Published in final edited form as:

AIDS Care. 2008 November ; 20(10): 1190–1196. doi:10.1080/09540120801919394.

Institutional support for HIV/AIDS care in China:

a multilevel analysis

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Abstract

A total of 1101 Chinese healthcare workers were surveyed to determine the perception of institutional support for HIV/AIDS care in China. Multilevel regression models with random effects were used to estimate individual and facility-level effects on healthcare workers' perceived institutional support. Regional workers (at the provincial, city, county levels) reported higher institutional support for HIV/AIDS care than local workers (at the township and village levels). Estimated relationships between perceived institutional support and HIV-related training were greater for the regional than for the local level. Urgent need exists to address the unbalanced healthcare system in China and to consider the policy implications for an effective response to the HIV/AIDS epidemic.

Keywords

HIV/AIDS; multilevel regression models; China; institutional support

Introduction

The HIV/AIDS epidemic poses challenges to both healthcare workers and the healthcare system of China, especially with the current expansion of HIV treatment. Healthcare workers face significant occupational challenges, including work-related infection risks, increasing demand for services, inefficiencies in the HIV care financing system and a lack of appropriate training for HIV/AIDS (Marchal, De Brouwere, & Kegels, 2005; Unger, Welz, & Haran, 2002). Previous research on AIDS impact on healthcare workers suggests that institutional factors are related to emotional exhaustion, anxiety and depression (Claxton, Catalan, & Burgess, 1998). Institutional factors may include policies and standard operational procedures. However, there has been a lack of research on institutional or structural factors associated with HIV services and care, which is important for informing effective interventions (Chan & Reidpath, 2005; Reidpath, Brijnath, & Chan, 2005).

Although China's healthcare system has gradually shifted away from a bureaucratically controlled, collectivist care system, it remains organized in a very hierarchical way that is parallel to its administrative system: province, city, county, township and village (Davis & Chapman, 2002) (Figure 1). Each level of government has a functional public health unit, under dual control of the corresponding governments and the public health units at a higher administrative level. Great disparities exist among different levels of hospitals in terms of

resource allocation and staff qualification and status (Hsiao, 1995; Shi, 1993). Given the unbalanced resource allocation at different levels of care in China, we speculated that healthcare workers' perceptions of institutional support for HIV/AIDS care in their facilities would vary. Specifically, what are the differences in perceptions across different levels of care and how is the perception of institutional support for HIV/AIDS care associated with characteristics of individual healthcare workers and those at the facility-level? How do the relationships between perceived support and other individual and facility characteristics vary across different levels of care? These are the questions this paper aims to answer.

Methods

Participants and procedures

The study was conducted in 2005 in Yunnan Province, where 40% of all reported HIV cases - the highest range of reported HIV infection in China - have occurred (State Council AIDS Working Committee Office & UN Theme Group on HIV/AIDS in China, 2004). In order to construct a representative sample of healthcare workers, we gathered staffing information from regional hospitals and local clinics from three districts. Three out of 9 provincial hospitals, 4 out of 7 city/prefecture hospitals, 10 out of 35 county hospitals, 18 out of 90 township health clinics and 54 out of 573 village clinics were randomly selected using a random number table. The staff list of each facility was obtained for random selection. Doctors and nurses were sampled proportionally to the doctor-nurse ratio at each hospital or clinic; lab technicians were over-sampled in order to obtain an adequate number for analysis.

A total of 1101 participants were randomly selected from 3579 eligible healthcare providers. They voluntarily participated in an anonymous survey, with a refusal rate of less than 8%. Participants included 557 doctors (50.6%), 439 (39.9%) nurses and 105 (9.5%) lab technicians. They were invited to take an anonymous, self-administered, paper-and-pencil survey in a private room. Before the survey, project field staff explained the purpose of the study, procedures, potential risks and benefits. To ensure anonymity, respondents were instructed not to place any personal identifiers on the questionnaire, which took, on average, an hour to complete. During the survey administration, the interviewer was present in case the participant had any questions to ask. After finishing the survey, participants put their completed questionnaire in an envelope, sealed it and placed it in a locked box. No monetary incentive was offered for survey completion.

Instruments and measures

The Health Professional Survey, developed specifically for this project, contained 172 questions assessing participants' demographics, medical training and experience, attitudes and behavior toward HIV/AIDS patients and their perceptions of infection risk and institutional support for HIV/AIDS care at their facilities.

