



UNRISD

United Nations Research Institute for Social Development

Working Paper 2013

The Influence of Migration on the Burden of and Response to Infectious Disease Threats in China

A Theoretically Informed Review

*Joseph D. Tucker, Chun Hao, Xia Zou, Guiye Lv,
Megan McLaughlin, Xiaoming Li and Li Ling*

prepared for the UNRISD project on
Health and Migration in China

November 2013



The United Nations Research Institute for Social Development (UNRISD) is an autonomous research institute within the UN system that undertakes multidisciplinary research and policy analysis on the social dimensions of contemporary development issues. Through our work we aim to ensure that social equity, inclusion and justice are central to development thinking, policy and practice.

UNRISD, Palais des Nations
1211 Geneva 10, Switzerland

Tel: +41 (0)22 9173020
Fax: +41 (0)22 9170650
info@unrisd.org
www.unrisd.org

Copyright © United Nations Research Institute for Social Development

This is not a formal UNRISD publication. The responsibility for opinions expressed in signed studies rests solely with their author(s), and availability on the UNRISD Web site (www.unrisd.org) does not constitute an endorsement by UNRISD of the opinions expressed in them. No publication or distribution of these papers is permitted without the prior authorization of the author(s), except for personal use.

Contents

Abstract.....	iv
Acknowledgements.....	iv
Authors.....	iv
Introduction.....	1
Methods.....	1
Search strategy and selection criteria.....	2
Results.....	2
Airborne infectious diseases	2
Blood-borne infectious diseases	3
Sexually transmitted infections (STI)	4
Mosquito-borne infections	5
Migration Phase-Specific Infectious Disease Control Policy Interventions.....	6
Conclusion	8
Figures.....	9
References	14

Abstract

Massive rural-to-urban migration in China may influence infectious disease spread, but the same powerful social forces that reliably promote migration can also be used to design more effective health systems. We systematically reviewed eight databases to identify research studies focused on migrant infectious disease epidemiology and control policies. Grounded in Zimmerman et al.'s migration-health framework, we examined the sequential phases of rural-to-urban migration (pre-departure, travel, destination, interception, and return) in terms of their influence on infectious disease epidemiology and control policies. The migration process has a profound impact on the distribution of airborne, blood-borne, sexually transmitted, and mosquito-borne infectious diseases in addition to influencing potential control strategies. The spread of vaccine preventable diseases in China underscores the need for more responsive vaccination systems among migrants. Scaling up successful pilot migrant infectious disease control policies and new programmes are urgently needed in order to achieve health equity for Chinese migrants.

Acknowledgements

This research was undertaken as part of the project “Migration and Health in China” implemented by the Sun Yat-sen Center for Migrant Health Policy and the United Nations Research Institute for Social Development and funded by the China Medical Board (Grant No. 10-009: Phase II Supplementary Grant of Construction Project of the Sun Yat-sen Center for Migrant Health Policy). Financial support for this research also came from an NIH Fogarty Career Development Award (US NIH 1K01TW008200-01A1). Thanks to Shufang Zhang at UNRISD for administrative support, He Qun for helpful discussions about this topic, and Teng Pan and Huijun Chen for assistance with searching for research studies. Thanks to two anonymous UNRISD reviewers for helpful comments on prior versions of this manuscript.

Authors

Joseph D. Tucker, MD (University of North Carolina Project-China, Guangzhou, China; University of North Carolina at Chapel Hill, Chapel Hill, United States; Sun Yat-sen University Center for Migrant Health Policy, Guangzhou, China)

Chun Hao, PhD (Sun Yat-sen Center for Migrant Health Policy, Guangzhou, China)

Xia Zou, MPH (Faculty of Medical Statistics and Epidemiology, School of Public Health, Sun Yat-sen University, Guangzhou, China; Sun Yat-sen University Center for Migrant Health Policy, Guangzhou, China)

Guiye Lv, MPH (Faculty of Medical Statistics and Epidemiology, School of Public Health, Sun Yat-sen University, Guangzhou, China; Sun Yat-sen University Center for Migrant Health Policy, Guangzhou, China)

Megan McLaughlin, MPH (University of North Carolina Project-China, Guangzhou, China; Sun Yat-sen University Center for Migrant Health Policy, Guangzhou, China)

Xiaoming Li, PhD (Prevention Research Center, Wayne State University School of Medicine, Detroit, United States; Sun Yat-sen University Center for Migrant Health Policy, Guangzhou, China)

Li Ling, PhD (Faculty of Medical Statistics and Epidemiology, School of Public Health, Sun Yat-sen University, Guangzhou, China; Sun Yat-sen University Center for Migrant Health Policy, Guangzhou, China)

Correspondence to Dr. Joseph D. Tucker (jdtucker@med.unc.edu) or Dr. Li Ling (lingli@mail.sysu.edu.cn).

Introduction

Infectious diseases remain a major public health threat in China, but their spatial distribution across China is uneven.^{1,2} The persistence of infectious diseases in rural regions, evolving rural health systems and massive movement of migrants from rural to urban areas make rural infectious diseases relevant on national² and international scales.^{3,4} Migrants' periodic return from urban destinations to rural origins also carries substantial public health implications.⁵ While migrants in China are often considered a high-risk group for many infections,² the underlying mechanisms linking the migration process and infectious disease spread are unclear.

Understanding migrant infectious disease epidemiology is fundamental for designing responsive control policies. China provides a unique opportunity to examine the relationship between migration and infectious disease control policies for several reasons. First, China's 225 million migrants, alongside an increasingly detailed understanding of their movements,⁶ create opportunities to examine the relationship between migration and infectious diseases on a large scale. Second, the China public health system has the capacity to rapidly implement new infectious disease control policies,⁷ substantially narrowing the gap between evidence and implementation. Finally, health reform in China provides a strong financial and organizational impetus to achieve health equity among migrant populations.⁸ The main purpose of this systematic review is to determine how the migration process influences infectious disease epidemiology and control responses in China.

Methods

While migration is a complex social phenomenon that encompasses many types of movement and resettlement, this review focuses on rural-to-urban migrants (referred to as "migrants" in the review) in China. One of the primary drivers for this massive rural-to-urban migration has been the search for better employment in urban regions, but there are many other reasons underpinning rural-to-urban migration.^{9,10} This review has two main components: 1) a systematic review of the burden and distribution of infectious diseases among migrants; 2) a policy-focused review considering how the migration process can enhance disease control efforts.

The first component includes notifiable infectious diseases in China associated with the greatest mortality in 2010 and transmitted via respiratory droplets, blood, sex or mosquitoes (Table 1).¹¹ In addition, some non-notifiable infections associated with a substantial burden of disease (human papillomavirus, influenza) are also discussed. Zoonotic and fecal-oral infections are not discussed in depth because their mechanism of transmission is not directly related to the migration process.

This analysis uses a migration phase-specific theoretical framework to inform analysis.¹² Developed by Zimmerman et al., this theoretical framework was created as a tool to improve policies related to migration and health. This framework focuses on five sequential phases of the migration process that may influence infectious disease transmission and require policy attention: pre-departure, travel, destination, interception and return (figure 1). These phases are separate stages that many migrants will iteratively move through in their lives, and these transitions characterize the migration process in action. From a health policy perspective, analyzing migration and health at multiple phases will be the most effective for creating responsive control policies. The second component of this paper moves through each of the five phases to describe ongoing and potential strategies to control infectious diseases that

incorporate our understanding of rural-to-urban migration in China. Through using this framework, we are able to draw broader portraits that connect the *migration process*, not simply migrant individuals, to explain risk and tailor effective control programmes.

Search strategy and selection criteria

The systematic review search strategy for the first component of the review (burden of disease) retrospectively analysed studies that included a quantitative measure of the burden of one of the selected infectious diseases among migrants in China. The review of published work was done in several phases, with PRISMA guidelines. Potentially relevant articles were selected from four English databases (Pubmed, EMBASE, Ovid and PsycInfo) and four Chinese databases (CNKI, Wanfang, CBM and VIP). Search terms included “China” AND (“migrant” OR “peasant worker” OR “migrant worker” OR “rural to urban” OR “work personnel” OR “peasant laborer” OR “mobile population” OR “floating population”) and one or more terms corresponding to the identified infectious disease. Only papers that identified migrant infectious disease epidemiology were included. The search algorithm was restricted to articles published in any language before 20 November 2012.

Abstracts were checked for relevance and had to meet the following criteria to be included: individual participants were entirely or partly (with disaggregation) rural-to-urban migrants; biomarker specimens were taken from Chinese residents and tested for an infectious disease; and sufficient detail was provided regarding test methodology, specificity, and sensitivity. All full-text articles meeting eligibility criteria were independently analysed by two reviewers before final inclusion. Data from selected full text research manuscripts were recorded.

