more than one system. One issue is that occasionally studies that track diseases over time prospectively should be classified as research rather than public health surveillance; these studies are important and they may eventually result in the development of public health surveillance systems.

Population-Based Surveillance

Notifiable Disease Surveillance. The United States has relied on routine reporting of cases of notifiable diseases as the backbone of infectious disease surveillance with all states reporting by 1928 (CDC, Summary of Notifiable Diseases, 2005). States have the legal authority for determining what diseases are notifiable in their jurisdiction, and physicians, hospitals, and laboratories are required to report any disease they diagnose that is on the list. On an annual basis, the states meet and agree on a list of nationally notifiable diseases which are reported voluntarily to the Center for Disease Control (CDC) on a weekly basis. The list includes approximately 60 diseases. CDC works with state health officials to guide decisions regarding modification, and provide input as requested. A number of diseases have been added or dropped in recent years; West Nile

illness and SARS have been added, and leptospirosis was dropped from the list, although some states still require reporting of the disease. Influenza deaths in children less than 18 years old were added to the nationally notifiable disease list following anecdotal reports during the 2003-04 winter that high numbers of children in the United States were critically ill or dying from influenza. Common respiratory diseases such as respiratory syncytial virus (RSV) and influenza have not been reportable in the past.

What are the strengths and weaknesses of notifiable diseases surveillance in the United States? A major strength is that the reporting is comprehensive. Every geographic area is covered. Anyone seeking health care in the United States and diagnosed with a notifiable condition is by law or regulation required to be reported. With some diseases, such as meningococcal disease, reports are required within 24 hours; with others such as West Nile disease, the reports are required within one week. Demographic data (e.g., age, sex, race/ethnicity) are also collected on cases, although these data are frequently incomplete. Advances in computer technology are being incorporated into reporting.

Third, the data are reviewed, analyzed and disseminated on a weekly basis to those who need to know, including healthcare providers and public health professionals. The summary reports are open to all.

Fourth, surveillance is "information for action" and a strength of this surveillance system is that our public health system responds to the reports of most notifiable diseases when needed. Every state has local and state health departments, and when an epidemic is suspected, the reports are investigated. If it is a large epidemic or one with unusual features, the CDC is often invited to assist in the investigation. In a circumstance where bioterrorism is suspected, law enforcement is also involved, and this complicates the investigation although it does not change the laboratory and epidemiologic investigation that is needed for public health purposes.

Another positive attribute of this system is that by having a discrete entity responsible for collecting and responding to case reports, healthcare providers should know who to contact if they suspect an infectious disease problem. When a physician in Florida saw Gram-positive rods on a Gram stain of cerebrospinal fluid that looked consistent with *Bacillus anthracis*, he called public health even before the cultures were positive. The surveillance system ties every physician, hospital and laboratory to public health; and that connection is formally established through the notifiable disease surveillance system in a concrete way.

A recent enhancement to notifiable diseases surveillance and response efforts is *Epi*-X, a web-based communication system through which CDC officials and state and local public health professionals can access and share preliminary health surveillance information both quickly and securely (CDC, 2005). Users can be notified of breaking

health events as they occur. This system has been effective in supporting surveillance of notifiable diseases as well as non-notifiable diseases, once a potential outbreak is communicated to the system.

What are the weaknesses of notifiable disease reporting? Studies show that most diseases are not completely diagnosed or reported; in fact, reporting can be quite poor (Doyle, 2002; Silk, 2005). Many individuals seeking healthcare are treated empirically and no etiology is confirmed. Physicians may not believe it is helpful to the management of the patient to get a definitive diagnosis particularly with respiratory infections, and they may treat with antibiotics without any diagnostic workup. The use of rapid diagnostics at the point of care may eventually be used to help with management of a patient with a lower respiratory infection. If no isolate is obtained, further molecular work and sensitivity testing cannot be accomplished. Separately, but importantly, the United States conducts far fewer autopsies than in the past, and definitive diagnosis of the microbial etiology is lacking for most deaths from pneumonia.

Second, there are problems with reporting of cases that are diagnosed. Physicians may believe that the laboratories will report or vice versa, and few physicians are likely to contact their public health professional directly. Recent advances in computer technology have allowed improvements in both completeness and timeliness of reporting through the use of automated electronic reporting from laboratories.

Third, the notifiable disease system is useful for a few respiratory conditions such as tuberculosis and drug-resistant invasive infections with *Streptococcus pneumoniae*, but less so for most acute respiratory infections. It is not very helpful for influenza, at least until quite recently, when pediatric deaths were added as a nationally notifiable disease. A baseline number of deaths in children is currently being established. In addition, there are efforts underway to convince states to support laboratory-confirmed influenza hospitalizations as a notifiable condition.

Of note, the detail provided through this surveillance system are frequently insufficient for many mathematical models, depending on their focus.

Zoonoses. There is a parallel system for notifiable conditions in animals. More attention has recently been paid to monitoring of disease in animals that may result in human infection. Veterinarians and departments of agriculture are working with public health professionals in a number of states on infectious disease monitoring, partly in response to concern with potential agroterrorism, but primarily as a result of emerging diseases, including monkeypox, SARS, and avian influenza.

Mortality surveillance using vital statistics from cities. A long-standing system specifically designed to measure the impact of influenza on mortality has been the 121

city surveillance system (the number of cities fluctuates). Currently, 122 cities report weekly to CDC the number of deaths in their city as well as the number of death certificates for which influenza or pneumonia is listed as a primary or contributing cause of death. The number of deaths is also tabulated by specific age and sex groups. The percentage of deaths due to pneumonia and influenza are compared with a baseline and an epidemic threshold value is calculated for each week. The system is fairly comprehensive and gives an accurate picture of mortality associated with an epidemic, but the system may lag in detection of an epidemic by one or more weeks.

