Original Article

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Clinical epidemiology of HIV/AIDS in China from 2004−2011

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Summary **This study retrospectively analyzed Chinese publicly reported data on Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS). The HIV/AIDS morbidity (1/100,000) and mortality (1/100,000) rates in China continually increased from 0.23 and 0.06 in 2004 to 1.53 and 0.69 in 2011, respectively. The AIDS case fatality rate decreased yearly from 53.57% in 2008 to 45.11% in 2011, and the fatality rate in rural areas (0.25-0.42%) was higher than that in cities (0.13-0.22%). The number of HIV/AIDS patients discharged from city-level hospitals increased from 329 in 2004 to 7,266 in 2011, and this number was higher than the number of similar patients discharged from county-level (rural) hospitals (the number of HIV/AIDS patients increased from 252 in 2004 to 5,957 in 2011). The factors contributing to these trends include: enhanced physician HIV/AIDS education regarding diagnosis, intervention, monitoring, testing, and treatment; improved safety of blood collection and use; and improved management of HIV/AIDS patients. Therefore, HIV/AIDS prevention and control in rural areas of China is the key to reducing HIV transmission and mortality in China.**

Keywords: HIV/AIDS, clinical epidemiology, China

1. Introduction

Among infectious diseases in China, Acquired Immune Deficiency Syndrome (AIDS) has recently become the leading cause of death, and the number of AIDS-related deaths is significantly higher than that due to any other infectious disease (*1*). Epidemiological reports of Human Immunodeficiency Virus (HIV)/AIDS from the United States, Brazil, and South Africa have been published (*2-6*). At present, there are several regional reports on the incidence of HIV/AIDS in China (*7-9*), but national reports of the clinical epidemiology of HIV/AIDS are rare. Therefore, HIV/AIDS prevention and control poses a challenge in China due to the lack of complete and accurate information on the epidemiology of HIV/AIDS. The current study retrospectively analyzed the HIV/AIDS morbidity, mortality, and case fatality rates, as well as hospital discharges in China from 2004 to 2011, to determine the distribution and characteristics of the HIV/AIDS population and provide further information on and guidance for HIV/AIDS prevention and control in China and the rest of the world.

2. Materials and Methods

2.1. *Data sources*

Most of the data in this study were obtained from the "China Public Health Statistics Yearbook (2005-2012)." The number of patients hospitalized each year and treatment outcomes were obtained from the "Statistical Annual Report of Medical Service in China." Data regarding morbidity, mortality, and fatality rates of infectious diseases were obtained from Annual Statistics on Infectious Diseases that Must be Reported by Law in the "Chinese Public Health Statistical Yearbook." These data were collected from a total of 31 regions in China and excluded Hong Kong and Macao.

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2.2. *Definitions*

Morbidity from infectious diseases that must be reported by law = number of cases of infectious diseases that must be reported by law/population × 100,000.

Mortality from infectious diseases that must be reported by law = number of deaths from infectious diseases that must be reported by law/population × 100,000.

Fatality rate from infectious diseases that must be reported by law = number of deaths from infectious diseases that must be reported by law/number of cases × 100%.

Age-specific mortality among males (females) = number of deaths among males (females) of a certain age group/average male (female) population of the same age group.

The number of discharged patients refers to the number of inpatients who were discharged from acute care hospitals.

Urban and rural area classification: urban areas include municipalities and prefecture-level cities while rural areas include counties and county-level cities, towns, and villages.

Urban and rural populations were calculated according to "Regulations on Statistical Classification of Urban and Rural Areas (draft)" released by the National Bureau of Statistics in 1999.

Population refers to the total number of living individuals within a certain area at a certain time point.

2.3. *Statistical analysis*

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 19.0. A chi-square (χ^2) test was performed, and the mean ± standard deviation (S.D.) was determined.

3. Results

3.1. *HIV/AIDS in China*

The HIV/AIDS morbidity, mortality, and fatality rates per year were first determined based on the the total population of China for that year, and then the p value was calculated using a Chi-square (χ^2) test. The HIV/AIDS morbidity rate (1/100,000) and mortality rate (1/100,000) continually increased in China from 2004 to 2011 ($p < 0.01$). The AIDS fatality rate (%) increased from 2004 to 2008 and then decreased yearly from 2009 to 2011 ($p < 0.01$; Figure 1).

Statistical analysis of data from 31 regions in China from 2004−2011 indicated the following: *i*) The regions with the highest HIV/AIDS morbidity rates were Henan Province from 2004 to 2006, Guangxi Province from 2005 to 2011, and Yunnan Province from 2006 to 2011.

