Original Article

Estimation and Projection of HIV/AIDS Epidemic and Treatment Demand in Beijing and Hunan Province with Spectrum

Ning Ma¹, Min Liu^{1*}, Min Zheng¹, Xi Chen², Hong-yan Lu³, Hong-guang Chen¹, Jun Zheng², Gui-ying Li³, Juan Wang³, Guo-wu Liu³ and Ning Wang⁴

Objective To estimate the HIV/AIDS epidemic and treatment demand and predict the situation in the next five years with Spectrum.

Methods Using Spectrum (version:3.54) to estimate the number of new HIV infections, number of people living with HIV, need for ART in adults and children, need for PMTCT and cotrimoxazole in Beijing and Hunan Province. Data used in the model including high-risk populations monitoring data and demographic information, was collected from Beijing Center for Disease Control and Prevention, Hunan Center for Disease Control and Prevention and extracted from statistical yearbooks and published literatures.

Results Few new HIV/AIDS were reported in Beijing prior to 1994, however, the number of HIV infections was increasing rapidly from 1995 to 2008, and decreased after that, increased rapidly again after 2012. The number of patients who need antiretroviral treatment was increasing among the group aged between 15-49 years with young patients aged 15-24 years peaked in 2010 and decreased rapidly after that. Few HIV-infected patients were reported before 1997 in Hunan Province, and the number of new infections was increasing rapidly since 1998. The number of patients who need antiretroviral treatment was increasing among the group aged between 15 - 49 years since 2000 with young patients aged 15-24 years in need of antiretroviral therapy increasing continuously.

Conclusions After HIV infection was first founded in Beijing and Hunan Province, there was a slow growth and then a rapid growth of HIV epidemic. According to prediction of Spectrum, the demand for antiretroviral therapy in Beijing would begin to decline since 2011, meanwhile, the HIV epidemic in Hunan Province would enter a rapid growth period with the demand for antiviral therapy continuing to increase. In this study, Spectrum was applied to estimate the HIV epidemic situation and need for treatment in the next five years in Beijing and Hunan Province. It provides the basis for health resource allocation and policy formulation of HIV management.

Key words: Acquired immune deficiency syndrome; Spectrum; Epidemic estimation; Antiretroviral therapy

Since the first AIDS case was detected among gay population in the United States in 1981, the number of new infections and deaths due to AIDS increased worldwide year by year, making HIV/AIDS the most widely spread disease worldwide and most far-reaching public health problem.¹ The first AIDS case was introduced into China in 1985 and entered into a period of wide range epidemic from 1995 before experiencing period of the input distribution and local epidemic. And now, HIV infections have been reported in all 31 provinces (autonomous regions and

municipalities) in China. It was reported by China's Ministry of Health before the eve of world AIDS day of 2010 that 37 million cases of accumulated HIV infections was found in China at the end of October in 2010, including more than 13 million AIDS patients, and nearly 70,000 deaths, demonstrating a low level epidemic overall with difference both in different regions and different populations, and diverse in the popular mode. The number of HIV/AIDS would continue to grow in the next period.¹

Large gap existed in China between the number of reported cases and actual cases due to the special nature of HIV high risk populations, occult of HIV infections, and social discrimination to HIV infections and AIDS patients. Recent studies showed that antiretroviral therapy would not only reduce mortality in AIDS patients,² it could also be used as a means to prevent HIV infection in certain high-risk groups,³⁻⁵ implicating

¹Department of Epidemiology & Biostatistics, School of Public Health, Peking University, Beijing 100871, China

²Hunan Provincial Center of Disease Prevention and Control, Changsha 410005, China

³Beijing Center for Disease Control and Prevention, Beijing 100013, China

⁴Chinese Center for Disease Control and Prevention, National Center for AIDS/STD Control and Prevention, Beijing 102206, China

*Correspondence: Min Liu, E-mail: liumin@bjmu.edu.cn

that model was necessary to be used to estimate the number of HIV infections and the number of AIDS patients in order to control the epidemic's development effectively and allocate health resources rationally. And then, selection of suitable and convenient estimation and forecast models was particular necessary.