Emerging Infections Programs. Established almost 10 years ago, the Emerging Infections Programs conduct intensive population-based surveillance in 10 states and/or metropolitan areas (Pinner, 2003). They were initiated, in part, to enhance surveillance and to address the problems of incomplete reporting of diagnosed cases and incomplete data submission on case reports. Cases of invasive bacterial disease, such as pneumonia accompanied by bacteremia, are identified through laboratory record review in the catchment area. These programs collect extensive data on each case and are resource intensive. Funding is provided by CDC to the respective state or city health department, and frequently these health departments partner with an academic health center.

The programs are expected to be responsive to urgent needs. For example, when SARS was identified as a public health problem, the Emerging Infection Programs established surveillance for severe pneumonia in healthcare workers, a surveillance initiative which was subsequently discontinued.

More recently, these programs began surveillance for laboratory-confirmed influenza-related hospitalizations in persons less than 18 years of age in 11 metropolitan areas of the United States. Cases are identified by reviewing hospital laboratory and admission databases and infection control logs for children with a documented positive influenza test (culture, DFA/IFA, PCR, or a rapid test) conducted as a part of routine patient care. Their weakness is that they are not fully integrated into national influenza surveillance.

New Vaccine Surveillance Network. Another population-based system is a geographically limited but intensive, system for respiratory illness in young children in one county in each of three states: Ohio, Tennessee, and New York. Children less than five years who are hospitalized with fever or respiratory symptoms are prospectively enrolled. Nasal swabs are collected and tested by viral culture and RT-PCR at CDC. Currently, surveillance is focused primarily on RSV and influenza. The strengths are the population base and the systematic diagnostic testing; the greatest weaknesses are the lack of timeliness, the high cost of the system, the lack of geographic coverage, and lack of coverage for those five years and over.

Sentinel Surveillance

There are a number of sentinel systems for respiratory disease surveillance which have the advantage of being relatively inexpensive, with the disadvantage being lack of geographic coverage and inability to calculate incidence and prevalence rates.

Laboratory -based Sentinel Surveillance. Notifiable disease surveillance does not cover common viral respiratory or enteric infections, and, partially to address this deficiency, the National Respiratory and Enteric Virus Surveillance System (NREVSS) was established in 1982 by CDC. It is a voluntary, laboratory-based surveillance system of about 90 clinical and public health laboratories in 40 states. The laboratories, the majority of which are based at academic health centers, report weekly to CDC on the number of specimens tested and the number positive for several respiratory viruses by antigen detection and virus isolation methods. Data on respiratory syncytial virus, influenza, and other viruses are collected; the information on influenza testing and results are integrated with the influenza surveillance system.

Healthcare Provider Sentinel Surveillance. For influenza surveillance, a sentinel system has been long established with family practitioners who volunteer to be part of a reporting system for influenza-like-illness (ILI), defined as a fever of more than 100 degrees F and a cough or sore throat. Currently, about 2000 providers are included in the system. Many of these physicians also collect specimens and transport them to the public health laboratory; these laboratories will test those specimens to identify influenza isolates and type them. The percentage of patient visits to sentinel providers for ILI reported each week is weighted on the basis of the state population. This percentage is compared each week with the national baseline of 2.5 percent. The baseline is the mean percentage of visits for ILI during non-influenza weeks for the previous four seasons plus two standard deviations. The system gives a national average for ILI illness, but the data are insufficient to be applied at a regional or state level (CDC).

Military training sites. Most public health surveillance for respiratory disease is conducted by the local and state health departments in collaboration with CDC. Separately, the Department of Defense conducts ongoing febrile respiratory disease surveillance at eight military training sites. Specimens are obtained from a systematic sample of trainees who have febrile respiratory illness and are sent to the Navy's laboratory in San Diego and tested for adenovirus, influenza, parainfluenza, and RSV. Each week the febrile respiratory illness rate status is classified as: 1) at or below expected value, 2) moderately elevated, or 3) substantially elevated.

Syndrome surveillance

Many syndrome surveillance systems have been established throughout the United States in the past decade by various governmental and non-governmental entities. These systems have examined such records as absenteeism, ambulance dispatch calls, pharmacy records, and chief complaints of persons presenting at emergency departments. Some of these systems have proven useful for detecting increases in viral illnesses for enteric and respiratory diseases of mild to moderate severity, including influenza. However, they have not been useful in the United States in early detection of outbreaks of severe illness. Serious illness is likely to result in hospitalization and a complete diagnostic workup. These systems continue to be investigated and real-time information on emergency department visits and other events may prove most useful in monitoring epidemics and in real-time assessment of healthcare utilization.

Global Surveillance supported by the United States

There are a number of public health programs supported by the United States which have some focus on respiratory disease surveillance globally.

Influenza surveillance in active duty military. Some of these programs are long-standing, such as Project Gargle, a worldwide influenza surveillance program initiated in 1976 by the Department of Defense. Specimens are collected from both active duty and dependents from U.S. Air Force bases in the United States and around the world and shipped to an Air Force Base in the United States for culture. Isolates are provided to assist the World Health Organization in worldwide influenza surveillance.

Global Emerging Infectious Surveillance (GEIS). In addition, in the past 10 years, the Department of Defense has established a Global Emerging Infections Surveillance system (GEIS) at its 5 overseas laboratories in Eygpt, Indonesia, Kenya, Peru, and Thailand. GEIS includes influenza surveillance among its core activities for all sites.

International emerging infections programs. CDC has recently established international emerging infections programs (IEIPs) in Thailand and Kenya, and is planning another in Egypt; in two areas of Thailand, CDC is working to conduct surveillance of hospitalized individuals with chest X-ray documented pneumonia. Nasopharyngeal swabs are collected along with acute/convalescent sera.

Geosentinel. Geosentinel is a surveillance system for illnesses in travelers. The system was initiated in 1995 by the International Society of Travel Medicine in collaboration with CDC. Travel medicine clinics inside and outside the United States report the illnesses of travelers returning from other countries. Many illnesses are respiratory illnesses; however, there is limited diagnostic testing**.**

Global systems of surveillance based on the Internet. The Program for Monitoring Emerging Diseases (ProMED) is an Internet-based reporting system; it is operated under the auspices of the International Society on Infectious Diseases and provides rapid global dissemination of information on infectious diseases. Sources of information include media reports, official reports, online summaries, local observers, and others. Reports are often contributed by ProMED-mail subscribers. Moderators review the reports before posting to the network. ProMED-mail currently reaches over 30,000 subscribers in at least 150 countries. The Gates Foundation, the Rockefeller Foundation, the Oracle Corporation, and the Nuclear Threat Initiative have all contributed financial support. In contrast to government systems, healthcare providers and others can openly exchange information. Both closed and open systems have strengths and weaknesses.