Results

The migrant infectious disease burden of disease search identified 368 citations (figure 2). These research studies included airborne, blood-borne, sexually transmitted, and mosquito-borne infections.

Airborne infectious diseases

Airborne infections are generally transmitted by inhalation of respiratory droplets containing a pathogen, providing an opportunity for a local epidemic to travel along established routes of human movement. Several airborne pathogens have expanded along migration routes in recent years, which calls for a further investigation of the travel phase of migration. Higher burden of vaccine-preventable diseases in pre-departure areas as well as barriers to accessing health services at destinations further exacerbate these travel-specific risks. Tuberculosis, SARS and influenza are all airborne infectious diseases that demonstrate the close link between the travel phase of migration and airborne infectious disease transmission.

Tuberculosis is primarily a migrant disease in middle and high-income nations¹³ and so it is not surprising that widespread movement within China may expand local TB transmission. In 2010 there were 429,812 smear-positive pulmonary tuberculosis cases in China, with migrants accounting for 7.0% (29,924).¹⁴ There are at least two separate mechanisms that likely underpin this relationship: the rural-to-urban migration of individuals from higher prevalence western and central provinces to lower prevalence eastern regions (higher pre-departure burden);¹⁵ and the cramped living conditions of migrant populations resulting in increased risk of acquisition (travel and destination conditions).¹⁶ But beyond biomedical explanations alone there are also specific aspects of social and cultural practices among Chinese migrants that predispose them to tuberculosis. Both micro-level variations in cultural

beliefs about illness and macro-level political and environmental influences can increase tuberculosis risk.¹⁷ Non-permanent residents in urban areas and those who travel have been found to have a higher risk of multi-drug resistant tuberculosis in China.¹⁸⁻²⁰ Returning migrants can also bring back urban-acquired TB infection to their home village.²¹ Tuberculosis epidemiology in China demonstrates how travel and destination phases can accelerate onward transmission.

SARS is another key airborne infection, with high transmission rates and high mortality.²² Epidemiological studies of SARS found that migrant labourers comprised a substantial portion of all cases reported.²³ A spatial analysis of SARS cases in mainland China found that locations with national highways or inter-provincial freeways showed the highest risk of SARS, adjusting for population density and medical capacity.²⁴ These same highways are the main arteries used by rural-to-urban migrants, revealing how travel-specific phases of migration could enhance SARS transmission. In addition to these biomedical data, anthropologists have described how the marginalized position of some migrants and their inadequate access to medical services further made them susceptible to SARS infection.²⁵

Influenza was associated with 652 deaths in China during 2009 and has clear public health importance. The particular ecology of south China is uniquely well-suited to influenza interspecies transmission, creating conditions that are frequently associated with the emergence of new influenza strains. Although the existing epidemiological data do not suggest that rural-to-urban migrants are at a greater risk for influenza compared to their urban counterparts, the travel phase of migration could be critical in accelerating a local influenza epidemic into a regional, national and international one.^{3, 4} Close contact on long train rides (over 40 hours) has been implicated in the spread of H1N1 influenza in China.²⁶ Proximity to airports and highways have also been associated with the disease.²⁷ Influenza vaccination coverage rates are lower in rural areas,^{28, 29} increasing its risk in the pre-departure phase for rural-to-urban migrants.

Measles is a vaccine-preventable airborne virus that is highly contagious and associated with poor outcomes in immunocompromised individuals. Measles vaccine is recommended for all children in China.³⁰ However, measles remains an important airborne disease more common among migrants. In 2010 the World Health Organization reported that China had a total of 44,597 confirmed measles cases.³¹ Migrant children have been at the forefront of China's measles epidemic, likely related to their lower rates of receiving the measles vaccine³² (higher pre-departure burden) and their greater reliance on unlicensed private physicians³³ (inadequate destination services). Differential access to high-quality preventive medical services at urban migrant destinations likely contributes to this trend. Many migrants are either not registered or have a temporary residence permit that does not confer the full health care service benefits entitled to local urban residents.^{9, 34}

Blood-borne infectious diseases

Blood-borne infections such as hepatitis B virus (HBV) and hepatitis C virus (HCV) are more common among subsets of migrants.^{35, 36} Much of this transmission reflects blood donation in central rural China during the mid-1990s alongside incomplete HBV vaccination coverage in the same regions, creating a higher pre-departure burden of disease. Migration of these individuals to urban China has created new public health needs. Since China's HIV epidemic

is predominantly sexually transmitted,³⁷ we will cover HIV in the sexually transmitted infection section. This section explores hepatitis B virus (HBV) and hepatitis C virus (HCV).

HBV is a vaccine preventable disease that causes cirrhosis and liver failure. Among the 350 million individuals infected with HBV worldwide, approximately one-third are in China.³⁸ The majority of cases of chronic HBV are related to perinatal transmission or early childhood transmission in China.³⁹ Chinese health authorities recommended vaccinating all infants in 1992, and widespread implementation of HBV vaccination started around 2002.³⁰ However, rural areas have been slower to implement the Expanded Program on Immunization compared to urban areas, resulting in low HBV vaccination coverage rates in rural areas (pre-departure phase).⁴⁰ At the destination phase, migrants may not be eligible for routine free HBV vaccines compared to urban resident counterparts.⁴¹ As a result of these two trends, low rates of HBV vaccination among young migrants in Beijing and Shanghai have been reported.^{32, 42}

Hepatitis C virus is another blood-borne pathogen that is more common in central China. The prevalence of HCV in China is 10 times greater than the United States, thought to be related to increased injection drug use⁴³ and professional blood donation.⁴⁴ One large study of HCV in Guangdong Province found a higher prevalence among migrants.³⁶ Harm-reduction programmes such as needle exchanges and methadone clinics can protect injection drug users from HCV infection to some extent.⁴⁵ However, migrants are generally not eligible for these programmes⁴⁶ and may be more difficult to retain over time.⁴⁷ Since there is no HCV vaccine, prevention is critical.

Sexually transmitted infections (STI)

Sexually transmitted diseases are often more common among subsets of migrants. Away from their spouses or the influence of extended family structures, rural-to-urban migrants may have greater risk of having multiple sex partners, unprotected and/or commercial sex.⁴⁸ Higher prevalence of several STIs, including syphilis, HIV and HPV have been noted among migrants in China.⁴⁹⁻⁵³

Syphilis is a bacterial STI that can be easily cured with penicillin. China has a resurgent syphilis epidemic, and the disease has become the most commonly reported infectious disease in many urban regions of China.⁵⁴ Migrant women in Shanghai have higher rates of stillbirth attributable to syphilis compared to local women. The context of delayed prenatal care among migrant populations likely explains some portion of syphilis-attributable stillbirths. Universal first-trimester syphilis screening and treatment could nearly eradicate syphilis among pregnant women and their offspring, but operationalizing this is challenging in the Chinese context.

HIV is the leading cause of infectious disease death over the past three years in China (table 1). There are an estimated 780,000 people living with HIV in China, with approximately 48,000 newly infected in 2011.⁵⁵ According to national HIV data from the National Center for AIDS Control and Prevention, migrants accounted for 12.7 per cent of all HIV cases in 2007 and 20.8 per cent of all HIV cases in 2010⁵⁰⁻⁵² (figure 3). A systematic review of 54 Chinese studies found that over half of HIV cases in urban areas were rural-to-urban migrants.⁵⁶ There are several potential explanations for this trend, including HIV-infected individuals seeking better health care in urban regions, worse stigma in rural areas and the ability to start a new identity at the destination. No empirical research has evaluated these

explanations, but the lack of rural health services to serve HIV-infected individuals has been noted before.

The HIV prevalence of migrants is lower than other traditional most-at-risk populations (MARPs, e.g., men who have sex with men, female sex workers and intravenous drug users) in China, although a large share of MARPs are also migrants.³⁷ Migrants in China are a heterogeneous group that includes individuals at a higher and lower risk of HIV infection. Among studies of China migrants between 2000 and 2010, the HIV prevalence ranged from 0% to 1.5 per cent in 10 separate provinces.⁵⁷⁻⁸¹ A higher HIV prevalence was noted among migrants in regions that have greater intravenous drug use, such as Yunnan Province.⁷⁶⁻⁷⁸ The highest HIV prevalence (1.5 per cent) among migrants was reported in Nanning, Guangxi Province.⁷⁹ The China Center for Disease Control and Prevention estimated that the prevalence of HIV among migrants in 2009 was 0.08 per cent.¹ Owing to China's large migrant population, its comparatively low prevalence still represents a substantial portion of the Chinese HIV burden.