To further understand the current situation of China's HIV/AIDS epidemic, estimate and forecast the development trend of the epidemic, allocate health resources rationally, and provide basis for developing strategies for HIV/AIDS control and prevention, Spectrum⁶ was used to estimate the AIDS epidemic and predict the epidemic trend in the next 5 years in Beijing and Hunan Province with the results reported below.

MATERIALS AND METHODS

Materials

Routine monitoring data

HIV/AIDS epidemic data in Beijing was from the Beijing Center for Disease Control and Prevention

by sentinel surveillance including injecting drug users in Beijing (2000 - 2010), MSM (2004 - 2010), commercial sex workers (1997 - 2010), clients (2004 - 2009), and maternal outpatient (2004 - 2009). HIV/AIDS epidemic data in population was from the Hunan Center for Disease Control and Prevention by sentinel surveillance including injecting drug users (1998 - 2007), MSM (2003 - 2009), commercial sex workers (1999 -2009), and the general population (2002 -2009).

Literatures

Beijing Statistical Yearbooks and related literatures published publicly about the HIV/AIDS infection and HIV high risk populations in Beijing were used, such as HIV prevalence rate among clients was from the literatures based on monitoring data targeted Beijing clients population;⁷ HIV prevalence rate among general population was from literatures based on large-scale non-related detection implemented in Beijing.⁸⁻¹¹ Hunan Statistical Yearbook and literatures and published publicly about the HIV/AIDS infection and HIV high risk populations in Hunan province were used, including injecting drug users, sex workers, clients

Table 1. Estimations on the number of HIV/AIDS in Beijing with Spectrum

Year	Living with HIV			New infections		
	Total	Male	Female	Total	Male	Female
1985	0	0	0	0	0	0
1986	6	5	1	6	5	1
1987	7	6	1	0	0	0
1988	13	11	2	6	5	1
1989	13	11	2	0	0	0
1990	21	17	4	7	6	1
1991	27	22	5	8	6	2
1992	35	28	7	8	6	2
1993	50	40	10	15	12	3
1994	72	57	15	23	18	5
1995	138	108	30	68	53	15
1996	214	166	48	77	59	18
1997	337	259	78	125	95	30
1998	545	416	129	213	161	52
1999	841	638	203	303	228	75
2000	1206	910	296	377	281	96
2001	1588	1191	397	400	296	104
2002	1958	1461	497	402	295	107
2003	2342	1738	604	431	315	116
2004	2788	2059	729	515	376	139
2005	3316	2439	877	603	438	165
2006	3922	2872	1050	688	497	191
2007	4568	3332	1236	750	540	210
2008	5162	3751	1411	717	514	203
2009	5706	4131	1575	670	477	193
2010	6215	4484	1731	633	448	185
2011	6537	4700	1837	626	445	181
2012	6657	4770	1887	452	319	133
2013	6819	4870	1949	541	383	158
2014	7009	4990	2019	610	433	177
2015	7228	5131	2097	675	479	196

and part of the general population's HIV prevalence data.^{12,13} In addition, demographic information such as total fertility rate each year, the annual age-specific fertility rates, the annual sex ratio at birth, life expectancy of men and women each year, the life table models in this study was from the data reported in "World Population Prospects (version 2008)".

Methods

HIV prevalence rate estimation

HIV prevalence rate used in Spectrum was estimated by Estimation and Projection Package (EPP) in previous study.^{14,15}

Before HIV prevalence rate estimation, total population aged over 15 years in Beijing and Hunan province was calculated by accounting for the proportion of population with 15 to 49 years old in

the population aged over 15 years. Among them, population aged 15 to 49 years was in line with the ones used in Workbook model for epidemic estimation in Beijing and Hunan Province Center for Disease Control and Prevention in 2009. Size estimation of high risk populations in this study was calculated by averaging the high and low base value of various high risk population estimated by Workbook model. In addition, part of the demographic characteristics data on the injecting drug users was from recommendation of the model: Male's proportion in IDU population: 0.9, annual excess mortality rate of IDU: 1.07%.

Population size estimation in Beijing and Hunan Province

Time span from 1982 to 2015 was defined in the Spectrum in this study. The demographic data used for the study included: the number of male and

Figure 1. Estimations on the number of people living with HIV in Beijing with Spectrum.

