The 2007 Estimates for People at Risk for and Living With HIV in China: Progress and Challenges

Lu Wang, MD, PhD, Ning Wang, MD, PhD,* Liyan Wang, MPH,* Dongmin Li, MPH,* Manhong Jia, BS,† Xing Gao, MD, PhD,* Shuquan Qu, MPH,* Qianqian Qin, MPH,* Yanhe Wang, PhD,* and Kumi Smith, MPIA**

Objective: To present the methods used for the 2007 estimates for the number of people at risk for and infected with HIV.

Design: Estimation work took place throughout 2007, led by the National Center for AIDS and Sexually Transmitted Disease Control and Prevention in collaboration with United Nations AIDS and the World Health Organization.

Methods: The workbook method was used to process prefecture and county-level surveillance data to generate HIV prevalence by risk group for each prefecture, which was in turn imported into the spectrum model to generate estimates of new infections and HIV-related deaths.

Results: The working group estimated that as of 2007, there were 700,000 people living with HIV/AIDS in China, with 50,000 new infections and 20,000 HIV-related deaths in that year. Injection drug use and sexual contact are still primary modes of HIV transmission, with heterosexual contact quickly becoming the dominant route, making up 44.7% of new infections in 2007. The HIV/AIDS epidemic is still highly concentrated in certain areas, with wide variation in prevalence across regions.

Conclusions: The 2007 estimates are based on the most accurate and local-level data available to date, including case reports, sentinel surveillance data, results from mass screening of key target groups, and special epidemiological studies.

Key Words: China, estimation techniques, epidemiologic methods, HIV/AIDS

(*J Acquir Immune Defic Syndr* 2009;50:414–418)

INTRODUCTION

The 2007 estimates for the number of people exposed to and infected with HIV in China utilized data newly available through expanded screening and surveillance, while also building on the experience gained during the 2003 and 2005 estimation work. As with past estimates, the workbook method recommended by the World Health Organization (WHO) and United Nations Program on HIV/AIDS (UNAIDS) was chosen as the most suitable for an epidemic still concentrated among certain subpopulations and in a situation where data are still relatively limited.[1]

Populations at higher risk for HIV infection including female sex workers (FSWs), injecting drug users (IDUs), and men who have sex with men (MSM) still make up a large portion of new infections in 2007. However, there are signs that HIV is increasingly becoming a generalized epidemic as sexual contact replaces injecting drug use as the most common mode of transmission. The HIV/AIDS epidemic in China can still be considered "concentrated" as defined by the UNAIDS estimation protocol, with vast differences in recorded prevalence rates across regions and provinces (The word "province" in this article includes the following: provinces, autonomous regions, and municipalities including the Xinjiang Production and Construction Corps).

The 2007 estimates build on the teamwork and protocols established in 2005, whereas utilizing newly available or more accurate data from more systematic measuring begun in the past few years (national sentinel surveillance system).

METHODS

The Estimation Process

Many of the same experts and member organizations who participated in the 2005 estimations reconvened to work on the 2007 estimates. Under the direction of the Ministry of Health, the China Center for Disease Control and Prevention formed the 2007 National HIV Epidemic Estimation Working Group with participation from domestic AIDS experts in Ministry of Health and Peking University, Qinghua University, and Peking Union Medical College. International representatives came from UNAIDS, WHO, the US Center for Disease Control and Prevention, and Family Health International.

To ensure comparability of the data across regions and with past estimates, the working group closely adhered to the 2007 National HIV/AIDS Estimation Technical Guidance Protocol,[2] which was updated from the 2005 version through adjustment of parameters, standardization of terms and definitions, and establishment of a single set of rules for borrowing estimates across regions. Per suggestion of

Received for publication June 11, 2008; accepted November 17, 2008.
From the *National Center for AIDS and STD Control and Prevention, Chinese Center for Disease Control and Prevention, Beijing, China; and †Yunnan Provincial Center for Disease Control and Prevention, Kunming, China.
Supported by the Ministry of Health of the People's Republic of China.
Correspondence to: Dr. Ning Wang, MD, PhD, National Center for AIDS/STD Control and Prevention, Chinese Center for Disease Control and Prevention, 27 Nanwei Road, Xuanwu District, Beijing, P.R. China 100050 (e-mail: wangnbj@163.com).