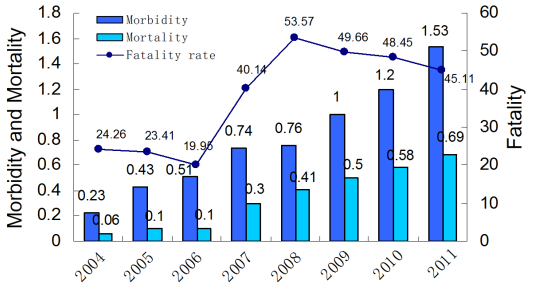

Figure 1. The HIV/AIDS morbidity (1/100,000), mortality (1/100,000), and fatality rates (%) in China from 2004−2011.

ii) The regions with the highest HIV/AIDS mortality rates were Henan Province from 2004 to 2009, Yunnan Province from 2007 to 2011, and Guangxi Province from 2009 to 2011. *iii*) The areas with the highest HIV/AIDS fatality rates included Gansu Province (90.91%) in 2004, Jiangxi Province (66.13%) in 2005, Gansu Province (80%), and the Ningxia Autonomous Region (100%) in 2006, Henan Province in 2008, the Inner Mongolia Autonomous Region (100%) in 2009, Henan and Hainan provinces (100%) in 2010, and Hainan Province (72.92%) in 2011. Regions with low HIV/AIDS fatality rates included Tibet (0%) in 2007 and Beijing (12.68%) in 2008. In addition, the regions with HIV/AIDS morbidity and mortality rates above the national averages were Xinjiang, Sichuan, and Chongqing from 2009 to 2011 (Table 1), while Shanghai had an HIV/AIDS morbidity rate above the national average from 2010 to 2011.

3.2. *HIV/AIDS mortality rate*

The HIV/AIDS mortality rate among Chinese residents from 2004 to 2011: The HIV/AIDS mortality rate in rural areas was higher than that in urban areas of China. In addition, the HIV/AIDS mortality rate among men was higher than that among women ($p < 0.01$; Figure 2).

3.3. *Hospitalization of HIV/AIDS patients in China*

Distribution by age groups. HIV/AIDS patients discharged from Chinese hospitals from 2004 to 2011 fell primarily into three age groups: 15-44 years, 45-59 years, and 60 years and older. The proportion of HIV/AIDS patients who were younger decreased from 72.7% in 2004 to 55.5% in 2011, the proportion of middle-aged patients increased from 18.3% to 27.1%, and the proportion of elderly patients increased from 6.6% to 15% (Figure 3). Men accounted for the majority of HIV/AIDS patients among individuals aged 60 years and older ($p < 0.01$).

Differences between rural and urban areas. From 2004 to 2011, the number of HIV/AIDS patients discharged from city-level hospitals was higher than that of HIV/AIDS patients discharged from county-level (rural) hospitals ($p > 0.05$) (Figure 4).

Table 1. Morbidity, mortality and fatality rates in China and six of it's regions from 2004-2011

Year	2004			2005			2006			2007			2008			2009			2010			2011		
Parameters	MBR	MTR	FR	MBR	MTR	FR	MBR	MTR	FR	MBR	MTR	FR	MBR	MTR	FR	MBR	MTR	FR	MBR	MTR	FR	MBR	MTR	FR
National averages	0.23	0.06	24.26	0.43	0.1	23.41	0.51	0.1	19.95	0.74	0.3	40.14	0.76	0.41	53.57	1	0.5	49.66	1.2	0.58	48.45	1.53	0.69	45.11
Guangxi	0.7	0.11	15.54	1.85	0.19	10.18	2.67	0.18	6.59	5.17	0.66	12.7	5	1.23	24.6	7.31	2.27	31.11	8.41	3.09	36.72	10.88	4.35	40.01
Yunnan	0.68	0.24	35.23	0.72	0.18	25.08	1.86	0.26	13.75	3.26	1.19	36.53	3.77	1.69	44.86	4.49	2.1	46.91	4.81	2.37	49.32	5.92	2.74	46.38
Xinjiang	0.1	0.03	27.78	0.53	0.03	5.77	1.33	0.06	4.48	1.23	0.19	15.42	1.04	0.72	69.27	1.91	1.2	62.81	2.5	1.65	66.05	3.18	2.05	64.65
Sichuan	0.11	0.04	35.29	0.11	0.04	33.33	0.16	0.06	39.55	0.5	0.26	51.34	0.67	0.39	58.75	1.06	0.53	49.6	1.94	0.97	50.19	2.68	1.26	46.94
Chongqing	0.06	0.03	39.29	0.15	0.05	32.61	0.16	0.06	35.56	0.34	0.12	34.74	0.65	0.34	52.75	1.06	0.55	52.16	1.49	0.67	44.94	2.54	1	39.24
Henan	1.35	0.2	14.9	2.35	0.59	25.2	2.28	0.53	23.2	2.44	1.81	74.18	1.91	1.96	102.86	1.96	1.84	93.84	1.58	1.54	97.6	1.86	1.44	77.4

Note: The data were obtained from the "China Public Health Statistics Yearbook" (2010-2012); MBR = Morbidity rate(1/100,000); MTR = Mortality rate(1/100,000); FR = Fatality rate (%).