A second system resulting from advances in computer technology is the Global Public Health Intelligence Network (GPHIN) directed by Health Canada; it is a unique multilingual system that gathers and disseminates relevant information on disease outbreaks and other public health events by monitoring global media sources such as news wires and web sites. It has had both government and non-government sponsors, including the US-based foundation, NTI. WHO is first alerted to an epidemic by GPHIN approximately 40 percent of the time.

Summary

Notifiable disease surveillance remains the backbone of infectious disease surveillance. There is a diverse array of surveillance systems used by the United States to supplement this system and to support surveillance outside the country. These systems include both population-based surveillance in smaller geographic areas as well as sentinel provider systems. Population-based surveillance is far more resource intensive than sentinel system surveillance; it has the advantage of providing more complete data and being able to estimate rates of disease more accurately; sentinel surveillance is relatively less expensive and has greater geographic coverage than intensive population-based systems. Every system has weaknesses and some redundancy in the system enhances robustness overall of surveillance.

Of note, in most of these systems, data collected in routine surveillance may be insufficient for modelers who need detailed data (e.g., time of onset of symptoms, use of isolation & quarantine, days hospitalized). Advances in rapid diagnostics and in computer technology are resulting in the potential for strengthened surveillance systems and the potential for more complete and timely data.

> *Not everything that counts can be counted, and not everything that can be counted counts.*
>
> Albert Einstein

References:

Berkelman RL, Stroup DF, Buehler JW. Public health surveillance. In: Oxford Textbook of Public Health 3rd edition. (eds: Detels R, Holland WW, McEwen J, Omenn GS), Oxford University Press, 1997, Vol 2, pp735-750.

Centers for Disease Control and Prevention. National Respiratory and Enteric Virus Surveillance System. Accessed at URL: http://www.cdc.gov/ncid/dvrd/revb/nrevss/index.htm,

Centers for Disease Control and Prevention, Summary of Notifiable Diseases – United States, 2003. April, 2005.

Centers for Disease Control and Prevention. Overview of Influenza Surveillance in the United States. Available at URL: http://www.cdc.gov/flu/weekly/fluactivity.htm.

Centers for Disease Control and Prevention. *Epi*X Available at URL: http://www.cdc.gov/epix

Department of Defense. Febrile respiratory illness surveillance. Accessed at URL: http://nhrc.navy.mil/geis/studies

Doyle TJ, Glynn KM, Groseclose SL. Completeness of notifiable infectious disease reporting in the United States: an analytical literature review. *Am J Epidemiol* 2002;**155**:866-874.

Hefferman R, Motashari D, Besculides M et al. System descriptions: New York City Syndromic Surveillance Systems. *MMWR Supplement*, September 24, 2004 **53** (suppl), 23-27.

Henderson DA. Surveillance of smallpox. *International J Epidemiol* 1976;**5**:19-28.

HHS Statement by Julie Gerberding. .Influenza Preparedness. Available at URL: http://www.hhs.gov/asl/testify/t050412b.html.

Pinner RW, Rebmann CA, Schuchat, Hughes JM. Disease Surveillance and the academic, clinical, and public health communities. *Emerg Infect Dis* (serial online) Jul 2003. Available at URL: http://www.cdc.gov/ncidod/EID/vol9no7/03-0083.htm

Silk BJ, Berkelman RL. A review of strategies for enhancing the completeness of notifiable disease reporting. *J Public Health Manag Pract* 2005;**11**(3):191-200.

Panel for Surveillance

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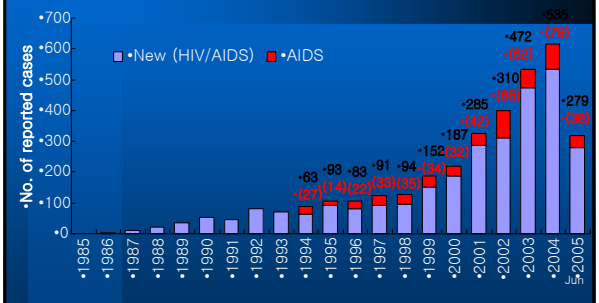
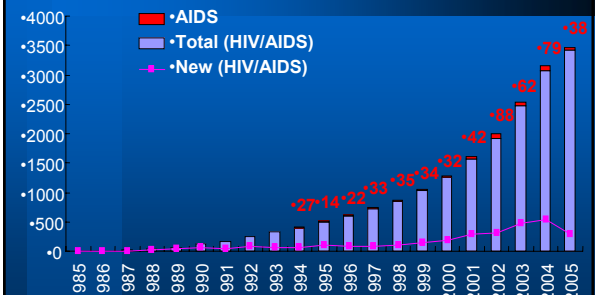
HIV/AIDS in Korea

- First case of HIV was identified in 1985
- First case of AIDS was notified in 1987



Newly Reported Cases of HIV/AIDS by year in Korea



HIV/AIDS in Korea

- Currently (until 2005 June), 3,468 people are infected with HIV and 680 have succumbed to the disease. Therefore, in Korea 2,788 people suffer from HIV/AIDS.
- 72.3 persons / million in Korea, 96.9 per million in China

Reported Cases of HIV/AIDS by year

Year	1985 ~ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Jun 2005	total
No. of HIV infected persons (Female)	517 (64)	105 (12)	124 (17)	129 (18)	186 (26)	219 (25)	328 (35)	399 (34)	534 (32)	612 (53)	317 (17)	3,468 (334)
No. of AIDS patients	41	22	33	35	34	32	42	88	62	79	38	506
No. of death persons	76	33	36	46	43	52	58	76	96	114	50	680