UNAIDS, systematic evaluations on data quality were performed and the results were verified against the results of various other estimation methods.

The Workbook Method

UNAIDS and WHO recommends the workbook method for making current and projected estimates of HIV prevalence in countries with low-level and concentrated epidemics. Model inputs include HIV size estimates and prevalence rates of subpopulations exposed to HIV, divided into high and low-risk categories. The advantages of the workbook method are its transparency as an estimation/projection process and its use of regional level estimates to allow closer analysis of the epidemic in countries where there is great regional variation prevalence rates.[3] In addition, application of the workbook method helps identify gaps in behavioral and serological data needed to understand the epidemic.

Sources of Data

The demographic data used for the workbook estimation was adjusted from 2005 census data.

HIV Prevalence Data

Data on HIV prevalence rates came from sentinel surveillance data, special epidemiological surveys, mass screenings of target populations, and literature searches in scientific journals. China's HIV/AIDS surveillance system has expanded greatly since 2005 during which the number of serological surveillance stations increased from 329 to 391 and behavioral surveillance stations from 42 to 159. Efforts to integrate various surveillance activities were greatly helped by the March 2005 launching of a national web-based case reporting system. All activities were coordinated under a single protocol and implementation plan to provide standardized training for all levels of staff working on epidemiological estimation work.[4]

In 2004, the national government launched its national free voluntary counseling and testing strategy to obtain better epidemiological data and to identify infected individuals for treatment. In addition, government and academic institutions have conducted mass HIV screenings and special epidemiological surveys to track the epidemic among certain at-risk populations. These have included mass screenings of former commercial plasma donors (FPDs) at the local level in Henan and Shanxi,[5,6] as well at the national level,[7] and those conducted for migrant laborers,[8–11] MSM,[12,13] and HIV screening for detainees in all detention centers including drug detoxification centers.[14] These various types of data together with findings from surveys of other vulnerable groups and specialized studies of molecular epidemiology were also included in calculations for the 2007 estimates.[15]

Population Size Data and Newly Identified Groups

Estimates on the size of target populations were compiled from risk group population size surveys, behavioral surveillance surveys, mass screenings carried out by the Public Security Bureau (PSB), literature searches, and expert estimations.

For the 2007 estimates, the working group conducted separate estimates for additional populations at higher risk to better reflect the epidemic situation in China. These include MSM between 50 and 64, children at risk for infection through mother-to-child transmission (MTCT), persons with history of blood transfusion or use of contaminated blood products, former FSWs, former IDUs, participants of methadone maintenance treatment (MMT) programs, immigrant wives, and foreign nationals.

MSM Between 50~64.

The MSM group used in the workbook method specifies an age restriction of 15–49, which were then used to calculate population size estimates for older MSM aged 50~64. The ratios of high-risk to low-risk MSM aged 50–64 were adjusted downwards from the same ratios for younger MSM based on the assumption that older MSM are less sexually active than their younger counterparts. For urban MSM, it was adjusted from 7:3 to 4:6 and for rural MSM, from 4:6 to 2:8. For urban MSM, it was adjusted from 7:3 to 4:6 and for rural MSM, from 4:6 to 2:8. These proportions were then multiplied by the overall percentage of MSM thought to be engaging in high-risk sex with other men; for urban MSM, this proportion was 2.0~4.0% and for rural MSM, 0.5%–1.0%.

MTCT.

Inclusion in the workbook-specified populations who engage in drug use, commercial sex, or blood/plasma selling are not restricted by age. Only those categorized as infected through MTCT are specified as being under the age of 15. Two methods were used to estimate the size of the population infected through MTCT:

The 2007 workbook data reported 535,000 total HIV-positive individuals, of which 0.9% were estimated to have been infected through MTCT (this rate was based on the percentage of reported infections occurring through MTCT in 2004 national case reports), yielding 535,000 × 0.9% or 4851 cases of new HIV infections contracted through MTCT in 2007.