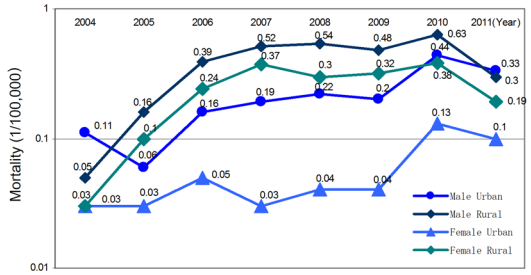

Figure 2. Gender-specific HIV/AIDS mortality rates (1/100,000) in rural and urban areas of China from 2004–2011.

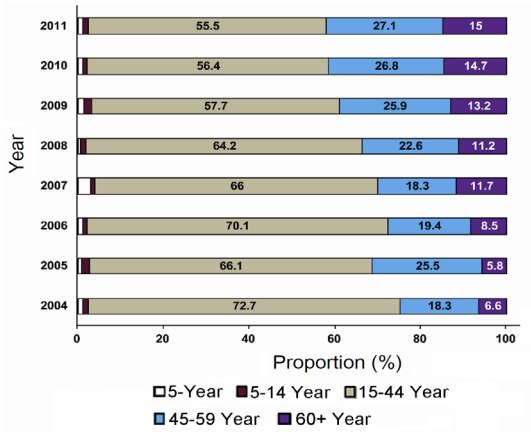

Figure 3. Age-specific proportions (%) of HIV/AIDS patients discharged from Chinese hospitals from 2004-2011.

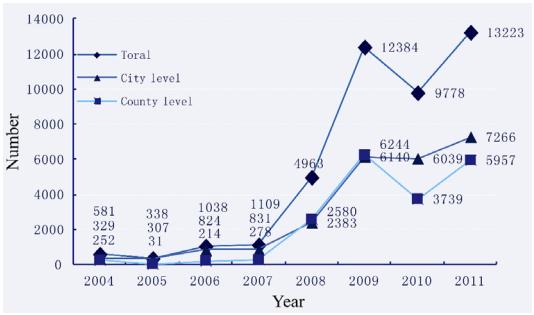

Figure 4. Number of HIV/AIDS patients discharged from Chinese hospitals from 2004-2011 (person) (total, city-level and county-level hospitals).

4. Discussion

4.1. *HIV/AIDS morbidity and mortality rates in China are continuing to increase*

The high HIV/AIDS morbidity rate in Henan Province was mainly due to the illegal selling of blood by poor donors (selling blood is illegal in China). This rate has decreased since 2007, as the government took great measures to crack down on the illegal blood trade (*10*). Guangxi and Yunnan are close to the Golden Triangle in Burma, where injectable drug use was once the main source of HIV transmission, but unprotected sex has recently become a major source of HIV transmission

(*10*). Studies in Guangxi found that most HIV/AIDS patients come from low-income families. HIV/AIDS patients in Yunnan Province primarily live in regions such as Honghe and Dehong (*11*). The HIV/AIDS morbidity rate continually increased in China from 2004 to 2011, primarily due to the high morbidity rates in these three provinces. In addition, the HIV/AIDS morbidity and mortality rates in Xinjiang, Sichuan, and Chongqing were higher than the national averages, with injectable drug use and sexual activity serving as the main modes of HIV transmission. These issues, as well as an increase in men having sex with men and HIV transmission between married couples, lack of services to prevent mother-to-child HIV transmission, and an increased resistance to anti-HIV drugs, are common in these regions.

The HIV/AIDS mortality rate in Henan Province decreased significantly when the morbidity rate was controlled, as high morbidity is always associated with high mortality (*1*). Yunnan Province is closer to Burma than Guangxi Province, and HIV transmission through transnational marriage is more common in Yunnan. The HIV/AIDS mortality rate continually increased in China from 2004 to 2011, primarily due to the high mortality rates in these three provinces.