Data from KNIH

The age* distribution of the HIV infected by sex

Age	Male		Female		Total	
	No.	%	No.	%	No.	%
0~9	10	0.4	2	0.1	12	0.5
10~19	29	1.2	8	0.3	37	1.5
20~29	553	23.0	79	3.3	632	26.3
30~39	773	32.1	81	3.4	854	35.5
40~49	457	19.0	49	2.0	506	21.0
50~59	231	9.6	30	1.3	261	10.9
60~	95	4.0	8	0.3	103	4.3
Total	2,148	89.3	257	10.7	2,405	100.0

*Age at the time of diagnosis, Data from KNIH

Method of HIV transmission in Korea

Routes	No.	%
Heterosexual contacts	1,273	64.8
Homosexual contacts	643	32.7
Transfusion	26	1.3
Blood products	17	0.8
Vertical infection	5	0.3
Drug injection	2	0.1
Others	208	-
Under investigation	231	-

Data from KNIH

Emerging infectious diseases in Korea

- Newly identified and previously unknown infections which cause public health problems either locally or internationally
- Examples of emerging diseases
  - Rotavirus, Human immunodeficiency virus (HIV), Hepatitis C, Hantaan virus, Coxsackie virus A24 etc.
  - *Legionella pneumophilia, Escherichia coli O157:H7, Borrelia burgdorferi, Vibrio cholerae O139* etc.

New pathogenic microbes recognized since 1963

First recognized year in Korea	Microbe	First recognized year in the world
1963	*Vibrio Cholerae O1* El Tor	1961
1973	*Listeria monocytogenes*	1926
1977	Hantaan virus	1977
1980	*Vibrio vulnificus*	1970
1980	*Yersinia pseudotuberculosis*	1883
1982	*Pasteurella multocida*	1913
1984	*Legionella pneumophila*	1977
1985	Human Immunodeficiency Virus	1981
1988	*Gymnophalloides seoi*	1988
1990	Hepatitis C virus	1989
1991	*Histoplasma capsulatum*	1906
1992	*Coxiella burnetii*	1938

First recognized year in Korea	Microbe	First recognized year in the world
1994	*Vibrio cholerae* O139	1992
1995	*Cryptosporidium parvum*	1976
1997	*Francisella tularensis*	1914
1997	Human herpesvirus-8	1995
1998	*Escherichia coli* O157:H7	1982
1998	*Borrelia burgdorferi*	1982
2000	*Ehrlichia chaffeensis*	1991
2001	*Salmonella* Typhimurium DT104	1995
2002	Coxsackie virus A24 (acute hemorrhagic conjunctivitis)	1970
	Rotavirus	1973
	Campylobacter jejuni	1977
	Helicobacter pylori	1983

Reemerging infectious diseases in Korea

- Reappearance of, and an increase in, the number of infections from a disease, which is known, but which had formerly caused so few infections that it had no longer been considered a public health problem
- Examples of reemerging diseases
  - Leptospirosis, Malaria, Tsutsugamushi disease, Salmonellosis etc.

Reemerging infectious diseases in Korea

Reemerging year	Disease	First recognized year in Korea
1998	Leptospirosis	1942
1993	Malaria	
1984	Endemic typhus	1959
1985	Tsutsugamushi disease	1951
1988	Salmonellosis	
1997	Viral Hepatitis A	
1998	Shigellosis	
1998	Mumps	
2000	Measles	
2002	Brucellosis	1939

Surveillance Systems in Korea

- Notifiable communicable diseases
  - 64 infectious diseases
- Sentinel surveillance systems
  - Influenza and school absenteeism (1997)
  - Hepatitis B, C, STD etc. (2000)
- Rumor surveillance system (2000) 'K-Promed'
- Infection specialists network (2000)
- Syndromic surveillance system (2000)
- Epinet after SARS
- Laboratory based surveillance system

Organization

- Korean Center for Disease Control and Prevention (KCDC, 2004. 1)
- Infectious Disease Surveillance Division
  - Communicable Disease Monthly Report (CDMR)

Attributes of a Surveillance System (CDC)

- Sensitivity
- Timeliness
- Representativeness
- Predictive Value Positive
- Simplicity
- Acceptability
- Flexibility

Problems of Surveillance Systems in Korea

- Low reporting rate
- Lack of representativeness of reports
- Lack of participation
- poor utilization

Reporting rate

- 1962-1963
  - Pertussis 6.3%-2.8%, measles 3.0%-0.9%, diphtheria 5.7%-4.5%
- 1987
  - Typhoid fever 11.9%, paratyphus 0.2%, pertussis 7.7%, measles 12.4%, mumps 1.9%, total 4.3%
- 1994
  - Notifiable acute communicable diseases 27.0% (95% CI: 25.6, 28.5%)
  - Class 1 71.0% (95% CI: 67.2, 75.3%)
  - Class 2 20.0% (95% CI: 18.9, 21.3%)

Reasons of failure to report

- Uncertainty of diagnosis
- Neglect of reporting by physicians
- Lack of knowledge concerning notifiable diseases

Improvement of reporting performance

- Continued physician education
- Reorientation of reporting system
- Reward system
- Active participations of laboratories

Confidentiality

- To obtain valid data
- To prevent harm to the persons surveyed

Future Plans in Korea

- Establishment of web-based reporting system
- Integration of EDI and laboratory surveillance system
- Extension of eletronic reporting system to private sectors
- Continuous human resources development to build capacity
- Enhancement of collaboration with private sector
- Enhanced collaborations with vetenarians and the governmental departments of agriculture and defense
- comprehensive methods of system evaluation

Public Health Surveillance in US

- Notifiable Disease Surveillance (1952)
- Zoonosis
- Mortality surveillance using vital statistics
- Emerging Infections Programs
- New Vaccine Surveillance Network
- Sentinel Surveillance
- Syndrome Surveillance

Global Surveillance System in US

- Influenza Surveillance in Active Duty Military
- Global Emerging Infectious Surveillance
- International Emerging Infectious Surveillance
- Global systems of surveillance based on the internet

Korea Influenza Surveillance Scheme

- Korean National Institute of Health (KNIH) started laboratory surveillance for influenza virus isolation in 1968 in collaboration with WHO.
- The Laboratory of Respiratory Viruses in KNIH was designated as a National Influenza Center (NIC) by the WHO in 1972.
- In 1997, the Laboratory of Respiratory Viruses started influenza surveillance with about 70 voluntary sentinel physicians.
- Influenza was designated as a Group III National Notifiable Communicable Disease in 2000.
- The Korean Government extended influenza surveillance by launching the Korean Influenza Surveillance Scheme (KISS) nationwide since from the 2000-2001 season.