Although HIV prevalence is low among migrants, persistent high risk sexual behaviours suggest the potential for onward transmission. One study found that 20 per cent of migrants workers had engaged in commercial sex.⁶³ Studies of migrant sexual behaviour have shown low rates of condom use^{83, 84}—approximately 6-10 per cent of migrants always use condom with their stable sexual partners.^{80, 81, 85} This increased sexual risk could have implications for their rural wives/girlfriends after returning home. The return phase of STI epidemics in China has not been well explored.

Human papillomavirus virus (HPV) is a sexually transmitted vaccine-preventable cause of cervical cancer.⁸⁶ Last year there were 75,434 cervical cancer cases in China and 33,914 deaths attributable to cervical cancer.⁸⁷ Approximately 12 per cent of women in China are estimated to have HPV infection.⁸⁷ Rural areas have a higher burden of invasive cervical cancer. Migrant women in Hong Kong have been found to have a higher risk of invasive HPV infection compared to their local counterparts.⁵³ Although HPV vaccination has been implemented in many regions globally, China has not implemented widespread HPV vaccination.⁸⁸ Migrants may have more risky sex at destinations,⁴⁸ expanding the HPV and STI epidemics.

Mosquito-borne infections

Several major mosquito-borne infections, including Japanese encephalitis and malaria, are more common in pre-departure migrants. A study of malaria in Jiangsu Province China found that 25 per cent of cases were from rural-to-urban migrants and 26 per cent were from overseas Chinese visiting Africa.⁸⁹ Returning Chinese migrant workers from Africa have brought back *P. falciparum* infections.^{90, 91} Migrants who have lower vaccination rates have a higher chance of contracting Japanese encephalitis (JE),⁹¹ a mosquito-borne viral infection that is vaccine preventable. In the context of JE control, incomplete vaccination in pre-departure regions leads to an increased burden of disease among migrants. . This low vaccination rate is complicated by barriers to accessing preventive services at destinations, similar to other infectious diseases discussed. Migration of Chinese within Southeast Asia and Africa also create opportunities to acquire malaria infections during their journeys.⁹²

Migration Phase-Specific Infectious Disease Control Policy Interventions

Examining the burden and distribution of infectious diseases as they relate to the migration process sheds new light on creating more responsive infectious disease surveillance, monitoring and control systems. This section explores how each of the five phases of the migration process (pre-departure, travel, destination, interception and return) has already been leveraged or could be leveraged to improve migrant health (figure 4).

First, the pre-departure phase is a critical driver and potential entry point for migrant health policy reform. Although health reform across China has contributed to decreases in infectious diseases, there are still large inequalities in the burden of disease and control infrastructure.⁹³ Specific pre-departure phase trends such as higher rural burden of disease (especially with tuberculosis and blood-borne diseases), insufficient rural vaccination rates (measles, JE virus, HPV), and limited rural health systems capacity converge to increase the risk of these infectious diseases among migrants. In order to confront the higher burden of HBV in pre-departure regions, enhanced school-based HBV vaccination in specific rural areas has been piloted.⁹⁴ The high rate of school attendance across China makes such efforts wide-reaching in their potential scope. Routine HBV screening at rural blood banks has also been instituted, reaching an older subset of the population.⁹⁵ Expanding school-based and blood bank-based pilots that have been successful for HBV to other preventable infectious diseases (JE virus, HPV, measles) would be a potentially useful control strategy. Unfortunately these types of programmes would not apply to HCV infection for which there is no vaccine available.

Following the pre-departure phase, the travel phase incorporates the period after leaving the pre-departure location and prior to arrival. Within the Chinese context, these transit periods are often spent in buses or trains and may take hours to days.¹⁰ The transit phase is especially important in the context of airborne infectious diseases such as SARS and influenza. The short incubation period of influenza (1-4 days)²⁶ increases the importance of timely surveillance and monitoring systems at key travel points. China now requires an identity card or passport for all train travellers, increasing the feasibility of more extensive epidemiological investigations of the spread of influenza and other airborne infectious diseases in train settings. The nationwide electronic China Information System for Disease Control and Prevention (CISDCP) also helps to accelerate disease reporting about cases in transit.⁹⁶ At the same time, routine influenza surveillance in China still heavily relies on passive hospital-based case reporting⁹⁷ instead of exploiting the train stations and other hubs of human movement. There have been small pilots during influenza outbreaks that focused on more extensive temperature monitoring at schools.⁹⁸ Such community-based monitoring could be expanded to train or bus stations. The high volume of travel at most stations creates substantial logistical challenges for widespread surveillance efforts, but selective monitoring at such sites may be more feasible.⁹⁹ The transit phase is a critical period for understanding and responding to airborne infectious diseases among migrant populations in China.

Destination-phase migrant infectious diseases control policy interventions also show great promise. In the Chinese context, migrant destinations are often urban areas.¹⁰ Destination-phase programmes in this context include vaccination programmes targeting migrant children and disease-specific programmes for adult migrants. Focusing on destination-phase interventions carries the advantage of leveraging existing urban public health and medical infrastructure. Responding to measles, the Chinese public health infrastructure launched a widespread immunization campaign in 2010. Immunization programmes targeting migrant

preschool children were found to be particularly effective.¹⁰⁰ These measles immunization campaigns were packaged as part of a supplementary immunization activity that included vaccines for polio, diphtheria-pertussis-tetanus, meningococcus, and Japanese encephalitis virus.¹⁰⁰ In the field of tuberculosis control, China has instituted free sputum smears and four-drug therapy for migrants, although these programmes do not cover inpatient hospital bills and other out-of-pocket costs that may prevent access.¹⁰¹

Disease-specific destination interventions have also been used for HIV surveillance and control responses. Until recently, HIV prevention efforts in China paid little attention to the migrant population. National HIV sentinel monitoring have not included migrants the last two years⁵¹ and current HIV prevention programmes are estimated to reach less than 1 per cent of the migrant population.¹⁰² There have been few HIV-related interventions targeting migrants in China.^{103, 104} Most of these HIV migrant interventions have focused on increasing HIV awareness instead of behaviour change. Furthermore, most of these interventions have been small pilots^{93, 103, 105} and not theoretically grounded. More research is needed to develop effective and feasible behavioural interventions that target migrants.

Finally, interventions for destination-phase infectious disease control have begun to focus on the prevention and control of other STIs. HIV control has special priority, and other STI control campaigns receive fewer resources and devoted programmes.⁵⁴ STI control interventions have been piloted for migrant women in South China^{53, 102, 106} and need to be scaled up, as do successful pilot programmes for migrants, accompanied by cost-effectiveness studies. Utilizing the destination-specific phase represents a feasible component to enhance health systems for migrants in China.

In addition to vaccination and disease-specific destination-phase programmes, structural health systems issues in urban areas could be effective in alleviating the destination-phase burden of infectious diseases. Lack of insurance among migrants is a major problem that leads to delayed diagnoses and other complications associated with late presentation. Migrant health insurance schemes have already been developed in many regions of China.^{107, 108} For example, Shanghai migrant workers have access to the Shanghai Migrant Worker Hospitalization Insurance and the New Rural Cooperative Medical System.¹⁰⁸ Translating these new programmes into efficient and comprehensive plans will take time, but is critical for destination-phase infectious disease control efforts. Other structural interventions such as stigma-reduction campaigns for health care providers could be useful to promote health-seeking behaviours and establish trusting physician-patient relationships.

The interception phase refers to situations of detention or interim residence, chiefly among forced migrants.¹² China's enormous rural-to-urban migration has underpinned much of the rapid economic growth during the past 30 years, so there are relatively few instances in which rural-to-urban migration is forced. The detention of female migrant sex workers in China likely serves to increase social suffering and may exacerbate STI risk. Female sex workers in China are often fined, detained or placed in "re-education through labour camps."¹⁰⁹ Women who are detained for selling sex are not processed through courts, but rather dealt with through the administrative detention system. Individual police make decisions about how to enforce regulations against women selling sex. Although the interception phase does not appear to be a useful strategy in China, the larger ethical and social context of internal migration is important for ensuring migrant health.