4.2. *The HIV/AIDS fatality rate in China has continually decreased since 2009*

Despite the continuous increase in HIV/AIDS morbidity and mortality rates and the limited availability of anti-HIV drugs in China, the HIV/AIDS fatality rate has been effectively controlled, as many local governments have made great efforts to prevent and control HIV/AIDS. The "Four Frees and One Care" policy (free screening test, free treatment of poor AIDS patients, free schooling for orphans of AIDS patients, free counseling and antiretroviral therapy for pregnant women with HIV, and social assistance for affected households) is one such measure. However, some regions continue to suffer from a shortage of health care services, an increase in anti-HIV drug resistance, and inadequate attention to HIV/AIDS prevention and control, resulting in higher than national average fatality rates. These regions include Gansu, Ningxia, Inner Mongolia, and Jiangxi, where the economic conditions are relatively poor. The HIV/AIDS fatality rate increased in these provinces due to multiple factors, including a poor economy, a lack of health care services, individuals not wishing to be tested, patients not wishing to disclose their status, lack of early treatment, and opportunistic infections (*12,13*). Data from Hainan showed that high HIV/AIDS fatality rates increased for two years running. Therefore, the rate of HIV detection must increase and early treatment must be provided to HIV/AIDS patients in this province. According to current statistics, the HIV/AIDS fatality rates in Guangxi and Yunnan will probably increase in the near future. The low HIV/AIDS fatality rate in Tibet might be due to the low rate of HIV detection due to factors including its remote geographic location, health care conditions, and religion. Beijing is the political and cultural center of the country, with a booming economy and the country's best health care services. Therefore, the residents of Beijing are more aware of the importance of HIV prevention (*10*). Accordingly, Beijing had a low HIV/AIDS fatality rate in 2008.

4.3. *Differences between HIV/AIDS patients in rural and urban areas*

Rural areas of China are relatively poor, with high rates of drug use and unprotected sex. Low awareness of HIV/AIDS prevention and a lack of heath care service are more common in rural areas than in urban areas. HIV/AIDS typically remains undetected until the late stage of the disease. Therefore, the HIV/AIDS fatality rate in rural areas is higher than that in urban areas. This also means that the HIV/AIDS fatality rate is higher among HIV/AIDS patients who live in the poor regions of China.

Although the number of hospitalized HIV/AIDS patients in China increased from 581 in 2004 to 13,223 in 2011, this only accounted for a small proportion of the HIV/AIDS patients in China, as the number of new cases in China in 2011 totaled 20,450 (*1*). Rural areas had fewer hospitalized HIV/AIDS patients than did cities.

4.4. *Availability of HIV/AIDS specialists in China*

The proportion of Chinese physicians specializing infectious diseases dropped from 2.4% in 2005 to 0.9% in 2011. A three-tier medical treatment system has been established in China where general hospitals are the principal care provider, specialized hospitals provide backup, and basic medical and health facilities are auxiliaries. In 2011, 39.04% of Chinese medical and health facilities were general hospitals and these facilities outnumber specialized hospitals by 6.75 to 1. In addition, 44.63% of practitioners worked in general hospitals. The proportion of medical practitioners caring for urban and rural populations in China differed, with 2.78 physicians per 1,000 individuals in urban areas and 0.96 physicians per 1,000 individuals in rural areas in 2011. There are 164 infectious disease hospitals and 9,307 practicing physicians in China in 2011, and 135 hospitals were located in cities while only 29 were located in rural areas. There were 10,219,397 visits for outpatient services compared to 662,258 hospitalizations. The number of urban HIV patients exceeded that of rural patients by 1.22-fold (*1*). Overall, the outlook for general hospitals is more hopeful than that for specialized hospitals in China.

A huge workload and low income are the main causes of the high rate of turnover for doctors working in infectious disease hospitals. Based on these data, China is clearly experiencing a severe shortage of physicians, particularly in rural areas where there is a higher demand for HIV/AIDS health care professionals.

4.5. *Economic burden of HIV/AIDS care*

The estimated number of HIV/AIDS patients in China was approximately 780,000 until the end of 2011; of these, only 154,000 were AIDS patients and 48,000 were newly discovered cases (*14*). That means that approximately 578,000 cases were undetected. The average annual income per person in 2011 was 23,979.2 RMB in urban areas of China and 9,833.1 RMB in rural areas. The hospitalization cost was 7,108.2 RMB per discharged HIV/AIDS patient in China in 2011 (*1*). The total hospitalization cost could be as high as 93,990,000 RMB when calculated on the basis of 13,223 hospitalized patients. If the total hospitalization cost is calculated on the basis of 154,000 HIV/AIDS patients, then it would be a sizable economic burden for China. The financial cost of HIV/AIDS treatment is also a major financial burden for individual patients, particularly for those from poor regions, as not all care is covered by the government.