Aims of KISS

- To monitor the trends of influenza activities and to detect influenza epidemics as early as possible in Korea.
- To contribute to the recommendation on the influenza vaccine formulation by the analysis of isolated influenza virus prevailing in Korea
- To contribute to the development of influenza control measures based on the collected data, and to reduce the morbidity and mortality due to influenza
- To monitor the efficacy of the influenza vaccine

Case Definition of ILI

- fever more than 38℃, and
- cough or sore throat

Time of Reporting

- Weekly report (every Monday)

Data for Reporting

- Number of consultation according to the age group (0-2, 2-6, 7-19, 20-49, 50-64, 65 years of age older)
- Total number of patients visited during the week

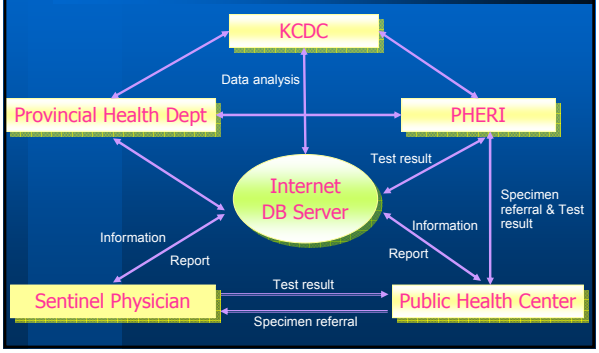
Data for Reporting

- Total Number of consulted specimens for virus isolation
- Number of isolated viruses and their type/subtype

Components of KISS

- clinical surveillance
  - reports made by private sentinel physicians including pediatricians, internal medicine and general practitioners, and county Public health centers.
    - county Public health centers: 239 number
    - Private clinics: 391 number
- laboratory surveillance
  - referrals from some private sentinel physicians on a voluntary basis and county public health centers.
    - Public health centers: 239 number
    - Private clinics: 157 number

Reporting system



Causes emergence or re-emergence of infectious diseases

✓ Alteration of the environment and climatic changes
✓ Increasing number of people living and moving in the world
(international travel, overcrowding in cities with poor sanitation, increased international trade in food, mass distribution of food and unhygienic food preparation practices, increased exposure of humans to disease vectors and reservoirs in nature)
✓ Abuse of Antibiotics

Emerging and Re-emerging infectious diseases

Severe Acute Respiratory Syndrome (SARS) in Korea

- Probable cases; 3 persons
- Suspicious cases; 17 persons
- No confirmed cases were reported in Korea
- House arrest; 2,290 persons
- PCR positive 5 persons (all; Ab test negative)
- Follow up survey for 226,774 persons with entrance from riskful areas
- Inspection ; 5,136 airplanes (614,661 persons), 9,513 ships (276,114 persons)

International Surveillance System

Infectious Disease Surveillance in Practice - New York City

Marci Layton, MD
New York City Department of Health

NYC's Vulnerability to Emerging Infections

- **Demographics**
  - High population density
  - 1/3 of NYC population is foreign born
- **Environment**
  - Unfiltered surface water supply
- **International travel/commerce**
  - 22.1 million international passengers arrive annually
- **Remains a likely bioterrorist targets**

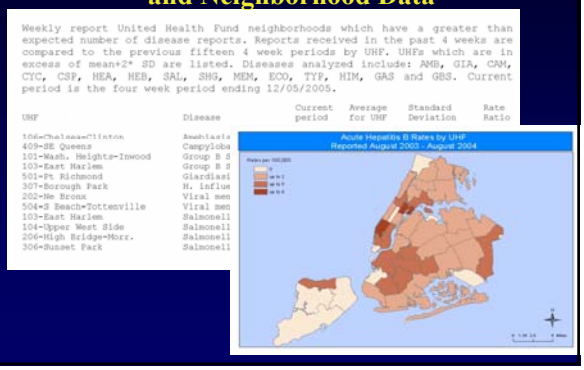
Infectious Disease Surveillance in New York City

- Traditional Surveillance via Key Partners
  - Physicians
  - Infection control practitioners
  - Laboratorians
  - Medical examiners
  - Veterinarians
- Syndromic Surveillance

Traditional Disease Reporting

- Health Code mandates reporting
  - 73 diseases
  - Unusual manifestations/cluster
- Reporting mechanisms:
  - Telephone, fax and mail
  - Electronic lab reporting
  - Web based reporting
- DOH conducts case/contact investigations for select diseases

Weekly Trend Analyses for Citywide and Neighborhood Data

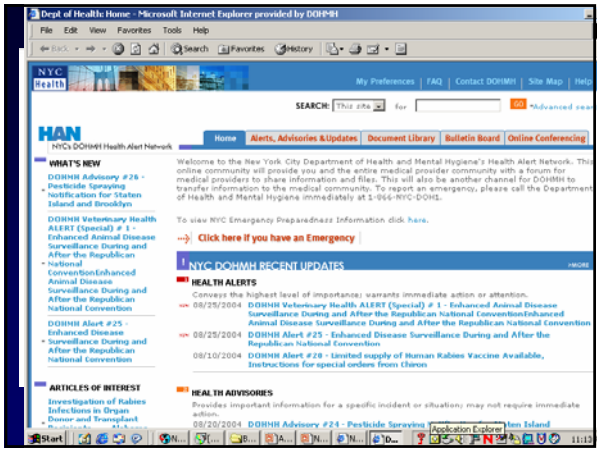


Weekly report United Health Fund neighborhoods which have a greater than expected number of disease reports. Reports received in the past 4 weeks are compared to the previous fifteen 4 week periods by UHF. UHFs which are in excess of mean+2* SD are listed. Diseases analyzed include: AMB, GIA, CAM, CYC, CSP, HEA, HEB, SAL, SHG, MEM, ECO, TYP, HIM, GAS and GBS. Current period is the four week period ending 12/05/2005.