Perceived institutional support for HIV/AIDS care—Perceived institutional support for HIV/AIDS care (PISC), the main outcome variable in the study, was measured using 10 questions. The first six questions covered accessibility to sterile rubber gloves, sterile needles, rubbing alcohol, disposal containers, a working autoclave and written HIV/AIDS treatment regimens at the participant's care facility. The other four questions covered the availability of HIV testing and AIDS treatments, whether healthcare workers had access to free HIV testing and if health insurance coverage was available for work-related infection. Each question was scored as 1=yes and 0=no or don't know responses. The scale was constructed by summing all items ($\alpha=0.7$). Higher scores indicated a more favorable perception toward institutional support for HIV/AIDS care.

Perceived infection risk at work—Perceived infection risk at work was constructed by summing the responses from three questions regarding: (1) the possibility of having a dirty needle pierce their skin; (2) the likelihood of getting infected with HIV if a dirty needle pierced their skin; and (3) the likelihood of being infected while providing medical care to HIV-positive patients. Each participant rated the possibility on a scale from 0=not possible to 3=high possibility. A higher score was associated with higher perceived risk of HIV infection at work ($\alpha=0.7$).

Knowledge of HIV/AIDS—Knowledge of HIV/AIDS was ascertained using 10 questions. These questions have been used often in HIV studies to measure HIV-related knowledge. Questions included whether AIDS is curable, whether HIV can be transmitted through pregnancy, childbirth, breast-feeding, daily contact (such as sharing a public bathroom) or mosquitoes and whether HIV transmission can be stopped by increased nutrient intake or physical exercise. For each item, the response was coded as 1=correct answer or 0=incorrect answer. The scale for knowledge of HIV/AIDS was calculated by summing all 10 items.

We also collected respondents' demographic and professional information, including age, gender, medical degree, if they had personal contact with HIV-positive patients and if they had HIV-related training.

Data analysis

We used multilevel regression models to examine the relationship between PISC and characteristics of healthcare workers and their facility. Multilevel models are often used to analyze hierarchically structured health research data with complex patterns of variability (Chen, Choe, Chen, & Zhang, 2005; Snijders & Bosker, 1999; Stephenson & Tsui, 2003; Stephenson, Baschieri, Clements, Hennink, & Madise, 2006). The data in this study are hierarchically structured, with healthcare workers nested within healthcare facilities. Individuals within a healthcare facility often shared facility-level characteristics and thus may be more similar in their perception of institutional support for HIV/AIDS care (PISC) than individuals from different healthcare facilities. Multilevel modeling allows separation of the nested sources of variation, which helps to avoid under- or over-estimation of the fixed effect variances, increases efficiency in identifying important sources of variation, and enables identification of important cluster structure in the outcome of interest. The number of participants within individual township and village clinics was relatively small, so for purposes of analysis we grouped all the township clinics within each district as one healthcare facility, and did the same for the village clinics. This resulted in a total of twenty-three healthcare facilities, which are the facility-level random effects in our multilevel model.

The individual-level covariates include age, gender, whether a healthcare worker had at least an associated medical degree, had ever treated or interacted with any patients who were HIV-positive, had HIV-related knowledge and training and perceived infection risk at work. The facility-level covariates are the five levels of care (provincial, city, county, township and village) and the number of HIV/AIDS patients that the facility had treated.

We used the following multilevel regression model with random effects to estimate the individual- and facility-level effects on an individual's PISC:

$$Y_{ij} = \alpha_0 + \sum_{s=1}^p \alpha_s x_{sij} + \sum_{t=1}^q \beta_t z_{tij} + \sum_{u=1}^r \gamma_u w_u + \eta_i + \varepsilon_{ij}$$

$$i=1, \dots, K \text{ and } j=1, \dots, n_i$$

where Y_{ij} is the j^{th} healthcare worker's PISC at the i^{th} healthcare facility, x_{sij} is the individual-level covariate, z_{ij} is the facility-level covariate and w_u is the cross-level interaction term between individual and facility-level covariates. Here α_0 is the intercept and α_s , β_t and γ_u are the regression coefficients for the individual-level, the facility-level and the cross-level, respectively. The facility-level random effect η_i and the residual ε_{ij} are assumed to be independent of each other and have normal distributions with mean zero and unknown variance σ_γ^2 and σ_ε^2 , respectively. When $\sigma_\gamma^2=0$, the model reduces to the regular regression model, indicating no significant between-facility variance of the outcome variable. The intra-class correlation coefficient (ICC) was calculated as $\sigma_\gamma^2 / (\sigma_\gamma^2 + \sigma_\varepsilon^2)$ and is used to assess the amount of variability of PISC explained by differences between healthcare facilities (Beckman et al., 2004; Chen et al., 2005; Snijders & Bosker, 1999). A larger ICC indicates that differences between healthcare facilities cannot be ignored.