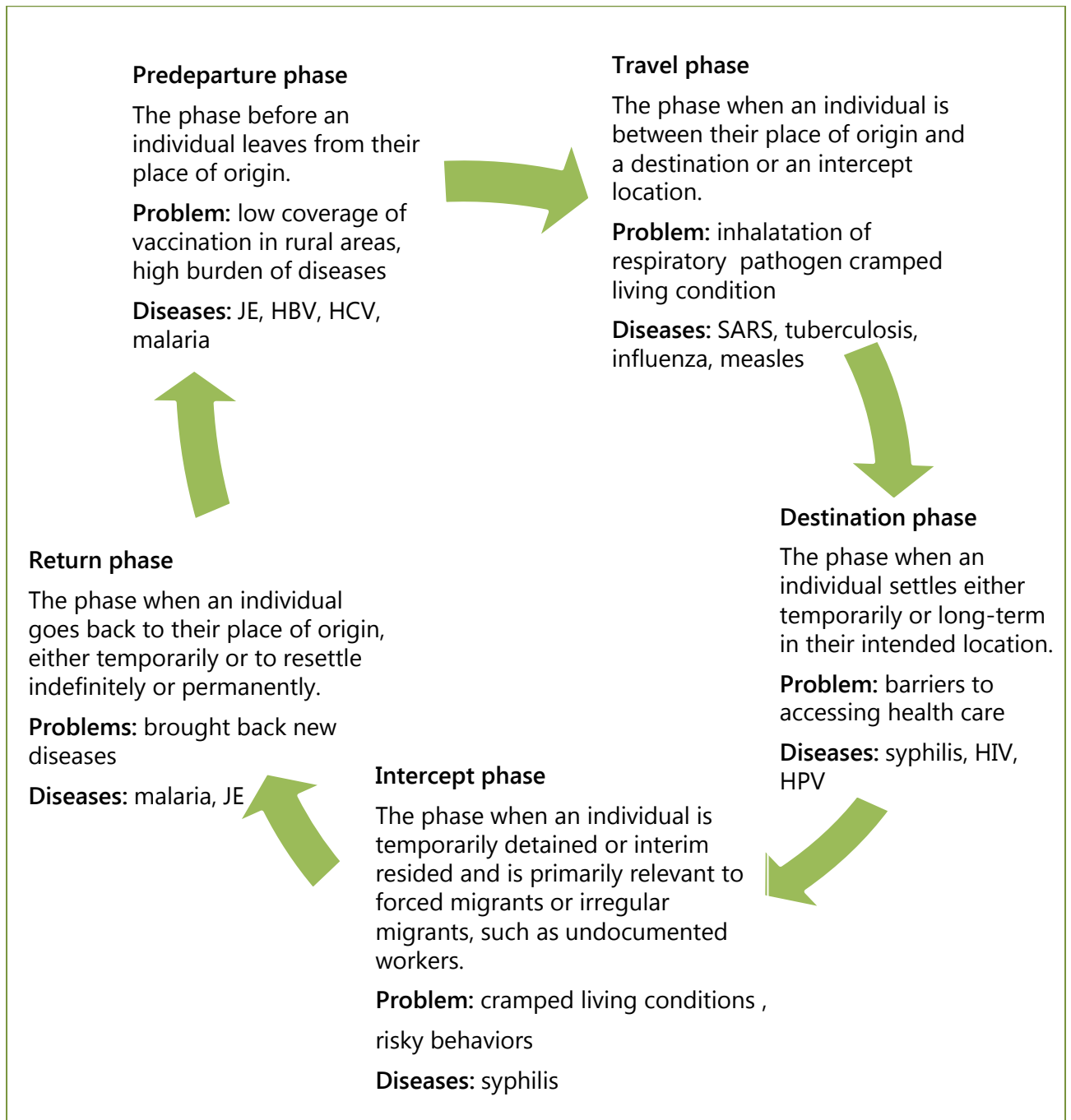
Finally, the return phase refers to when migrants return to their place of origin, either temporarily or permanently. This phase can represent an opportunity for an infectious disease acquired in the urban destination to be spread among individuals in origin locations. There is less research undertaken in many migrant origin communities in China, limiting the extent to which we understand how migrant behaviours influence their origin communities. A higher prevalence of STIs has been reported in rural parts of China that do not usually have increased STI risk,¹¹⁰ raising the possibility that migrants have returned with untreated STIs. Research has also suggested that migrants returning to their rural origins may have persistently risky sexual behaviours.¹¹¹ New models for tuberculosis detection and treatment that encompass the return phase have been developed in China. A 60-county pilot provided free tuberculosis services to all individuals, regardless of migration status. Records of individuals who moved during their course of therapy were moved with them.¹¹² Between 2006 and 2008 this new system screened approximately 23 million migrants for tuberculosis and had over 90 per cent cure rates. This pilot has since been gradually expanded nationwide, accounting for the relationship between migration and tuberculosis spread.¹¹² The availability of health systems, records and providers at both destinations and origins was critical. Migrants who have to pay for hospital expenses out of pocket in urban areas may return to rural locations for less expensive health services. Several pilot schemes for expanded migrant health insurance have been effective, warranting scale-up and further implementation research.

Conclusion

Our analysis of migration and infectious diseases in China highlights several important lessons for the development of migrant health policy. The dynamic nature of China's population has laid the foundation for the expansion of many infectious diseases, but the same powerful social forces that promoted migration could also be used to generate more effective and sustainable surveillance and interventions. The spread of vaccine preventable diseases (measles, hepatitis B virus and HPV) in China underscores the need for more robust vaccination systems for rural residents and urban migrants. The need for integration of disease control mechanisms across borders is another priority, with promising pilots from tuberculosis control efforts showing how this could be achieved. One cross-cutting theme was inadequate health care access and suboptimal health insurance coverage, contributing to seeking care at unlicensed physicians or other informal settings. Effective pilot programmes need to be scaled up and new programmes will be needed in order to achieve health equity among Chinese migrants.

Figures

Figure 1: Impact of migration phases on infectious disease spread



JE=Japanese encephalitis. HBV=hepatitis B virus. HCV=hepatitis C virus. SARS= severe acute respiratory syndrome. HIV=human immunodeficiency virus. HPV= human papillomavirus.

Figure 2: Schematic outlining systematic review of migrant infectious disease burden

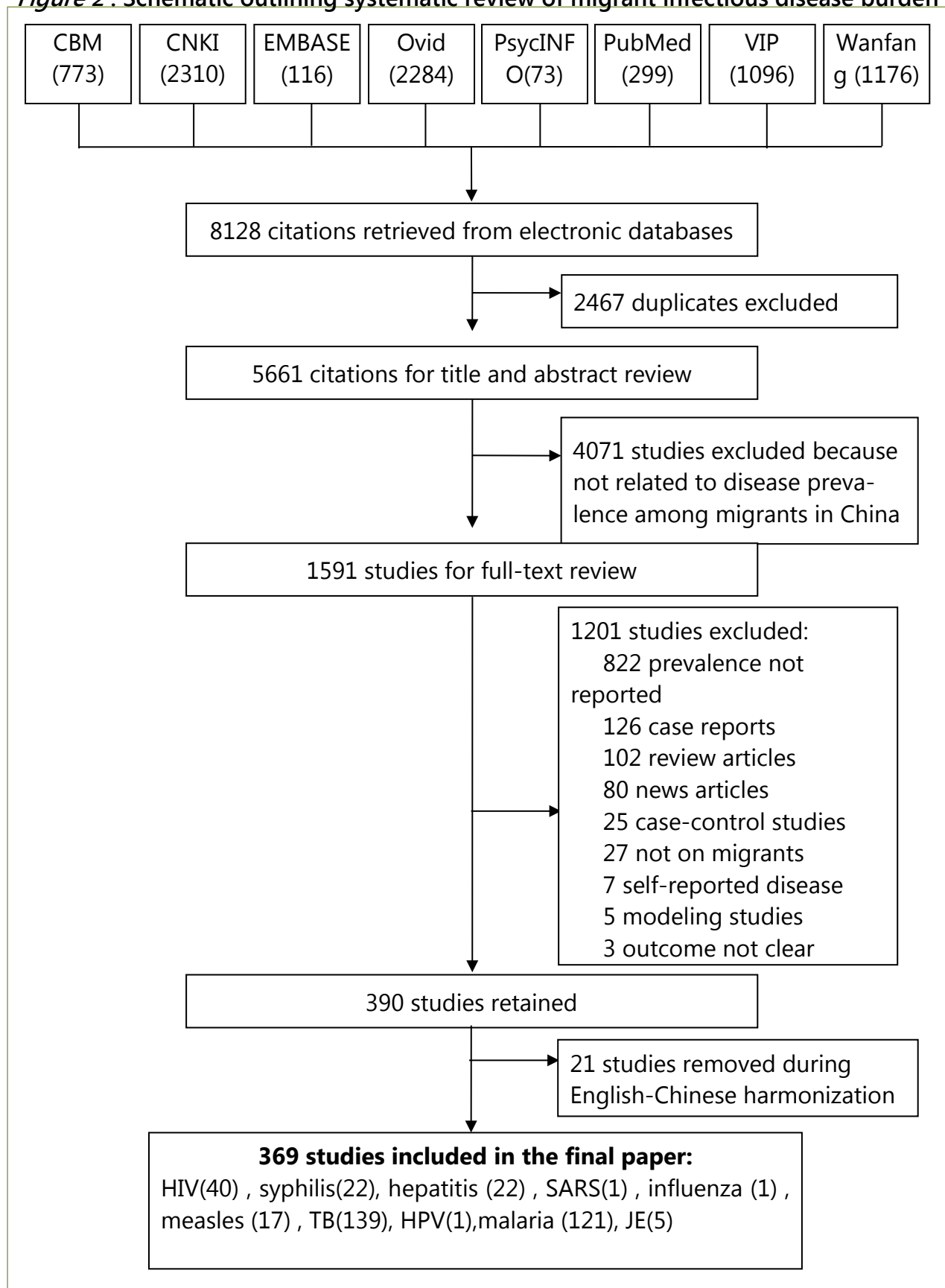


Figure 3: Proportion of migrants among reported HIV cases in China, January 2007 - June 2010¹