Notes: This figure showed the estimated number of people living with HIV in Beijing. The red line represents the number in men and the green line represents the number in women. The blue line represents the total number.

Figure 2. Estimations on the number of new HIV infections in Beijing with Spectrum.

Notes: This figure showed the estimated number of new HIV infections in Beijing. The red line represents the number in men and the green line represents the number in women. The blue line represents the total number.

Table 2. Estimations on the number of HIV/AIDS in Hunan Province with Spectrum

Year	Living with HIV			New infections		
	Total	Male	Female	Total	Male	Female
1985	3	2	1	0	0	0
1986	3	3	1	0	0	0
1987	6	5	1	4	3	1
1988	606	470	136	600	465	135
1989	728	562	166	129	98	31
1990	845	650	195	134	101	33
1991	980	750	230	162	121	41
1992	1155	878	277	214	159	55
1993	1333	1006	327	231	170	61
1994	1548	1161	387	282	207	75
1995	1821	1356	465	355	259	96
1996	2187	1617	570	464	337	127
1997	2710	1990	720	641	464	177
1998	3504	2557	947	937	676	261
1999	4765	3458	1307	1434	1032	402
2000	6744	4872	1872	2195	1577	618
2001	9478	6823	2655	3015	2162	853
2002	12490	8967	3523	3386	2423	963
2003	15243	10919	4324	3254	2324	930
2004	17504	12509	4995	2918	2078	840
2005	19331	13783	5548	2661	1892	769
2006	20907	14874	6033	2596	1845	751
2007	22427	15922	6505	2727	1939	788
2008	24069	17057	7012	3030	2157	873
2009	25984	18388	7596	3480	2481	999
2010	28297	20007	8290	4052	2893	1159
2011	31169	22030	9139	4785	3421	1364
2012	34762	24548	10178	5656	4049	1607
2013	39052	27622	11430	6628	4749	1879
2014	44171	31268	12903	7651	5487	2164
2015	50034	35450	14584	8662	6216	2446

female age-specific population in the initial forecast year, the annual total fertility rate, the annual age-specific fertility rates, the annual sex ratio at birth, life expectancy of men and women each year, life table model, men and women net flow population and so on. Among them, age-specific populations of Beijing in 1982 were calculated based on the third population census and age-specific rates from Beijing population sample survey in 1987. Age-specific populations of Hunan province in 1982 were calculated based on the third population census and age-specific rates from Hunan population sample survey in 1991. The other indexes were from the reference of the model ever being used as United Nations "World Population Prospects (version 2008)".

HIV epidemic and treatment demand evaluation

Spectrum (Version: 3.54) was applied to estimate and predict HIV/AIDS epidemic and treatment demand in Beijing and Hunan Province. Spectrum was a policy models with demographic projections as its core, meanwhile including forecasting and analysis of other modular. AIM module was used in this study to estimate the HIV/AIDS epidemic and forecast the impact. Based on demographic projections, AIM module read the infection rate's predictive value from the EPP and combined with data on HIV incidence and death to estimate HIV infection.

Quality Control

Surveillance data from Beijing and Hunan CDC and publicly published literatures were integrated to be

Figure 3. Estimations on the number of people living with HIV in Hunan Province with Spectrum.

Notes: This figure showed the estimated number of people living with HIV in Hunan Province. The red line represents the number in men and the green line represents the number in women. The blue line represents the total number.

Figure 4. Estimations on the number of new HIV infections in Hunan Province with Spectrum.

Notes: This figure showed the estimated number of new HIV infections in Hunan Province. The red line represents the number in men and the green line represents the number in women. The blue line represents the total number.

used, taking high priority on literates and sharing the same field with this study, if still not enough, referring to the relevant provinces in China, with reference to foreign data if necessary. Assurance of the data's authenticity, combined with best fitness to the model's characters, in order to improve accuracy of the results.

RESULTS

Overall estimation on the HIV/AIDS epidemic in Beijing with Spectrum

Overall estimation results on HIV/AIDS epidemic in Beijing was shown in Table 1. Very few HIV infections emerged every year before 1994, with HIV infection increasing slowly. Since 1995, the number of HIV infections was increasing rapidly and reached a peak

by 2008; there was a brief plateau period from 2000 to 2003, during which the number of new HIV infections changed a little; after 2008, the number of new HIV infections decreased and even fell to a low level in 2012, then increased again rapidly (Figure 1 and Figure 2). Male to female ratio in HIV infections gradually decreased, with the ratio no less than 4 before 1994, 3 by 2000, 2.6 by 2010, even less than 2.5 in 2015.