We fitted a series of nested models to examine how the facility-level covariates were associated with individual PISC score. Model 1 includes individual-level covariates and facility-level random effects, Model 2 adds facility-level fixed effects to Model 1 and Model 3 adds cross-level fixed effect to Model 2. We conducted the analyses using PROC MIXED in SAS version 9.1 (SAS Institute Inc, Cary, NC).

To explore differences in PISC across different levels of care, we also conducted descriptive analyses for the selected institutional support items, such as availability of sterile gloves, written HIV/AIDS regimens, availability of treatment/testing and health insurance for work-related infection.

Results

Table 1 presents the characteristics of study participants by level of care. More than 36% (401/1101) of the sample came from county hospitals and less than 10% (102/1101) from village clinics. More than 70% of healthcare workers were women at all levels of care, except in the village clinics (56.9%). The average age of the healthcare workers in the provincial, city and county hospitals was approximately 36.5 years old. The average age was lower in the township facilities (31.6) and higher at the village facilities (38.9). Substantial differences were observed in the level of medical education. The percentages having at least an associated degree was 80.1% at the provincial level, 72.2% at the city level, 59.8% at the county level, 36.5% at the township level and 10.9% at the village level.

Differences associated with the level of care were also evident in other characteristics. Approximately 65% of those from provincial and city hospitals had treated or had contact with HIV-positive patients within their hospitals, whereas only one of the 102 participants from village clinics reported this experience (Table 1). A similar pattern was found in the number of HIV-positive patients that the hospital treated at the five different levels of care. Perceived HIV infection risk at work was similar at the provincial, city, county and township levels, but lower at the village level. The majority of the sample (61.1-73.0%) at all five levels of care reported having HIV-related training; healthcare workers at these levels of care also reported similar levels of HIV/AIDS knowledge.

Table 2 presents the reported availability of institutional support items at different levels of healthcare facilities. Approximately 80-86% of the healthcare workers in the provincial, city, county and township facilities reported availability of sterile rubber gloves when they were needed, compared to less than 60% of healthcare workers in the village clinics ($p<0.001$). The majority of healthcare workers (>95%) said sterile needles and rubbing alcohol were available when needed. Differences in the availability of HIV/AIDS testing and treatment for patients

and healthcare workers were observed between regional (provincial, city, county) and local (township, village) levels of care ($p<0.001$).

Individual- and facility-level effects

Table 3 presents the parameter estimates of the three multilevel regression models. All results indicated that PISC scores were higher for women than men ($p<0.001$) and increased with age ($p<0.05$) and HIV-related training ($p<0.001$).

The results for Model 2 and Model 3 indicated that PISC scores are significantly different among the five levels of care ($p<0.0001$). The estimated mean PISC scores at the regional levels were similar and higher than those at the local levels. The number of HIV-positive patients treated at the facilities was positively related to the PISC score.

Cross-level effect

The cross-level fixed effect (level of care by HIV training) included in Model 3 was significantly associated with individual PISC score ($p=0.03$). The estimated differences in PISC score across the five levels of care were dissimilar, with the estimated difference in PISC score for healthcare workers who had HIV-related training versus those who did not much greater for the regional level than for the local level. Generally, for all five levels, healthcare workers who had HIV-related training reported a higher PISC than those without training.

Random effects

The estimated variance of the facility-level random effects in Model 1 ($\sigma^2_\gamma=0.74$) was much higher than that in Model 2 ($\sigma^2_\gamma=0.19$) and Model 3 ($\sigma^2_\gamma=0.21$) (Table 3). The estimated residual variance (σ^2_e) was similar for all three models. The intra-class correlation coefficient in the model with the individual-level fixed effects and the facility-level random effects (Model 1, 0.22) was the highest among the three models. The intra-class correlation coefficient reduced by 68.2% when the facility-level fixed effects were included in the model (Model 2), indicating that the unexplained between-facility variance of PISC is substantially reduced when compared to Model 1. The facility-level fixed effects explained the majority of between-facility variance as compared to Model 1. The intra-class correlation coefficient did not change when the cross-level effect was added in Model 3. The between-facility variances for all three models significantly differed from zero ($p<0.05$), meaning that the facility-level random effects cannot be ignored and thus multilevel regression models are appropriate for analyzing this type of data. Both Models 2 and 3 explain the variance structure better than Model 1. Model 3, which is identical to Model 2 with inclusion of the cross-level variable, allows us to see that the differences in PISC score are dissimilar among the five levels of care.