The second method calculated the proportion of births and deaths using the following formula, elements of which are described below:

$$N_{\text{infected children}} = \sum_{t=0}^{14} [N_{\text{infected females}} \times r_{\text{birth}} \times P(\text{MTCT}) \times (1 - r_{\text{infant mortality}}) \times P(\text{survival})] - N_{\text{averted MTCT}}$$

Population of HIV infected females. Adult female (15–49) population size estimates from workbook data were multiplied by the antenatal clinic (ANC) prevalence rates.
Infant mortality rates. Back calculated using 2005 census data, infant mortality approximated from existing 2000 data.
Birth rates. The 2005 birth rate of 3.83% was used as annual rate from 1991 to 2005.
Probability of MTCT. Estimated at 33.3% until 2005 when medical advances reduced it to 20% in 2005–2006; 15% in 2007.
Infant survival rates. This used the UNAIDS recommended formula of Pr (survival) = 1−Pr (death). This calculation yielded the final number of 7200 infected through MTCT.

The final estimate for infections through MTCT in 2007 was taken as the average of the 2 results, (4815 + 7200)/2 = 6025.5, or 6000.

Former FSW.

This population was calculated using estimates on population of HIV-infected former FSW, average duration of sex work, overall female HIV prevalence rates, and AIDS-related death rate. Duration of sex work was estimated at 6 years based on data from annual behavioral and serological surveillance reports.[16] Numbers of HIV-infected former FSW were calculated in 2 periods, 1998–2002 and 2003–2006, using a downward adjusted back calculation for the first period, and for the second method, by multiplying prevalence rates, population size estimate, and ratio of average duration of sex work for each year with available data. The rate of HIV-related deaths in this population was calculated by multiplying the estimated population size by the fraction of the national number of HIV-related deaths over the number of HIV/AIDS–infected people in 2005 or 2.5:65. The formula for calculating the number of infected partners of former FSW was borrowed from documented rates of sexual transmission between IDUs and their partners, which was then multiplied by 1.5 to account for the higher frequency of sexual intercourse among former FSW given the decreased sex drive of long-term IDU.

Past Recipients of Blood Transfusions/Blood Products.

Two separate methods to estimate the size of this population. The first combined case reports with an estimated rate of missed cases (calculated as the difference between reported cases and number of HIV-infected individuals reported in studies/screenings of the same population), adjusted by a location-specific multiplier to account for local factors in each province. The second method calculated the proportion of the 2007 reported cases of HIV infection that was made up of past recipients and applied the same proportion to the total estimated number of infections. This yielded the number of estimated number of people infected with HIV through contaminated blood transfusions or blood products by 2007.

Undocumented IDU.

This estimation was based on known information about HIV prevalence rates among IDUs who are not registered with the PSB, collected from sentinel surveillance data and from MMT programs operating in 22 provinces. The results were adjusted by comparing known rates from data on groups participating in MMT clinics.

Immigrant Wives.

Certain areas of China such as Shanxi and Shandong provinces have experienced localized HIV epidemics due to the increasingly common practice of men in economically depressed areas "buying" their wives from even poorer regions in southern China or Southeast Asia where HIV prevalence rates can be as high as 1%–2.5%.

Foreign Nationals Living in China.

The HIV prevalence rate for this population was estimated at 1.4% based on a meta-analysis of 32 published research articles conducted on this population, which included groups of undocumented immigrants and asylum-seeking refugees from neighboring countries. Estimates on population size were based on a special article released by a PSB investigation, which estimated that in 3%–5% of the 16 million foreign entries to China in 2004 resulted in overstayed visas.[17] Final estimate of number of HIV cases was calculated as 1.4% × (range: 1,000,000–1,700,000) producing a range of 14,000–23,800. Because this estimate is based on data centrally managed by the National Exit–Entry Inspection and Quarantine Bureau, there is no information on the regional distribution of HIV infection for this group.

Estimation Methods

Using the estimation results of 2003 and 2005, the working group used the spectrum model to estimate the numbers of new infections, PLWHA, and HIV-related deaths.

Number of New HIV Infections

The workbook method estimates for the number of adults infected with HIV/AIDS in 2003, 2005, and 2007 were fitted to the concentrated epidemic curve and generated China's adult HIV prevalence rates. These in turn were imported into the spectrum model to generate estimates of new infections in 2007. Spectrum estimates performed at the provincial level were summed to a national total of 60,000 new infections in 2007, whereas a comprehensive nation-level spectrum estimate found 40,000 new infections. The final figure of 50,000 is the average of these 2 estimates.

Number of HIV-Related Deaths

To estimate the number of deaths due to AIDS, the working group separated the country into regions with those with and without concentrations of FPDs, and taking into account the national case fatality rate (CFR) and the life-extending effects of antiretroviral treatment (ART) calculated the total number of HIV-related deaths.