Overall estimation on the HIV/AIDS epidemic in Hunan Province with Spectrum

Overall estimation results on Hunan's HIV/AIDS epidemic was shown in Table 2. As shown in Figure 3 and Figure 4, very few HIV infections emerged each year before 1997, with existing HIV infection increasing slowly. Since 1998, the number of HIV

Table 3. Estimations on the number of HIV infection and need for ART of adult aged over 15 years old in Beijing with Spectrum

Year	Aged 15 - 49 years old		Aged over 15 years old		Aged 15 - 24 years old	
	HIV infection	Need for ART	HIV infection	Need for ART	HIV infection	Need for ART
1985	0	0	0	0	0	0
1986	6	0	6	0	2	0
1987	6	0	6	0	2	0
1988	12	0	13	0	5	0
1989	13	1	13	1	4	0
1990	19	1	20	2	7	0
1991	26	2	27	2	9	1
1992	33	3	35	3	12	1
1993	47	4	50	5	16	1
1994	68	6	72	6	23	2
1995	129	8	138	9	44	2
1996	199	13	213	14	66	3
1997	310	20	335	22	98	5
1998	499	31	542	34	154	7
1999	768	49	836	54	230	11
2000	1097	77	1199	86	325	17
2001	1437	117	1577	131	423	24
2002	1763	169	1944	191	515	34
2003	2095	232	2322	264	622	47
2004	2484	303	2763	347	751	61
2005	2939	382	3285	442	916	137
2006	3459	478	3883	558	1105	204
2007	3989	607	4520	714	1298	263
2008	4472	745	5103	885	1390	448
2009	4900	1606	5635	1916	1466	881
2010	5273	1892	6131	2280	1511	1265
2011	5489	2076	6440	2526	1521	350
2012	5530	2268	6546	2785	1480	357
2013	5602	2426	6696	3006	1466	357
2014	5697	2551	6873	3189	1465	356
2015	5823	2647	7082	3337	1494	356

infections was increasing rapidly and reached a peak by 2004 with more than 3000 new infections; there was a brief plateau period from 2003 to 2006; after that, the number of new HIV infections increased rapidly and would exceed 5000 in 2014 and 6000 in 2015. Male to female ratio in HIV infections decreased gradually, with the ratio no less than 3 before 1994, remaining 2.4-2.5 since 2000. However, the proportion in the new infections increased.

Estimations on AIDS treatment demand in Beijing with Spectrum

Estimations and projections of HIV infections in each age group and its need for HIV-infected antiretroviral therapy were shown in Table 3. HIV epidemic trends among groups with age of 15-49 years old and adult population age above 15 years old were broadly

consistent with the model's estimation in Beijing, while the group aged 15-24 years showed a little different that number of HIV infections remained at level of 1,400 to 1,500 after 2008; HIV infections among groups aged 15-49 years and adults over 15 years old who need antiretroviral treatment were growing at a lower level before 2008. After that, the number was rapidly increasing and over 1500 in 2009, over 2,000 in 2011; HIV infections in need of antiretroviral treatment among groups aged 15-24 years would continue to increase by 2010 and reached a peak in 2010 (1265), then decreased rapidly, and maintained at a lower level after 2011 (Figure 5).

As shown in Table 4 and Figure 6, the cotrimoxazole and antiretroviral treatment requirements for HIV-infected children under the age of 14 years old increased gradually in Beijing and no clear slowing

Table 4. Estimations on the number of need for PMTCT and treatment among HIV(+) children in Beijing with Spectrum