Hospitalized HIV/AIDS patients in China are primarily in the age range of 15-44 years. These young patients tend to work far from home, being part of the migrant population in cities (*10,15*). They may also transmit HIV to their sexual partners, many of whom might become pregnant. Not only are the life expectancy and quality of life of individuals with HIV affected, but many of their children become orphaned and represent a major societal burden (*6,16-18*).

The number of HIV/AIDS patients aged 60 years and older has increased. One reason is because many HIV/AIDS patients who were infected with HIV at a younger age have become older and fallen into this age group. In addition, male patients account for the majority of patients in this age group. Men over 60 still desire sex, regardless of whether they are from cities or rural areas. However, many of these individuals lack awareness of HIV prevention and rarely use condoms, thus increasing the rate of HIV infection (*10-12*).

4.6. *Measures taken by the Chinese Government to improve HIV/AIDS care*

The number of hospitalized HIV/AIDS patients is rather low in China and most of these patients receive treatment at city-level hospitals. This includes some rural patients who cannot receive appropriate treatment at local hospitals due to the lack of medical resources and poor economic conditions. Since the majority of HIV/AIDS patients live in poor rural areas of China, controlling HIV/AIDS morbidity and mortality rates in rural areas is difficult since county-level hospitals cannot provide appropriate diagnostic and treatment services. Therefore, the overall HIV/AIDS epidemic in China will be a challenge to control, and rural areas should be key targets for HIV/AIDS prevention and control in China. Public education of HIV prevention should be provided to increase awareness. The government's "Four Free and One Care" policy (free screening test, free treatment for poor AIDS patients, free schooling for orphans of AIDS patients, free counseling and antiretroviral therapy for HIV-infected pregnant women, and care and economic assistance to affected households) needs to be implemented in these areas. Long-distance medical services and knowledge sharing (*19,20*) are also keys to HIV/AIDS control in China, particularly in the poor regions.

The Chinese Government has directed great attention to the prevention and control of HIV/AIDS. Although problems such as the availability of many commercial and free anti-HIV medications remain because China is a developing country, the Government has taken important measures to prevent and control HIV/AIDS in China. These efforts include establishing the Classification and Diagnostic Criteria of HIV/AIDS for Adolescents and Adults and publishing materials such as the "National Manual for Free Antiretroviral Treatment of HIV/AIDS" and the "Guidelines on Diagnosis and Treatment of HIV/AIDS." In January 2012, the first 58 clinical pathways for diagnosis and treatment of HIV/AIDS and related diseases in China were recommended by the Clinical Pathway Pilot Project of the Ministry of Health of the People's Republic of China (*21*). At present, there are a total of 32 approved anti-HIV drugs from six major classes available in China. The recommended standard protocols include: highly active antiretroviral therapy (HAART): two nucleotide reverse transcriptase inhibitors (NRTIs) plus one NNRTI; or two NRTIs plus a boosted protease inhibitor (PI) (with ritonavir); and if necessary, combinations of three NRTIs. Since the availability of anti-HIV drugs in China is limited, the first-line regimen for patients who have not received any prior anti-virus medications is zidovudine (AZT) or stavudine (d4T) plus lamivudine (3TC) plus nevirapine (NVP) or efavirenz (EFV). For patients who fail to respond to the first-line regimen, the second-line regimen is tenofovir disoproxil fumarate (TDF) (abacavir [ABC] for children) plus 3TC + r (*22*). In January 2012, the "Notice regarding Publication of China's 12-Year Action Plan to Contain and Control HIV/AIDS" was issued by the General Office of the State Council of the People's Republic of China. This official document stated that the number of new HIV/AIDS cases should decrease by 25% and the fatality rate should decrease by 30% at the end of 2015 compared to 2010, and the total number of HIV/AIDS

patients should be less than 1,200,000 (*23*). Local governments at various levels are required to expand HIV/AIDS education and intervention, increase the safety of blood collection and use to prevent iatrogenic transmission, expand HIV/AIDS monitoring, testing, and treatment, improve services for and management of HIV/AIDS patients, and provide classification guidelines. Therefore, the Chinese Government is clearly determined to prevent and control HIV/AIDS.

In conclusion, information regarding the epidemiologic features of HIV/AIDS in China and early outcomes of government policies is the key to controlling the HIV/AIDS pandemic in China. This information can help with HIV/AIDS prevention and control around the world. Effective measures to control the HIV/AIDS pandemic in China include taking additional measures to surveil and monitor HIV infection among the migrant worker population in cities, among men over age 60, and in poor regions with high HIV/AIDS morbidity rates (*10,12,24-25*).

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