Discussion

This study provides evidence that Chinese healthcare workers at regional-level facilities (provincial, city, and county) perceived significantly higher institutional support for HIV/AIDS care than those at local-level facilities (township and village). This finding is consistent with the reality that China's healthcare system is unbalanced in resource allocation across all levels. United Nations data showed that in 2002 the average level of per-capita health spending in urban areas was more than twice the national average and 3.5 times the average level of health spending in rural areas (United Nations Health Partners Group, 2005). The disparity in government healthcare spending between urban and rural areas is increasing (Gill, 2006). Consistent with this imbalance, we observed a huge gap in medical education for healthcare workers across different levels. Medical practitioners in China ranged from poorly educated

rural health workers (“bare foot doctors”) to graduates of traditional Chinese medical colleges or western-style medical universities. According to Hsiao’s 1995 study (Hsiao, 1995), village stations are staffed by village doctors whose training consists of three to six months after junior high/middle school and an average of two to three weeks of continuing education per year. Township health centers were usually led by a physician who received a three-year medical school education after high school, aided by assistant physicians with two years of medical training beyond junior high/middle school. Urban hospitals often had a highly trained staff who graduated from western medical colleges or Chinese traditional medical colleges (Hsiao, 1995; Shi, 1993).

The imbalance of resources and staffing at different levels of care has important implications for China’s HIV/AIDS control and treatment. In China, most HIV infections occur among rural populations (China Internet Information Center, 2002; Wu, Rou, Xu, Lou, & Detels, 2005), yet most HIV treatment and care takes place at the regional level of care. In this study, more healthcare workers from the provincial and city levels of care reported that they treated or had contact with HIV-positive patients within their hospitals than those at lower levels of healthcare settings. Two explanations are possible for this: first, people living with HIV/AIDS sought care in better-equipped facilities and they had more trust in healthcare workers with more medical education and training; second, HIV testing and standardized anti-retroviral therapy was not available at these rural facilities. The gap between where the epidemic occurs and where care and treatment are offered poses a big challenge to HIV care and treatment in China.

The Chinese government has realized the challenges the HIV/AIDS epidemic poses for the Chinese healthcare system. In 2004, China started a new policy of offering free treatment for rural and poor urban residents, free and voluntary HIV screening tests and free education for orphans of people living with HIV/AIDS (China Ministry of Health, 2006). This national program has reached more rural populations in need for HIV testing and treatment (Wu, 2006). How this national program, as well as others, can be integrated into the existing unbalanced healthcare system in China remains a challenge. Although a range of treatments is provided, standardized anti-retroviral therapy is difficult to deliver at the local level because crucial elements of the HIV/AIDS treatment and care package are not readily available. Also, the medical staff in rural areas has limited training and experience in treating and counseling AIDS patients. Because people living with HIV/AIDS are primarily concentrated in rural areas, long-term HIV/AIDS testing and care need to be integrated and strengthened at local medical care facilities.

In addition to facility-level and individual-level findings, we also found that the relationships between perceived institutional support and HIV-related training appeared stronger at regional level facilities than at the local level. These findings suggest that, although HIV-related training is important at all levels of care, more effective training and interventions should be tailored to different levels of care facilities where staff training needs are likely to be different.

Our study has limitations, as it relied entirely on self-report data. Issues surrounding recall accuracy can be raised. We assessed institutional support based on self-report without data on institutional indicators (e.g. equipment and rules at each hospital or clinic), which is a limitation for future policy implications and implementation. Nevertheless, institutional support perceived by the healthcare workers reflected their level of satisfaction with their work environment, which can be important in terms of providing good quality of service for patients.

In conclusion, there is urgent need to recognize and address the unbalanced healthcare system in China and to consider the policy implications for an effective response to the HIV/AIDS epidemic.

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Figure 1.
Health service agencies in China.