Year	Number of need for PMTCT	Number of need for ART	Number of need for cotrimoxazole
1985	0	0	0
1986	0	0	0
1987	0	0	0
1988	0	0	0
1989	0	0	0
1990	0	0	0
1991	0	0	0
1992	0	0	1
1993	0	0	1
1994	1	0	1
1995	1	0	2
1996	2	1	3
1997	3	1	5
1998	4	1	9
1999	7	2	13
2000	10	3	20
2001	14	5	27
2002	17	6	35
2003	20	8	44
2004	25	11	55
2005	30	13	68
2006	37	17	83
2007	44	29	101
2008	51	35	120
2009	58	41	140
2010	64	60	159
2011	69	68	176
2012	72	76	191
2013	72	82	202
2014	73	88	213
2015	75	93	225

trend showed over time. There would be nearly 100 children under the age of 14 years old in need of receiving antiretroviral therapy by 2015. Requirement of antiretroviral treatment for PMTCT was growing rapidly before 2010, with over 50 cases in 2008, and gradually stabilized after 2011, then by 2015, there would be 75 pregnant women in need of antiretroviral treatment to prevent mother to child transmission.

Estimations on AIDS treatment demand in Hunan Province with Spectrum

Estimations and projections of HIV infections in each age group and its need for antiretroviral therapy were shown in Table 5. As shown in Figure 7, HIV epidemic trends among groups aged 15 - 49 years and adult population aged above 15 years were broadly consistent with the model's estimation in Hunan Province, while the group aged 15-24 years showed a little difference that number of HIV infections in this group remained

around 5000 after 2004, and rapidly increased again after 2012. The number of HIV infections among groups aged 15 - 49 years and adults over 15 years old who need antiretroviral treatment was growing rapidly after 2000, and would exceed 1000 by 2002, over 5000 after 2010. HIV infections in need of antiretroviral treatment among group aged 15-24 years would continue to increase by 2006, and then entered into a relative stable period by 2012, and increase rapidly again after that.

As shown in Table 6 and Figure 8, the cotrimoxazole and antiretroviral treatment requirements for HIV-infected children under 14 years increased gradually in Hunan Province and no clear slowing trend showed as time goes on. There would be nearly 600 children under 14 years old in need of receiving antiretroviral therapy by 2015. Requirement of antiretroviral treatment for PMTCT was growing rapidly before 2006, and after that with a slowing growth period, rapidly increasing

Table 5. Estimations on the number of HIV infection and need for ART of adult aged over 15 years old in Hunan Province with Spectrum

Year	Aged 15 - 49 years old		Aged over 15 years old		Aged 15 - 24 years old	
	HIV infection	Need for ART	HIV infection	Need for ART	HIV infection	Need for ART
1985	3	0	3	0	1	0
1986	3	0	3	0	1	0
1987	6	0	7	0	2	0
1988	588	1	605	1	217	0
1989	700	19	724	19	240	6
1990	805	47	839	50	257	14
1991	925	80	971	85	278	22
1992	1082	115	1142	123	311	29
1993	1241	152	1316	164	340	34
1994	1434	190	1527	207	380	37
1995	1681	231	1795	254	436	40
1996	2015	275	2155	306	522	43
1997	2500	327	2672	366	660	48
1998	3243	390	3458	439	888	56
1999	4431	475	4707	536	1271	72
2000	6302	597	6669	672	1879	98
2001	8886	780	9378	874	2703	140
2002	11709	1051	12357	1171	3545	202
2003	14246	1421	15069	1576	4203	282
2004	16271	1873	17282	2075	4607	371
2005	17848	2374	19057	2635	4803	454
2006	19163	2889	20578	3221	4881	518
2007	20411	3393	22042	3806	4931	557
2008	21768	3871	23625	4375	5034	572
2009	23386	4321	25481	4924	5254	573
2010	25384	4754	27732	5462	5641	572
2011	27917	5188	30537	6006	6251	582
2012	31104	5646	34024	6580	7112	617
2013	35019	6160	38273	7214	8221	681
2014	39676	6757	43305	7938	9548	776
2015	45016	7468	49070	8785	11037	900

again after 2010, with over 200 cases in 2004, and over 400 in 2012. By 2015, there would be 600 pregnant women in need of antiretroviral treatment to prevent mother to child transmission.