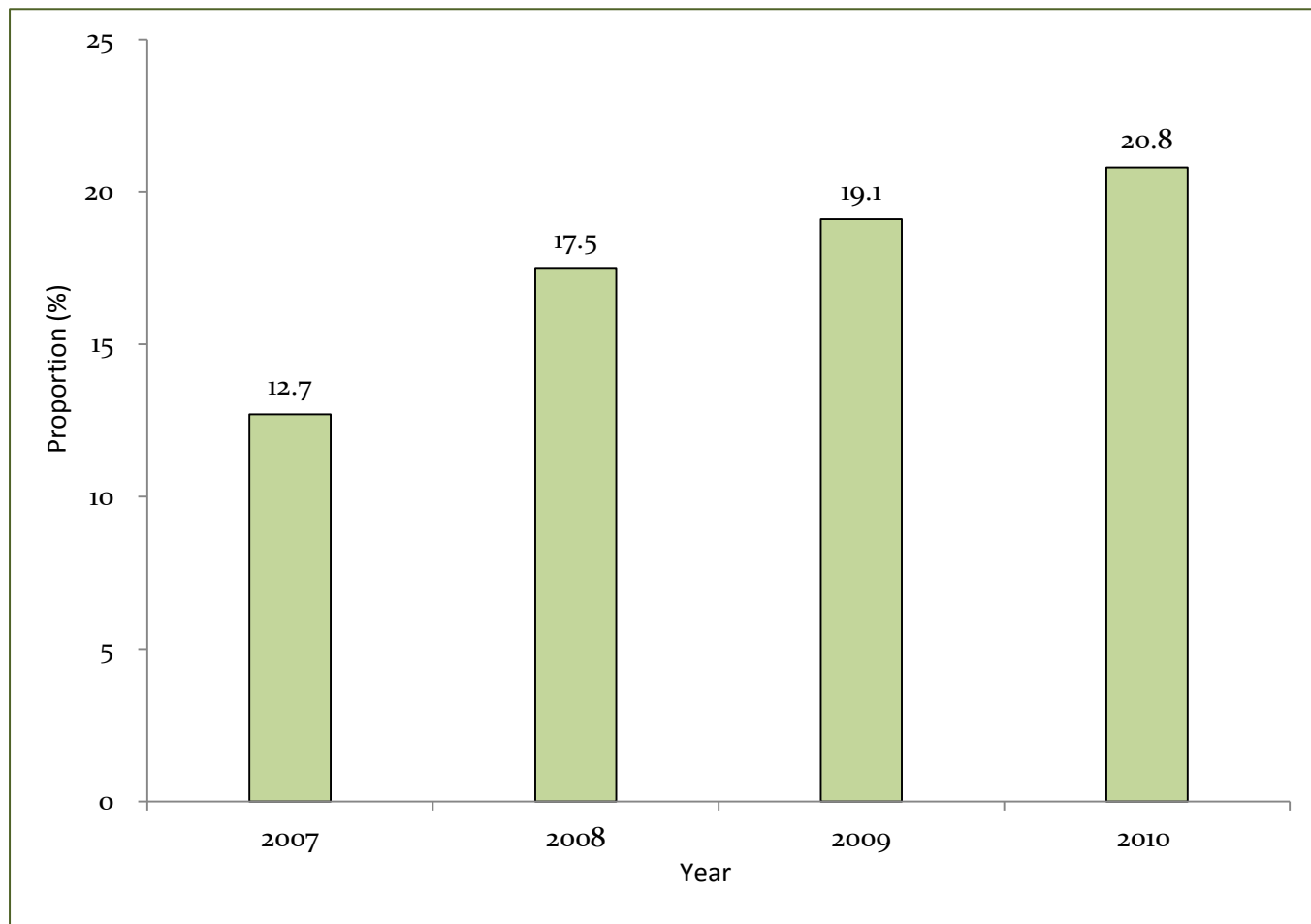
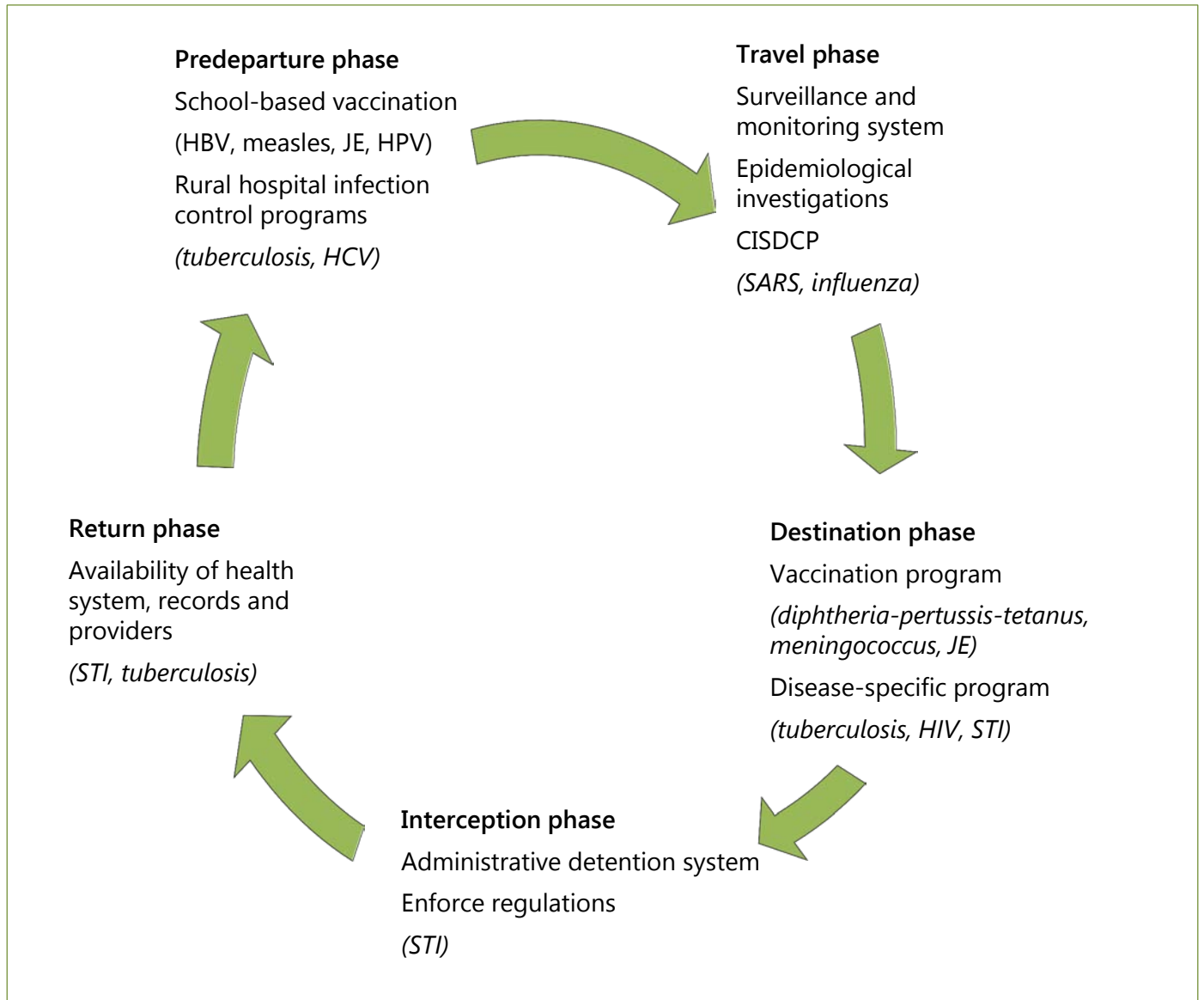


Figure 4: Migration phase-specific infectious diseases control policy interventions