By 2006, 25,600 people were receiving ART treatment in China, significantly reducing the CFR in certain provinces such Henan and Hubei. To calculate the number of HIV-related deaths in 2007, we estimated the number of people living with AIDS to be between 80,000 and 90,000 (estimation methods for which are explained in the following subsection); for CFRs, we used 8% for those receiving ART treatment and 30% for those not receiving treatment. The spectrum model generated proportions of the share of infections borne by each province, and these percentages were used to calculate the regional distributions of the total 25,600.

Number of AIDS Cases Estimated From Total Number Living With HIV/AIDS

The working group estimated the number of AIDS cases based on information on people with HIV/AIDS (PLWHA) by integrating 2 separate estimates: 1 for FPD/transfusion and blood product recipients and 1 for all other groups.

The number of individuals infected as FPDs or recipients of contaminated blood products or transfusions was estimated to be about 60,000 people of the total 535,000 PLWHA. Applying the UNAIDS probability of incidence and

mortality, the number of those who had progressed to AIDS was estimated at 30,000–35,000.

For those who contracted HIV by other transmission routes, the ratio of people living with HIV to those living with AIDS was estimated at 6.2:1. However, the ratio was adjusted to 9.9:1 by taking into account the higher reporting rate and a lower rate of missed cases for AIDS diagnosis relative to reported cases of HIV, and data on the same ratio from the 2005 workbook. Using the total number of PLWHA in 2007 less those infected through contaminated blood products (700,000–60,000 or 640,000) and multiplying it by the ratio of HIV: (HIV + AIDS) calculated as [1: (9.9 + 1)], this population was estimated at 58,000. The sum of the 2 groups produced a range cumulative total of AIDS cases of 88,000–93,000, which was rounded to 80,000–90,000, resulting in an average of 85,000.

Evaluation of the Data Sources

Because of the diverse sources of data used in the 2007 HIV epidemic estimation work, the 2007 Protocol incorporated a standardized point system to score the quality and reliability of all new data. Ratings on population estimate data took into account factors such as sample size, sampling methods, and whether surveys mixed different at-risk groups or were conducted as serial surveys. For prevalence rate data, the point system examined factors including type of survey method, type of data source (survey, PSB reports), reliance on expert estimations, and whether or not data was imputed from similar subgroups or regions.

RESULTS

As shown in Table 1, the total number of people in China estimated to be living with HIV in 2007 is 700,000 (range: 550,000–850,000), with 50,000 new infections taking place in that year. Among them, 85,000 are estimated to be living with AIDS and 20,000 to have died of HIV-related causes in 2007. Women are thought to make up 30.8% of the total number of HIV infected, and the national HIV prevalence rate is estimated at 0.05% (0.04%–0.06%).

It is estimated that within the 50,000 new HIV infections in 2007 that 44.7% were transmitted through heterosexual contact, 12.2% through male homosexual contact, 42% through injection drug use, and 1.1% through MTCT. It is thought that about one-third heterosexual transmissions are among regular partners and two-thirds between nonregular partners. Case reports over the years show that HIV transmission through heterosexual and homosexual contact is trending upwards, with homosexual contact increasing from 0.4% to 3.3% and heterosexual contact increasing from 10.7% to 37.9% between 2005 and 2007.

The severity of the epidemic varies greatly across regions and provinces. The 2007 estimates show that in 5 provinces the figures exceed 50,000, in 9 provinces there are 10,000–50,000 PLWHA, and there are only 4 provinces with less than 2000 PLWHA (Table 2). The first 5 provinces on the list together make up 53.4% of the total number, whereas the last 5 provinces only represent 0.9% of the total. Figures directly reported through the national surveillance system indicate that there are broad differences in the reported figures for different provinces. The first 5 provinces with the most reported cases of people living with HIV and AIDS make up 70%–80% of the total reported number for the country.