Table 1

Sample characteristics by level of care ($n=1101$)

	Level of care				
	Provincial	City	County	Township	Village
<i>n</i>	251	199	401	148	102
Age					
Mean (SD)	36.7 (8.2)	36.5 (8.2)	36.4 (8.3)	31.6 (7.1)	38.9 (12)
Gender					
Female (%) [*]	178 (70.9)	166 (83.8)	304 (75.8)	112 (75.7)	58 (56.9)
Associate medical degree or higher (%) ^{**}	201 (80.1)	143 (72.2)	239 (59.8)	54 (36.5)	11 (10.9)
Personal contact with HIV-positive patients (%)	162 (64.5)	133 (66.8)	164 (40.9)	19 (12.8)	1 (1.0)
# of HIV-positive patients treated Median (Min, Max)	104 (84,110)	50 (20, 612)	4 (0,112)	0 (0, 5)	0
HIV-related training (%) ^{***}	176 (73.0)	118 (61.1)	272 (68.2)	102 (68.9)	70 (68.6)
Knowledge of HIV					
Mean (SD)	8.6 (1.2)	8.4 (1.5)	8.3 (1.4)	8.5 (1.4)	7.7 (2.0)
Infection riskat work					
Mean (SD)	2.2 (0.5)	2.2 (0.5)	2.1 (0.6)	2.0 (0.5)	1.5 (0.6)

* Missing gender information=1

** Missing medical degree information=3

*** Missing medical degree information=18.

Table 2

Frequencies of available institutional support items

Items	Level of care				
	Provincial	City	County	Township	Village
	% Available within level				
Sterile rubber gloves *	85.7	80.9	84.0	79.7	57.8
Sterile needles	95.6	96.5	96.0	97.3	95.1
Rubbing alcohol	95.6	96.5	95.8	96.6	98.0
Disposal containers *	86.9	91.0	88.5	80.4	74.5
Working autoclave *	91.2	94.5	96.3	92.6	80.4
Written HIV/AIDS treatment regimens	51.0	47.2	50.4	39.2	40.2
AIDS treatment availability *	31.9	56.8	21.7	13.5	12.8
HIV testing *	92.8	94.5	85.5	31.1	12.8
Free HIV testing for needle stickincident *	54.2	58.8	52.6	29.7	23.5
Health insurance coverage for worked-related HIV infection *	33.9	32.7	32.4	30.4	9.8
Total participants	251	199	401	148	102

* $p < 0.001$.

Table 3

Multi-level model estimates of effects

Fixed effects	Model 1 Estimate (SE)	Model 2 Estimate (SE)	Model 3 Estimate (SE)
Facility-level			
Level of care (<i>p</i>)		<0.0001	<0.0001
Provincial		6.818 (0.278)	6.715 (0.294)
City		6.882 (0.306)	6.878 (0.319)
County		6.817 (0.172)	6.834 (0.181)
Township		5.827 (0.298)	5.901 (0.314)
Village		4.866 (0.318)	4.996 (0.335)
Number of HIV-positive patients treated		0.002 (0.001)	0.002 (0.001)
Individual-level			
Age *	0.020 (0.006)	0.020 (0.006)	0.019 (0.006)
Gender (F-M) **	0.457 (0.120)	0.427 (0.120)	0.397 (0.120)
Medical degree (yes-no)	-0.019 (0.114)	-0.038 (0.115)	-0.063 (0.115)
HIV-related training (yes-no) **	1.179 (0.112)	1.210 (0.111)	1.109 (0.123)
Personal contact with HIV-positive patients (yes-no)	0.208 (0.118)	0.169 (0.118)	0.161 (0.118)
Knowledge of HIV	-0.032 (0.035)	-0.035 (0.035)	-0.032 (0.035)
Infection riskat work	-0.037 (0.094)	-0.075 (0.094)	-0.063 (0.094)
Cross-level			
Level of care by HIV training			
Provincial **			1.714 (0.245)
City **			1.375 (0.241)
County **			1.167 (0.185)
Township *			0.810 (0.298)
Village			0.478 (0.356)
Random effects variance *	0.740 (0.253)	0.186 (0.086)	0.206 (0.093)
Residual	2.593 (0.113)	2.590 (0.114)	2.570 (0.113)
Intra-class correlation coefficient	0.22	0.07	0.07
Reduction of unexplained facility-level variance ***	Reference	68.2%	68.2%

* $p < 0.05$

**
 $p<0.001$

*** Comparisons of Models 2 and 3 are to Model 1.