HBV=hepatitis B virus. JE=Japanese encephalitis. HPV= human papillomavirus. HCV=hepatitis C virus. CISDCP= China Information System for Disease Control and Prevention. SARS= severe acute respiratory syndrome. HIV=human immunodeficiency virus. STI= sexually transmitted infections

Table 1: Infectious diseases associated with highest mortality between 2004 and 2010 in China (Data from Ministry of Health of the People's Republic of China)

Year	No. of cases of mortality (in decreasing order)									
	1	2	3	4	5	6	7	8	9	10
2004	Rabies 2651	Tuberculosis 1435	Viral hepatitis 1059	AIDS 741	Tetanus 300	Hemorrhagic fever 254	JE 200	Meningococcal disease 165	BDIA 141	Other 75
2005	Tuberculosis 6713	Rabies 2545	AIDS 1316	Viral hepatitis 1208	Tetanus 306	Hemorrhagic fever 271	JE 214	Meningococcal disease 206	BDIA 137	Syphilis 74
2006	Tuberculosis 3339	Rabies 3215	Viral hepatitis 1352	AIDS 1331	JE 463	Tetanus 263	Hemorrhagic fever 173	Meningococcal disease 156	BDIA 111	Other 91
2007	AIDS 3904	Tuberculosis 3669	Rabies 3300	Viral hepatitis 1122	JE 227	Tetanus 207	Hemorrhagic fever 145	Meningococcal disease 124	BDIA 71	Other 68
2008	AIDS 5389	Tuberculosis 2802	Rabies 2373	Viral hepatitis 1049	Tetanus 191	JE 142	HFMD 126	Meningococcal disease 110	Hemorrhagic fever 103	Measles 102
2009	AIDS 6596	Tuberculosis 3783	Rabies 2131	Viral hepatitis 1018	H1N1 652	HFMD 353	JE 172	Tetanus 137	Hemorrhagic fever 104	Meningococcal disease 73
2010	AIDS 7743	Tuberculosis 3000	Rabies 2014	HFMD 905	Viral hepatitis 884	H1N1 147	Hemorrhagic fever 118	JE 92	Tetanus 86	Syphilis 69
2011	AIDS 9224	Tuberculosis 2840	Rabies 1879	Viral hepatitis 830	HFMD 509	Hemorrhagic fever 119	Syphilis 75	H1N1 75	JE 63	Tetanus 52

AIDS=acquired immunodeficiency syndrome. JE=Japanese encephalitis. BDIA=bacillary dysentery and intestinal amebiasis. HFMD=hand-foot-mouth disease. H1N1=influenza A virus subtype H1N.

References

1. Meng X, Wang L, Chan S, Reilly KH, Peng Z, Guo W, et al. *Estimation and projection of the HIV epidemic trend among the migrant population in China*. *Biomed Environ Sci*. 2011; **24**(4): 343-8.
2. Wang L, Wang Y, Jin S, Wu Z, Chin DP, Koplan JP, et al. "Emergence and control of infectious diseases in China." *Lancet*. 2008; **372**(9649): 1598-605.
3. Hsu LY, Lee CC, Green JA, Ang B, Paton NI, Lee L, et al. "Severe acute respiratory syndrome (SARS) in Singapore: clinical features of index patient and initial contacts." *Emerging Infectious Diseases*. 2003; **9**(6): 713-7.
4. Booth CM, Matukas LM, Tomlinson GA, Rachlis AR, Rose DB, Dwosh HA, et al. "Clinical features and short-term outcomes of 144 patients with SARS in the greater Toronto area." *JAMA: Journal of the American Medical Association*. 2003; **289**(21): 2801-9.
5. Hu X, Cook S, Salazar MA. "Internal migration and health in China." *Lancet*. 2008; **372**(9651): 1717-9.
6. Fan CC. *China on the Move : Migration, the State, and the Household*. London; New York: Routledge; 2008.
7. Pang X, Zhu Z, Xu F, Guo J, Gong X, Liu D, et al. "Evaluation of control measures implemented in the severe acute respiratory syndrome outbreak in Beijing." 2003. *JAMA: Journal of the American Medical Association*. 2003; **290**(24): 3215-21.
8. Yip WC, Hsiao WC, Chen W, Hu S, Ma J, Maynard A. "Early appraisal of China's huge and complex health-care reforms." *Lancet*. 2012; **379**(9818): 833-42.
9. Biao X. *Migration and Health in China: Problems, Obstacles and Solutions*. Singapore: Asian MetaCentre for Population and Sustainable Development Analysis; 2005.
10. Solinger DJ. *Contesting Citizenship in Urban China : Peasant Migrants, the State, and the Logic of the Market*. Berkeley: University of California Press; 1999.
11. Ministry of Health of the People's Republic of China. 2004-2012 [cited; Available from: <http://www.moh.gov.cn/publicfiles/business/htmlfiles/mohjbyfkzj/s2907/index.htm>
12. Zimmerman C, Kiss L, Hossain M. "Migration and health: a framework for 21st century policy-making." *PLoS Med*. 2011; **8**(5): e1001034.
13. Orcau A, Cayla JA, Martinez JA. "Present epidemiology of tuberculosis. Prevention and control programs." *Enfermedades Infecciosas y Microbiologia Clinica*. 2011; **29 Suppl 1**: 2-7.
14. Du X, Liu E, Cheng S. "Characteristics of new smear positive pulmonary tuberculosis in floating population in 2010." *China Journal of Antituberculosis*. 2011; **33**: 461-5.
15. Jiang SW, Wang J, Liu XQ, Zhou GC. ["Tuberculosis Control and Progress among Floating Population in China."] Chinese Antituberculosis Association and TB Control Committee Academic Conference. Xinjiang Uygur Autonomous Region, China. 2008.
16. Tao HB, Ye JJ, Miao WJ, Hou SY, Xiong GL, Yu Y, et al. ["Relevant factors of tuberculosis incidence among people in close contact with active tuberculosis case in rural areas."] *Chinese Journal of Public Health*. 2010; (02): 152-3. Chinese.

17. Ho MJ. "Sociocultural aspects of tuberculosis: A literature review and a case study of immigrant tuberculosis." *Soc Sci Med.* 2004; **59**(4): 753-62.
18. Law WS, Yew WW, Chiu Leung C, Kam KM, Tam CM, Chan CK, et al. "Risk factors for multidrug-resistant tuberculosis in Hong Kong." *Int J Tuberc Lung Dis.* 2008; **12**(9): 1065-70.
19. Wong MY, Leung CC, Tam CM, Kam KM, Ma CH, Au KF. "TB surveillance in correctional institutions in Hong Kong, 1999-2005." *Int J Tuberc Lung Dis.* 2008; **12**(1): 93-8.
20. Wang W, Wang J, Zhao Q, Darling ND, Yu M, Zhou B, et al. "Contribution of rural-to-urban migration in the prevalence of drug resistant tuberculosis in China." *Eur J Clin Microbiol Infect Dis.* 2011; **30**(4): 581-6.
21. Wang L, Wang X. "Influence of temporary migration on the transmission of infectious diseases in a migrants' home village." *J Theor Biol.* 2012; **300**: 100-9.
22. Hui DS, Chan PK. "Severe acute respiratory syndrome and coronavirus." *Infect Dis Clin North Am.* 2010; **24**(3): 619-38.
23. Distribution of Confirmed SARS Cases Occupation: Ministry of Health; 2003.
24. Fang LQ, de Vlas SJ, Feng D, Liang S, Xu YF, Zhou JP, et al. "Geographical spread of SARS in mainland China." *Trop Med Int Health.* 2009; **14 Suppl 1**: 14-20.
25. Biao X. "SARS and Migrant Workers in China." *Asian and Pacific Migration Journal.* 2003; **12**: 467-99.
26. Cui F, Luo H, Zhou L, Yin D, Zheng C, Wang D, et al. "Transmission of pandemic influenza A (H1N1) virus in a train in China." *J Epidemiol.* 2011; **21**(4): 271-7.
27. Fang LQ, Wang LP, de Vlas SJ, Liang S, Tong SL, Li YL, et al. "Distribution and Risk Factors of 2009 Pandemic Influenza A (H1N1) in Mainland China." *Am J Epidemiol.* 2012; **175**(9): 890-7.
28. Feng L, Mounts AW, Feng Y, Luo Y, Yang P, Feng Z, et al. "Seasonal influenza vaccine supply and target vaccinated population in China, 2004-2009." *Vaccine.* 2010; **28**(41): 6778-82.
29. Wu SS, Yang P, Li HY, Ma CN, Zhang Y, Wang QY. ["The coverage rate and obstructive factors of influenza vaccine inoculation among residents aged above 18 years in Beijing from 2007 to 2010".] *Zhonghua yu fang yi xue za zhi* [Chinese journal of preventive medicine.] 2011; **45**(12): 1077-81.
30. Zheng J, Zhou Y, Wang H, Liang X. "The role of the China Experts Advisory Committee on Immunization Program." *Vaccine.* 2010; **28 Suppl 1**: A84-7.
31. Reported measles cases and incidence rates by WHO Member States, 2011. Geneva: WHO; 2011.
32. Sun M, Ma R, Zeng Y, Luo F, Zhang J, Hou W. "Immunization status and risk factors of migrant children in densely populated areas of Beijing, China." *Vaccine.* 2010; **28**(5): 1264-74.
33. Gao J, He HQ, Shen JC, Huang ZY, Ma HL, Luo SY, et al. ["An outbreak of measles among unvaccinated migrant population in Zhejiang province, from June to August, 2010".] *Zhonghua Liu Xing Bing Xue Za Zhi.* 2010; **31**(10): 1163-5. Chinese.