UHF	Disease	Current period	Average for UHF	Standard Deviation	Rate Ratio
106=Chelsea-Clinton	Amebiasis				
409=SE Queens	Campyloba				
101=Wash. Heights-Inwood	Group B S				
103=East Harlem	Group B S				
501=Pt Richmond	Giardiasi				
307=Borough Park	H. influe				
202=Ne Bronx	Viral men				
504=S Beach-Tottenville	Viral men				
103=East Harlem	Salmonell				
104=Upper West Side	Salmonell				
206=High Bridge-Morr.	Salmonell				
306=Sunset Park	Salmonell				

Surveillance Requires a Partnership with Local Providers

- Active educational outreach to physicians, veterinarians and laboratorians:
  - Clinical and lab characteristics of notifiable diseases
  - Remain alert for unusual clusters/manifestations
  - Report certain diseases (suspect H5N1) immediately
  - Know WHO and HOW to call
- Promoting Reporting
  - Speakers Bureau, City Health Information Bulletin, Web
  - Toll free Provider Access Line (1-866-NYC-DOH1)
  - Responsive medical staff to triage calls 24 hour/7 days



1999 West Nile Viral Outbreak

West Nile Virus, 1999

Surveillance highlights:

- Initial 2 cases reported by astute physician
- Rapid initial epidemiological investigation identified unusual illness cluster of 8 cases
- Active casefinding citywide → 62 cases
- But took > 1 month to detect avian outbreak

Lessons learned

- Value of proactive provider communication
- Need to partner with animal health community

Animal Disease Surveillance

- Made animal diseases reportable to DOH
- Active outreach to clinical vets, wildlife specialists, and parks departments
- Veterinary Health Alert system

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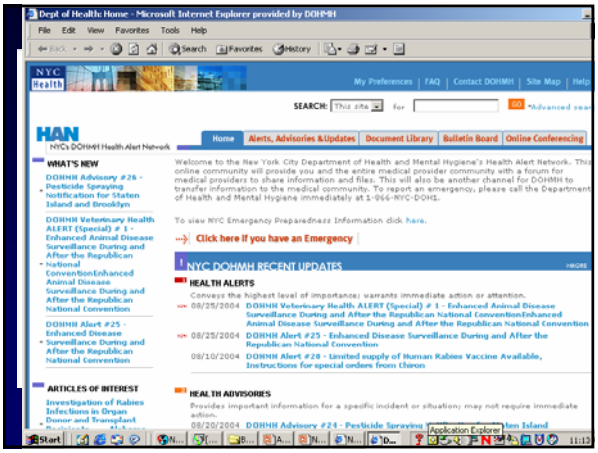

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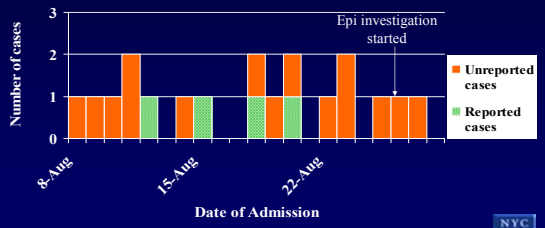
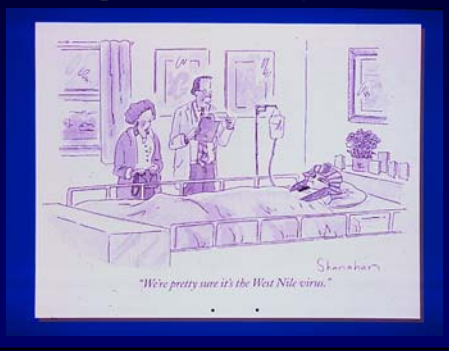
THE CITY OF NEW YORK
DEPARTMENT OF HEALTH
Animal Disease Case Report

Detection of West Nile in NYC: Power of Physician Reporting



Challenge in doing Surveillance for Nonspecific Clinical Syndromes



"Syndromic Surveillance"

Real-time" public health surveillance using clinical data that is routinely collected for other purposes

- Does not rely on physician reporting
- Immediately computerized
- Population-based and geographically representative
- Categorized by clinical syndrome
- Alert thresholds can be established

Potential Data Sources

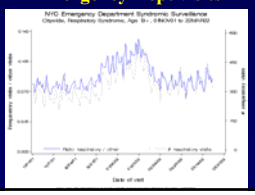
Day 0 - exposure occurs
Day 1 - feels fine
Day 2 - headaches, fever- l… OTC…
Day 3 - develops cough
Day 4 - sees private doct…
Day 5 - worsens- call… seen…
Day 6 - admitted- "pneumonia"
Day 7 - critically ill- ICU, lab tests +
Day 8 - expires- "respiratory failure"

Pharmaceutical Sales
Outpatient Visit Data
Ambulance Dispatch (EMS)
Emergency Department Logs
Diagnosed
Reported