DISCUSSION

Characteristics and application of the Spectrum

Spectrum used for estimating and projecting the HIV/AIDS epidemic was developed based on Epimodel by WHO and UNAIDS at the beginning of this century.⁶⁻¹⁵ Spectrum was a statistical prediction model based on demographic statistics, and AIDS Impact Model was one of its modules mainly used to perform HIV/AIDS epidemic estimation and projection. Spectrum can read the estimated HIV infection results from EPP model and workbook model, combined with epidemiological

study data on HIV incidence and death, based on demographic model DemProj, to estimate the number of HIV infections, AIDS cases and deaths.¹⁶ Estimation results of Spectrum depended not only on the accuracy of estimated HIV infection rate, but also on the results of demographic projections. If demographic indicators available were accurate and enough, then the predictions would be more accurate.

Spectrum was based on population growth projection and combined with the epidemiological characteristics of HIV infection and estimated infection rates from other model, to calculate HIV infection and its further impact on the social and economic. The model could work out lots of helpful indicators, including number in need of treatment (including adults, PMTCT, child), the estimated treatment cost, the estimated number of orphans caused by AIDS, the

Figure 5. Estimations on the number of HIV infection and need for ART of adult aged over 15 years old in Beijing with Spectrum.

Notes: This figure showed the estimated number of people living with HIV and need for ART in Beijing. The sky blue line represents the number of people aged 15 to 24 living with HIV and the orange line is the number of people need for ART in this group. The green line represents the number of people above 15 years old living with HIV and the orange line represents the number of people need for ART in this group. The dark blue line represents the number of people aged 15 to 49 living with HIV and the orange line represents the number of people need for ART in this group.

Figure 6. Estimations on the need for PMTCT and treatment among HIV+ children in Beijing with Spectrum.

Notes: This figure showed the estimated number of HIV positive children in need of PMTCT and treatment in Beijing. The red line represents the children need for ART. The blue line represents the children need for PMTCT and the green line represents the number of children in need for cotrimoxazole.

number of TB/HIV, providing a basis for decision-makers.¹⁶

Spectrum's estimation on HIV/AIDS epidemic was based on demographic projections model, which was a policy model with its analysis results including no contents on transmission mode and epidemiological characteristics, etc., with the content of AIDS epidemic development process missing either, providing no guidance for preventive interventions. Result of the model was mainly used for analyzing the impact of AIDS epidemic on socio-economic and providing basis for budget development and policy adjustment.

Estimates and projections of HIV/AIDS epidemic with Spectrum in Beijing and Hunan Province

Estimation and projection results on Beijing's HIV/

AIDS epidemic showed that very few HIV infections emerged each year before 1994, with existing HIV infection increasing slowly. Since 1995, the number of HIV infection was increasing rapidly and reached a peak by 2008, and then decreased by 2012, after that increasing again rapidly. Male to female ratio in HIV infections gradually decreased. HIV infections among groups aged 15 - 49 years and adult aged over 15 years who need antiretroviral treatment was growing at a lower level before 2008. After that, the number was rapidly increasing. HIV infections in need of antiretroviral treatment among group aged 15 - 24 years would continue to increase by 2010 and reached a peak in 2010, then decreased rapidly and maintained at a lower level after 2011.

The results showed that the overall presentation

Table 6. Estimations on the need for PMTCT and treatment among HIV (+) children in Hunan Province with Spectrum

Year	Need for PMTCT (n)	Need for ART (n)	Need for cotrimoxazole (n)
1985	0	0	0
1986	0	0	0
1987	0	0	0
1988	5	1	8
1989	10	2	17
1990	12	3	22
1991	13	5	27
1992	15	6	33
1993	17	8	39
1994	20	9	46
1995	22	11	53
1996	26	13	63
1997	31	16	75
1998	40	20	94
1999	53	25	122
2000	75	33	166
2001	107	44	230
2002	147	60	312
2003	188	78	404
2004	224	99	496
2005	254	121	584
2006	279	143	665
2007	298	220	740
2008	316	245	812
2009	337	272	888
2010	359	379	967
2011	387	419	1056
2012	425	466	1165
2013	472	521	1290
2014	534	585	1444
2015	607	660	1623

of the HIV/AIDS epidemic in Beijing appeared as an "S" shaped curve, featured with infections dominated by men, and remained at a lower level in all. Since 1998, HIV/AIDS epidemic entered into a rapid growth period, and slowed down after 2008, with new infections beginning to decline after 2012 and the existing infections beginning to decline by 2017.