34. Hesketh T, Ye XJ, Li L, Wang HM. "Health status and access to health care of migrant workers in China." *Public Health Rep.* 2008; **123**(2): 189-97.
35. Liang X, Bi S, Yang W, Wang L, Cui G, Cui F, et al. "Epidemiological serosurvey of hepatitis B in China—Declining HBV prevalence due to hepatitis B vaccination." *Vaccine.* 2009; **27**(47): 6550-7.
36. Fu Y, Xia W, Wang Y, Tian L, Pybus OG, Lu L, et al. "The seroprevalence of hepatitis C virus (HCV) among 559,890 first-time volunteer blood donors in China reflects regional heterogeneity in HCV prevalence and changes in blood donor recruitment models." *Transfusion.* 2010; **50**(7): 1505-11.
37. Wang N, Wang L, Wu Z, Guo W, Sun X, Poundstone K, et al. "Estimating the number of people living with HIV/AIDS in China: 2003-09." *Int J Epidemiol.* 2010; **39** Suppl 2: ii21-8.
38. Custer B, Sullivan SD, Hazlet TK, Iloeje U, Veenstra DL, Kowdley KV. "Global epidemiology of hepatitis B virus." *Journal of Clinical Gastroenterology.* 2004; **38**(10 Suppl 3): S158-68.
39. Wang Y, Jia J. "Control of hepatitis B in China: Prevention and treatment." *Expert Rev Anti Infect Ther.* 2011; **9**(1): 21-5.
40. Sun Z, Ming L, Zhu X, Lu J. "Prevention and control of hepatitis B in China." *J Med Virol.* 2002; **67**(3): 447-50.
41. Liang X, Bi S, Yang W, Wang L, Cui G, Cui F, et al. "Evaluation of the impact of hepatitis B vaccination among children born during 1992-2005 in China." *The Journal of infectious diseases.* 2009; **200**(1): 39-47.
42. Sun J, Chen J, Yao Y, Zhang R, Zheng Y, Liu L, et al. "Minimum effective plasma concentration of efavirenz in treatment-naïve Chinese HIV-infected patients." *International Journal of STD and AIDS.* 2010; **21**(12): 810-3.
43. Gong JM, Li L, Wang HP, Tang WM, Yang HT, Zhang Y. ["Correlated Factors of Hepatitis C Virus Infection among Injection Drug Users".] *Pharmaceutical Biotechnology.* 2011; (01): 61-5. Chinese.
44. Dong R, Qiao X, Jia W, Wong M, Qian H, Zheng X, et al. "HIV, HCV, and HBV co-infections in a rural area of Shanxi province with a history of commercial blood donation." *Biomed Environ Sci.* 2011; **24**(3): 207-13.
45. Chan DP, Lee SS, Lee KC. "The effects of widespread methadone treatment on the molecular epidemiology of hepatitis C virus infection among injection drug users in Hong Kong." *J Med Virol.* 2011; **83**(7): 1187-94.
46. Work Program of Community-Based Methadone Maintenance Treatment for Opioid Addicts. In: *Ministry of Health Report: National Center for Disease Control and Prevention;* 2006.
47. Zhao X, Zhang J, Chen R. "A Survey on Reasons of Dropout of Clients in Methadone Maintenance Treatment." *Journal of Applied Preventive Medicine.* 2010; **17**(1): 171-2.
48. Li X, Fang X, Lin D, Mao R, Wang J, Cottrell L, et al. "HIV/STD risk behaviors and perceptions among rural-to-urban migrants in China." *AIDS Educ Prev.* 2004; **16**(6): 538-56.
49. Zhu L, Qin M, Du L, Xie RH, Wong T, Wen SW. "Maternal and congenital syphilis in Shanghai, China, 2002 to 2006." *Int J Infect Dis.* 2010; **14** Suppl 3: e45-8.

50. Burke RC, Sepkowitz KA, Bernstein KT, Karpati AM, Myers JE, Tsoi BW, et al. "Why don't physicians test for HIV? A review of the US literature." *AIDS*. 2007; **21**(12): 1617-24.
51. Benefo KD. "Determinants of Zambian men's extra-marital sex: A multi-level analysis." *Archives of Sexual Behavior*. 2008; **37**(4): 517-29.
52. Keiser O, Tweya H, Boulle A, Braitstein P, Schechter M, Brinkhof MW, et al. "Switching to second-line antiretroviral therapy in resource-limited settings: Comparison of programmes with and without viral load monitoring." *AIDS*. 2009; **23**(14): 1867-74.
53. Wong WC, Wun YT, Chan KW, Liu Y. "Silent killer of the night: A feasibility study of an outreach well-women clinic for cervical cancer screening in female sex workers in Hong Kong." *Int J Gynecol Cancer*. 2008; **18**(1): 110-5.
54. Tucker JD, Cohen MS. "China's syphilis epidemic: Epidemiology, proximate determinants of spread, and control responses." *Curr Opin Infect Dis*. 2011; **24**(1): 50-5.
55. National Center for AIDS/STD Control and Prevention, Chinese Centre for Disease Control and Prevention. 2011. "Estimates for the HIV/AIDS epidemic in China." Available at <http://www.chinaids.org.cn/n16/n1193/n4073/727891.html>, accessed 22 November, 2012. 2011: Chinese.
56. Zhang L, Chow EPF, Jahn HJ, Kraemer A, Wilson DP. "High HIV Prevalence and Risk of Infection among Rural-to-urban Migrants in Various Migration Stages in China: A Systematic Review and Meta-Analysis." *Sexually Transmitted Diseases*. In press.
57. Cai W, Lv JY, Wang N. ["A Survey on Sexually Transmitted Disease among Migrant Workers in Heze City".] *Journal of Huaihai Medicine*. 2005; **23**(4): 303. Chinese.
58. Tan Y, Wang T, Li L, Wang M, Lai XH, He BH, et al. ["Survey on Prevalence of HIV and Syphilis Among Migrants in Zhongshan in 2010".] *Practical Preventive Medicine*. 2011; **18**(5): 803-5. Chinese.
59. Li DM, Liu YW, Huang Y, Tan AJ. ["Survey on knowledge,behavior of AIDS and HIV prevalence among migrant workers."] *Chinese Journal of Health Education*. 2007; **23**(5): 346-8. Chinese.
60. Tang HL, Wu ZH, Xu YJ, Zhang CD, Zhang XF. ["Investigation on current status of AIDS infection and AIDS-related knowledge among out-migrant workers in Dongyang."] *Modern Preventive Medicine*. 2009; **36**(6): 1117-8, 29. Chinese.
61. Ruan JJ, Luo SY, Zhu BX, Tao JB. ["A sentinel surveillance analysis on AIDS among migrants in Yiwu City."] *Zhejiang Journal of Preventive Medicine*. 2010; **22**(10): 38-9. Chinese.
62. Jiang YF, Ren J, Cai YQ, Guo ZH, Guo WJ, Yao J, et al. ["HIV/syphilis prevalence and HIV knowledge among female migrants in Zhejiang Province."] *Zhejiang Medical Journal*. 2010; **32**(5): 646-8. Chinese.
63. Jing LH, Cai RE, Shi YC, Yu AQ, Wang YB. ["Results of HIV sentinel surveillance in Yangquan city, 2009."] *Disease Surveillance*. 2010; (07): 554-6. Chinese.
64. Xing AH, Wang LY, Wang JJ, Wang L, Chang WH, Lv F, et al. ["HIV and syphilis prevalence and related behaviors among returning home migrants workers in Shaanxi Province."] *Chinese Journal of AIDS & STD*. 2007; **13**(3): 260-1. Chinese.