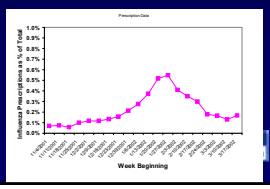
Ambulance calls

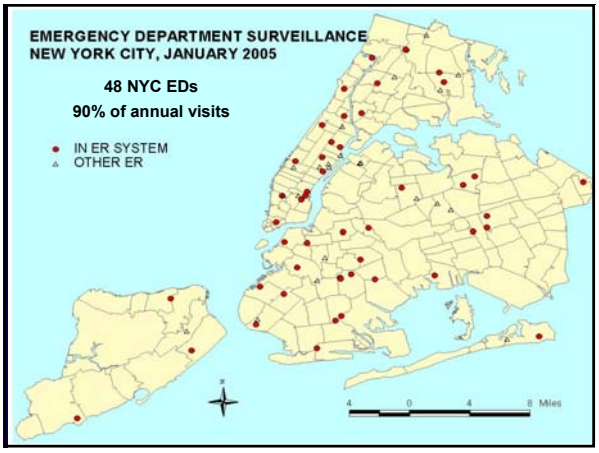
Employee health

Emergency Dept visits



Pharmacy sales





Emergency Dept Chief Complaints

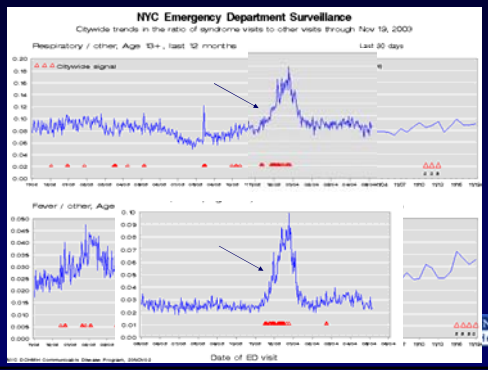
Age	Sex	Time	Chief Complaint	Zip
15	M	01:04	ASSAULTED YESTERDAY, RT EYE	11691
1	M	01:17	FEVER 104 AS PER MOTHER.	11455
42	F	03:20		11220
4	F	01:45	FEVER, COUGH	11507
62	F	22:51	ASTHMA ATTACK.	10013
48	M	13:04	SOB AT HOME.	10027
26	M	06:02	C/O DIFFICULTY BREATHING	
66	M	17:01	PT. MOTTLED AND CYANOTIC	10031

Respiratory = "RESP" or "COUGH" or "SOB"

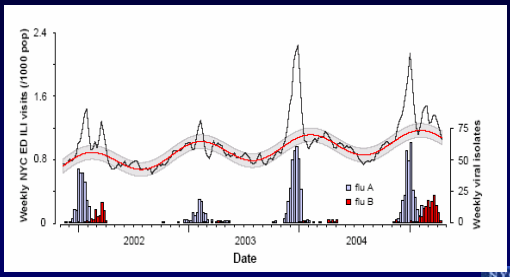
Statistical Analysis

- Citywide temporal trends
  - Serfling cyclical regression (3-year baseline)
  - Temporal scan statistic (2-week baseline)
  - CuSum (1-week baseline)
- Spatial clustering
  - Modified spatial scan statistic
- "Signal" – statistically significant aberration

Daily Reports: Respiratory/Fever
November 19, 2003



Respiratory ED Visits 2001-2005



Spatial cluster detection using SatScan

Diarrhea All ages Zip code 1-day 12 obs / 2.6 exp RR= 4.6 p=0.004

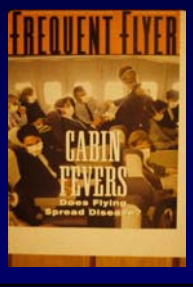
Details:	Zip	Obs / Exp	RR	UHF Neighborhood
	10455	3 / 0.7	4.6	Hunts Point - Mott Haven
	10459	5 / 0.5	10.9	Hunts Point - Mott Haven
	10473	4 / 1.2	3.3	Pelham - Throgs Neck
	10474	0 / 0.3	0.0	Hunts Point - Mott Haven

Investigation of Syndromic Surveillance "Signals"

- **Key Questions:**
  - ➢ True increase or natural variability of data?
  - ➢ Outbreak requiring public health intervention?
  - ➢ Natural or Bioterrorism related illness?
- **Available Methods:**
  - ➢ Review emergency department log
  - ➢ Call clinicians / laboratories
  - ➢ Chart reviews and patient interviews
  - ➢ Request increased diagnostic testing

What has Syndromic Surveillance been useful for?

- Detection of annual citywide outbreaks of norovirus, rotavirus and influenza
- Detected citywide increase in diarrhea after August 2003 power blackout
- Less useful for detecting localized outbreaks
- Reassurance when there are no citywide signals (e.g., SARS 2003, anthrax 2001)
- Future directions:
  - Point of care diagnostic assays
  - Incorporation of electronic health record data



Annual Number of Travelers—NYC

Airplane	85 Million
Bus	57 Million
Train	13 Million
Ship	0.6 Million

…about 210,000 non-commuter arrivals each day!

NYC's Response to SARS

- Enhanced surveillance for travel related cases
- Worked closely with CDC Quarantine staff
- Triaged > 300 calls re suspect cases
- Rapid case isolation and contact monitoring
- Guidance to health care community
- Public outreach – esp in Asian community

IMPORTANT NOTICE TO ALL PATIENTS

Please tell the nurse or staff **immediately** if:

1 You have **traveled** outside of the United States in the past 2 weeks

OR

You **live** with a **person who traveled** outside of the United States in the past 2 weeks and was ill with fever and cough

AND

2 You are here to see the doctor because you are having **fever**, **cough** or **breathing trouble**

重 要 通 知
請所有患者注意

如果有以下情形，請**立即**告知護士或工作人員：

1 您曾在過去2週內到美國**或者**境外**旅行**。

以及

您家中有人曾在過去2週內到美國境外**旅行**並且出現發燒和感冒症狀。

2您來看醫生是因爲**發燒**、**感冒**、或者**呼吸有問題**。

"As the human immunodeficiency virus (HIV) epidemic surely should have taught us, in the context of infectious diseases, there is nowhere in the world from which we are remote and no one from whom we are disconnected."