Estimation and projection results on Hunan's HIV/AIDS epidemic showed that HIV/AIDS epidemic was in a rapid growth period, with infections dominated by men, and remained at a lower level in all. HIV/AIDS epidemic in Hunan Province began to enter into rapid growth period in the late 1990s and slowed down after 2007, increasing rapidly again after 2010.

Results showed that very few HIV infections emerged each year before 1997, with existing HIV infections increasing slowly. Since 1998, the number of HIV infections was increasing rapidly and reached a peak by 2004; there was a brief plateau period from 2003 to 2006; after that, the number of new HIV infections increased rapidly. Male to female ratio in

HIV infections gradually decreased. However, the proportion in the new infections increased.

HIV/AIDS epidemic in Beijing was in a relative stable period after experiencing a rapid growth at early phase. Recent studies showed that HIV transmission mode in Beijing had transformed gradually from injecting drug use at early phase to sexual transmission with high percentage among homosexual population,^{17, 18} implying that the focus on high-risk interventions in Beijing should shift to special populations. The HIV/AIDS epidemic in Hunan Province was in rapid growth phase after experiencing a slowdown period, which showed that the HIV/AIDS prevention and control in Hunan Province had a long way to go in the new future, especially for controlling its rapid growth trend.

Estimations and projections of AIDS treatment demand in Beijing and Hunan Province with Spectrum

Estimations and projections of HIV infections in Beijing showed that HIV infections among groups

Figure 7. Estimations on the number of HIV infection and need for ART of adult aged over 15 years old in Hunan Province with Spectrum.

Notes: This figure showed the estimated number of people living with HIV and need for ART in Hunan Province. The sky blue line represents the number of people aged 15 to 24 living with HIV and the orange line represents the number of people need for ART in this group. The green line represents the number of people above 15 years old living with HIV and the orange line represents the number of people need for ART in this group. The dark blue line represents the number of people aged 15 to 49 living with HIV and the orange line represents the number of people need for ART in this group.

Figure 8. Estimations on the need for PMTCT and treatment among HIV (+) children in Hunan Province with Spectrum.

Notes: This figure showed the estimated number of HIV positive children in need of PMTCT and treatment in Hunan Province. The red line represents the children need for ART. The blue line represents the children need for PMTCT and the green line represents the number of children in need for cotrimoxazole.

aged 15 - 49 years and adult aged over 15 years who need antiretroviral treatment was growing at a lower level before 2008. After that, the number was rapidly increasing; HIV infections in need of antiretroviral treatment among group aged 15-24 years would continue to increase by 2010 and reached a peak in 2010, then decreased rapidly, and maintained at a lower level after 2011.

Estimations and projections of HIV infections in Hunan Province showed that the number of HIV infections among adults aged over 15 years who need antiretroviral treatment was growing rapidly after 2000. HIV infections in need of antiretroviral treatment among young continued to increase before 2006, remained at stable level from 2007 to 2012, and

increased rapidly again after 2012.

Consistent with the changes in HIV/AIDS epidemic trend, AIDS treatment needs in Beijing experienced a rapid growth period into a relatively stable period, while the demand for AIDS treatment in Hunan Province just showed the opposite, which implied that measures should be taken for Hunan Province to control the HIV/AIDS epidemic, meanwhile, prepared for AIDS treatment demand, including increasing the funds and adjusting related strategies for HIV/AIDS control and prevention and so on.

In general, the HIV epidemic situation will be in a stable condition and be growing rapidly in Beijing and Hunan Province, respectively, which means the intensity of HIV preventive measures in Hunan

Province should be strengthened. In order to reduce HIV spreading in high risk populations, the use of condoms in MSM and FSW populations and the range expanding of needle exchange and methadone maintenance treatment should be carried out. In the next few years, the need of HIV treatment will be increasing both in Beijing and Hunan Province. Especially in Hunan Province, the need is growing rapidly. This is a great challenge to health care system. It requires not only adequate supplies of drugs but also well-trained medical workers. The early stages of HIV epidemic in Beijing and Hunan Province are similar, but the situation and need for treatment would go different in the next few years. It is the most important meaning of model prediction to estimate the epidemic changing beyond population composition, culture and social differences, and the guidance of health resource allocation is most needed.

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