Other characteristics of the epidemic in China include low participation in voluntary counseling and testing and continued high-risk behavior in key vulnerable groups. Of the 700,000 people estimated to be living with HIV/AIDS in 2007, there are only 220,000 cumulative reported cases of HIV infection, which means that most people who are HIV positive are unaware of their serostatus and so cannot be targeted for prevention of secondary transmission. Moreover, comprehensive AIDS surveillance information shows that 40% of IDUs engage in needle-sharing behavior and that 60% of FSW are not able to maintain consistent condom use with every sexual act. Data also show that 70% of MSM have had sexual contact with multiple partners in the past 6 months, among whom 30% do not use condoms during anal intercourse and 50% do not maintain consistent condom use during sex with male sex workers.[18]

There is still a distinct lack of information on the changing dynamics in drug use and sexual partnering habits among younger Chinese. Several studies show upward trends of use of alternative drug and multiple sexual partnering (heterosexual and homosexual sex). Furthermore, there is evidence that HIV is being transmitted from former FSWs, immigrant brides, and foreign nationals living in China to the

TABLE 1. Estimated Population Sizes and Numbers Living With HIV in China, End 2007

	Population Size Estimate (Millions)	Prevalence Rates (%)	Estimated Number Living With HIV
IDUs	1.5–3.0	6.7–13.4	230,000
Commercial sex workers	1.8–3.8	0.33–0.94	18,000
MSM	3.1–6.3	0.57–2.17	69,000
FPDs	1.1–1.7	1.2–4.8	43,000
Male clients of FSWs	17.7–37.1	0.2–0.6	115,000
Regular partners of high-risk individuals	—	—	73,000
Others (including MTCT, older MSM, immigrant wives, foreign nationals, etc.)	—	—	122,000
New infections in 2007	—	—	50,000
HIV-related deaths in 2007	—	—	−20,000
Total	—	—	700,000

TABLE 2. Regional Distribution of HIV Infection

Population Estimates	Province/Region
>50,000	Yunnan, Guanxi, Sichuan, Xinjiang, Henan, Guangxi
10,000–49,999	Guizhou, Chongqing, Hunan, Zhejiang, Hubei, Anhui, Jiangsu, Beijing
1000–9999	Jilin, Jiangxi, Liaoning, Hebei, Fujian, Heilongjiang, Shanxi, Shanghai, Shandong, Gansu, Hainan, Shaanxi, Tianjin, Inner Mongolia, Bingtuan
<999	Ningxia, Qinghai, Tibet

general population through vertical and horizontal transmission. Data from the integrated supervisory project show that future intervention efforts must consider these epidemiological characteristics to slow spread of HIV.

DISCUSSION

As with past estimates, the 2007 estimates produced lower figures than in past rounds.[19] The main reasons for these differences include a greatly expanded surveillance system that improved representativeness of regional prevalence rates and the implementation of mass screenings and specialized surveys within key regions and populations that replaced informed estimates with real measured values. The number of national serological surveillance sites increased from 329 sites in 2005 to 391 in 2007, in addition to the 458 existing provincial level sites. China also launched a national behavioral surveillance system in 2004 which was operating 159 sites by 2007. Because the first surveillance sites were set up as an emergency response to the growing epidemic, they captured data in more severely hit areas, and any estimates based on these figures were inflated as a result. As the surveillance system has grown, epidemiological data has become more representative of the diversity of the epidemic.

In addition, the working Group consulted a more diverse range of information sources including published scientific research and a widely consultative body of experts. Continuing efforts have been made to adapt international recommended methods to China's situation. Indirect estimation methods have also improved with the input of behavioral surveillance data and with the identification and of additional risk groups unique to China. In addition, the 2007 estimation work 3 provinces used the county as the unit of analysis instead of the prefecture; many other provinces are also developing county level data though they have yet to begin reporting the local-level estimates directly to the national level.

In the course of conducting the estimates, the working Group identified several important data gaps, in particular for epidemiological and behavioral data on MSM, male clients of FSW, and the general population. In addition, the National Center for AIDS and Sexually Transmitted Disease Control and Prevention is now working on new projections for HIV/AIDS infections into the year 2020 using the Asian Epidemic Model developed by Tim Brown of the East-West Center and Wiwat Peerapatanopokin of the Thai Red Cross Society Collaboration on HIV/AIDS modeling, analysis, and policy. The evolution of the methods and processes for China's estimation work lays the foundation for improving the national surveillance system and the quality of epidemiological research and helps translate results into relevant policy solutions that deliver better prevention, care, and treatment services.