Institute of Medicine, 1992

Infectious Disease Laboratory Surveillance Network:

A Powerful Tool for Investigation of Infectious Disease Outbreak

Xu Jianguo
State Key Laboratory for Infectious Diseases Prevention and Control (China CDC)
National Institute for Communicable Disease Control and Prevention, China CDC

How to deal with outbreaks

- ***Prevent additional cases in the current outbreak***
- ***Reassure the public***
- ***Minimize economic loss***
- Identify the causing pathogen
- Identify the relationship in isolates
- Identify the scale of the outbreak
- Identify the source and vehicles of pathogens
- Learn what happened, so as to prevent future similar outbreaks
- Learn about a new disease
- Learn something new about an old disease

Current infection disease surveillance system in China

- Infectious diseases electro-reporting system, good
- Laboratory –based surveillance system: single disease
- Data comparable? poor
- Standardized methods ? On the way

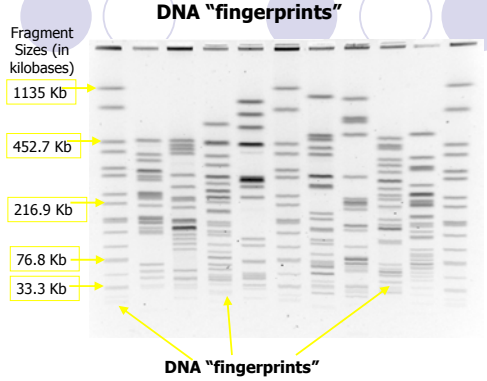
PulseNet China

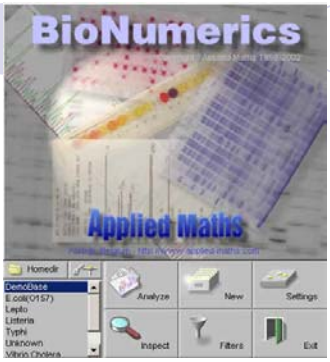
The National Molecular Subtyping Network for Bacterial Pathogens Surveillance

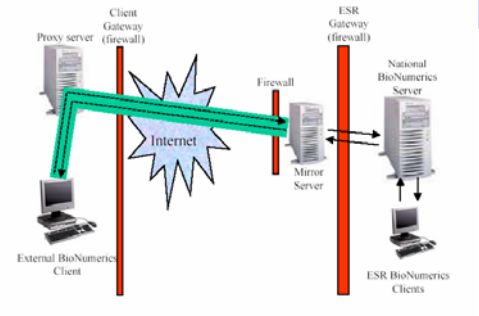
PulseNet China

- September 24, 2004
- Central Lab: National Institute of Communicable Diseases Control and Prevention, China CDC
- Provincial Laboratories

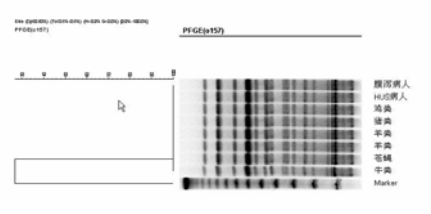
A typical set of *E. coli* O157:H7 DNA "fingerprints"



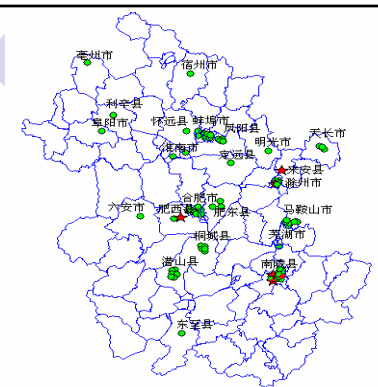




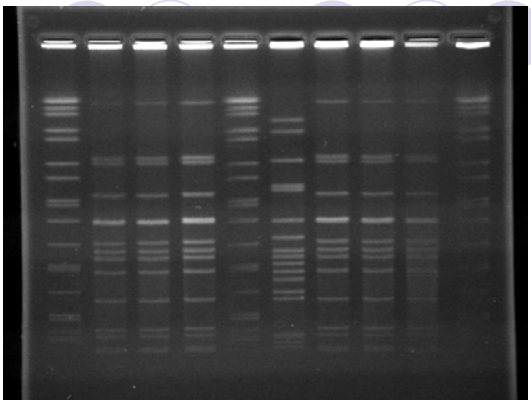
Examples of PulseNet China
in outbreak investigation

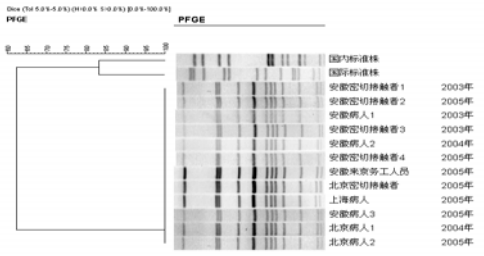


Outbreak caused by E.coli O157:H7 in 1999

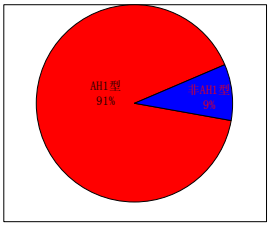


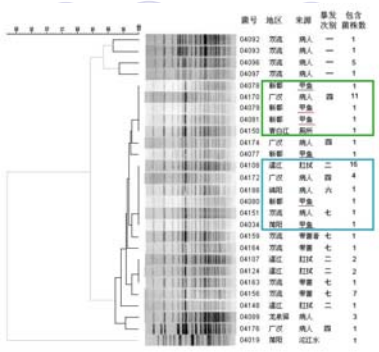
Cases of Meningitis in Anhui Province in 2004/05





Percentage of Type AH1 of Neisseria meningitidis Serogroup C in China





Investigation of Cholera outbreak related with turtles at Sichuan in 2004

PulseNet, a new concept for infectious diseases control and prevention

- Identical equipments
- Identical reagents
- Identical protocols
- Identical software for analysis data
- Trained personals
- Remote data analysis
- Data sharing

New technology

- No experimental variation in results
- Allowing direct inter-laboratory comparisons
- Offer more precise information on strain relatedness than does PFGE.
- Declining costs of DNA sequencing technology
- Simplify subtype data production and analysis
- Improve strain discrimination
- Reduce response time for outbreak investigation and other public health questions.

PulseNet International

- Global collaboration to deal infectious diseases outbreaks and bio-attacks
- **Data sharing among countries**