ACKNOWLEDGMENTS

L.W. and N.W. coordinated and led the 2007 HIV/AIDS estimation process. L.W. and her team of epidemiologists (L.W., D.L., X.G., S.Q., Q.Q., and Y.W.) carried out the bulk of the statistical analysis and estimation work and produced written work in Chinese documenting the methods and processes used. K.S. consulted with the China team and drafted the English article, and M.J. provided key inputs as insights from the provincial and lower level estimation work.

REFERENCES

1. Lu F, Wang N, Wu Z, et al. Estimating the number of people at risk for and living with HIV in China in 2005: methods and results. *Sex Transm Infect*. 2006;82:iii87–iii91.
2. *2007 National HIV/AIDS Estimation Technical Guidance Protocol*. Beijing, China: Epidemiology Department of the National Center for AIDS/STD Control and Prevention; May 2007. Available at: http://www.chinaids.org.cn/n435777/n436916/n436920/540339.html. [in Chinese]. Accessed May 3, 2008.
3. Walker N, Stover J, Stanecki K, et al. The workbook approach to making estimates and projecting future scenarios of HIV/AIDS in countries with low level and concentrated epidemics. *Sex Transm Infect*. 2004;80:i10–i13.
4. Sun X, Wang N, Li D, et al. The development of HIV/AIDS surveillance in China. *AIDS*. 2007;21:S1–S6.
5. Wu Z, Rou K, Detels R. Prevalence of HIV infection among former commercial plasma donors in rural eastern China. *Health Policy Plan*. 2001;16:41–46.
6. Yan J, Zheng X, Zhang X, et al. The survey of prevalence of HIV infection among paid blood donors in one county in China [in Chinese]. *Chin J Epidemiol*. 2000;21:10–13.
7. Ministry of Health Expert Consultation Committee. *Report on HIV Screening Among Key Populations in Henan Province*. Beijing, China: Ministry of Health; 2005.
8. Anderson AF, Qingsi Z, Hua X, et al. China's floating population and the potential for HIV transmissions: a social-behavioral perspective. *AIDS Care*. 2003;15:177–185.
9. Hong Y, Stanton B, Li X, et al. Rural-to-urban migrants and the HIV epidemic in China. *AIDS Behav*. 2006;10:421–430.
10. Hesketh TM, Lu L. HIV and syphilis in Chinese internal migrants. *AIDS*. 2005;19:1550.
11. Wang B, Li X, Stanton B, et al. HIV-related risk behaviors and history of sexually transmitted disease among male migrants who patronize commercial sex in China. *Sex Transm Dis*. 2006;34:1–8.
12. Liu H, Yang H, Li X, et al. Men who have sex with men and human immunodeficiency virus; sexually transmitted disease control in China. *Sex Transm Dis*. 2006;33:68–76.
13. He Q, Wang Y, Lin P, et al. Potential bridges for HIV infection to men who have sex with men in Guangzhou, China. *AIDS Behav*. 2006;10:S17–S23.
14. Minsitry of Health Expert Consultation Committee. *Report on HIV Screening Among Key Populations in Yunnan Province*. Beijing, China: Ministry of Health; 2005.
15. Qiu Z, Xing H, Wei M, et al, Characterization of five nearly full-length genomes of early HIV type 1 strains in Ruili city: implications for the genesis of CRF07_BC and CRF08_BC circulating in China. *AIDS Res Hum Retroviruses*. 2005;21:1051–1056.
16. National Center for AIDS/STD Control and Prevention. *National Center for AIDS/STD Control & Prevention, Annual HIV/AIDS Behavioral & Sentinel Surveillance Report*. Beijing, China; 2007.
17. The Public Security Bureau holds a meeting on the past 20 years of exit and entry administration. Public Security Bureau of the People's Republic of China. May 11, 2005. Available at: www.gov.cn. Accessed September 15, 2008.
18. Zhang KL. Rapid estimation on Size of MSM in China. Presented at: Conference sponsored by the Chinese Academy of Medical Sciences; September 26 to October 20, 2005; Beijing, China.
19. *2005 Update on the HIV/AIDS Epidemic and Response in China*. Ministry of Health, People's Republic of China, Joint United Nations Programme on HIV/AIDS, World Health Organization. Available at: http://data.unaids.org/publications/External-Documents/rp_2005chinaestimation_25jan06_en.pdf. Accessed September 15, 2008.