65. Wang LJ, Zhou Y, Liu SW. ["A survey on prevalence of HIV and HBsAg among migrant workers in Chongwen, Beijing".] *China Preventive Medicine*. 2006; (06): 541-2. Chinese.
66. Hong PK, Zeng XL, Lai QB, Xie X, Zhang W. ["Jinjiang 2010 of the floating population AIDS monitoring results analysis."] *Jilin Medical Journal*. 2010; **31**(36): 6735-7. Chinese.
67. Guo HJ, Gao FH, Liu C, Zhou YM, Yin XW. ["Evaluation on Anti-AIDS health education and behavior intervention among migrant workers in Ningyang County".] *Preventive Medicine Tribune*. 2010; (10): 881-2,5. Chinese.
68. Cao HJ. "HIV and sexually transmitted disease prevalence, risk behaviors, and stigma against people living with HIV/AIDS among migrant women living in Shanghai, China". US: *ProQuest Information & Learning*; 2010.
69. Hesketh T, Ye XJ, Lu L, Wang HM. "Health status and access to health care of migrant workers in China." *Public Health Reports*. 2008; **123**(2): 189-97.
70. Xiao Y, Wu JC, Huang JS, Sun YM, Zhang HP, Wei X, et al. ["Survey for HIV prevalence and AIDS-related KAP among outgoing country workers in Jiujiang."] *Practical Preventive Medicine*. 2007; **14**(1): 92-3. Chinese.
71. Hu SY, Yuan F, Shi ZH, Jiang QY, Yang JZ, Zhang J, et al. ["An intervention study of the status of HIV infection and preventing AIDS dangerous behavior in the floating population of Guiyang."] *Guizhou Medical Journal*. 2003; **27**(2): 120-2. Chinese.
72. Yan ZZ, Chen ZB. ["A sentinal surveillance analysis among peasant workers in Chongyang County in 2006."] *Journal of Xianning College (Medical Sciences)*. 2007; (06): 534-5. Chinese.
73. Zhang YQ, Shu HY, Liu DY, Kong Y, Zhang CY, Li ZC, et al. ["Investigation on AIDS prevention, infection situation and behavior in peasant workers."] *Chinese Journal of Public Health*. 2008; **24**(1): 8-9. Chinese.
74. Yi ZM, Li XP, Xiong YH, Du DC, Du JG. ["A survey on HIV knowlege and prevalence among returning home peasant workers of a county."] *Practical Preventive Medicine*. 2008; **15**(5): 1611-0. Chinese.
75. Meng XJ, Wang L, Meng XD, Ding GW, Guo W, Ding ZW, et al. ["Investigation on AIDS prevention, infection situation and behavior among peasant workers."] *Modern Preventive Medicine*. 2010; (14): 2696-9. Chinese.
76. Zhao R, Gao H, Shi X, Tucker JD, Yang Z, Min X, et al. "Sexually transmitted disease/HIV and heterosexual risk among miners in townships of Yunnan Province, China." *AIDS Patient Care and STDs*. 2005; **19**(12): 848-52.
77. Gao HC. [*Epidemiology on HIV-1 and sexually transmitted infections in a city of Yunnan Province*]: Southeast China University; 2006.
78. Zhang GL, Md MPH, Wong M, Yi P, Xu JJ, Li BS, et al. HIV-1 and STIs Prevalence and Risk Factors of Miners in Mining Districts of Yunnan, China. 2010 [cited 53; S54-S60.] Available from:
<http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=ovftk&NEWS=N&AN=00126334-201002011-00010>
79. Lan LX. ["Survey on AIDS knowledge and current infection rate in floating population."] *Modern Preventive Medicine*. 2011; (13): 2539-40+42. Chinese.

80. Wang YL, Ding XB, Yi RH, Pan CB, Zheng JQ, Zeng Y, et al. ["Investigation on knowledge and prevalence of AIDS among floating population."] *Chinese Journal of Public Health*. 2006; **22**(11): 1285-7. Chinese.
81. Xu Y. ["Monitoring analysis on AIDS of 400 migrant workers on Changxing Island of Chongming County in Shanghai."] *Chinese Journal of Social Medicine*. 2010; **27**(5): 322-3. Chinese.
82. Guo X, Cheng YM, Li Y, Huang N, Wu JQ, Ru XM. ["Research on prejudice and discrimination against AIDS."] *Maternal and Child Health Care of China*. 2006; **21**(23): 4. Chinese.
83. Wei SL, Zhou SJ, Tan ZY, Li D, Wang QY. ["Survey on HIV/AIDS related prevention knowledge, attitudes and high-risk behavior among migrant workers in Chongqing."] *Chinese Journal of Family Planning*. 2010; **18**(7): 411-3. Chinese.
84. Wang W, Wei C, Buchholz ME, Martin MC, Smith BD, Huang ZJ, et al. "Prevalence and risks for sexually transmitted infections among a national sample of migrants versus non-migrants in China." *International Journal of STD and AIDS*. 2010; **21**(6): 410-5.
85. Liu HJ, Li XM, Stanton B, Liu H, Liang GJ, Chen XG, et al. "Risk factors for sexually transmitted disease among rural-to-urban migrants in China: Implications for HIV/sexually transmitted disease prevention." *AIDS Patient Care and STDs*. 2005; **19**(1): 49-57.
86. Shi JF, Qiao YL, Smith JS, Dondog B, Bao YP, Dai M, et al. "Epidemiology and prevention of human papillomavirus and cervical cancer in China and Mongolia." *Vaccine*. 2008; **26 Suppl 12**: M53-9.
87. *Human Papillomavirus and Related Cancers in China, Summary Report 2010*. Geneva: WHO/ICO Information Centre on HPV and Cervical Cancer (HPV Information Centre); 2010.
88. Li J, Kang LN, Qiao YL. "Review of the cervical cancer disease burden in mainland China." *Asian Pacific Journal of Cancer Prevention : APJCP*. 2011; **12**(5): 1149-53.
89. Zhou HY, Wang WM, Cao J, Zhu GD, Gao Q. ["Epidemiological analysis of malaria situation in Jiangsu Province in 2009."] *Zhongguo xue xi chong bing fang zhi za zhi* [Chinese journal of schistosomiasis control.] 2011; **23**(4): 402-5.
90. Ming G. ["Malaria cases among those worked in and returned from Uganda."] *Zhongguo Ji Sheng Chong Xue Yu Ji Sheng Chong Bing Za Zhi*. 2008; **26**(3): 240, inside back cover.
91. Shan FX, Cheng JQ, Mou J, Zhang SY, He YQ, Xiao JH, et al. ["A survey of Japanese encephalitis antibody migrant workers in Shenzhen 2009."] *Zhonghua Yu Fang Yi Xue Za Zhi*. 2010; **44**(9): 806-9. Chinese.
92. Gao X, Nasci R, Liang G. "The neglected arboviral infections in mainland China." *PLoS neglected tropical diseases*. 2010; **4**(4): e624.
93. Ling RE, Liu F, Lu XQ, Wang W. "Emerging issues in public health: A perspective on China's healthcare system." *Public Health*. 2011; **125**(1): 9-14.
94. Chen JJ, Chang ET, Chen YR, Bailey MB, So SK. "A model program for hepatitis B vaccination and education of schoolchildren in rural China." *Int J Public Health*. 2011.

95. Zhang L, Zhang P, Wang F, Zuo L, Zhou Y, Shi Y, et al. "Prevalence and factors associated with CKD: A population study from Beijing." *Am J Kidney Dis*. 2008; **51**(3): 373-84.
96. Zhong YP. [Design and Implementation of Disease Prevention and Control Information System] Master: East China Normal University; 2006.Chinese.
97. Yang P, Duan W, Lv M, Shi W, Peng X, Wang X, et al. "Review of an influenza surveillance system, Beijing, People's Republic of China." *Emerg Infect Dis*. 2009; **15**(10): 1603-8.
98. Fu J, Chen S, Chen J, Wang J, Ling C. "Epidemiological characteristics of Pandemic Influenza A (H1N1-2009) in Zhanjiang, China." *PanAfrican Medical Journal*. 2011; **10**: 54.
99. ["A notice on Prevention and Control of Human Avian Influenza Disease by Health Department."] *Health Department Official Journal of the Republic of China*. 2004; (03): Chinese.
100. Luo FJ, Liu F, Zhang J. ["The effective evaluation on the supplementary immunization activities among the migrant pre-school children in Chaoyang District of Beijing."] *Zhongguo Yi Miao He Mian Yi*. 2009; **15**(3): 276-8. Chinese.
101. Tobe, RG, Xu L, Song P, Huang Y. "The rural-to-urban migrant population in China: Gloomy prospects for tuberculosis control." *Biosci Trends*. 2011; **5**(6): 226-30.
102. Qian X, Smith H, Huang W, Zhang J, Huang Y, Garner P. "Promoting contraceptive use among unmarried female migrants in one factory in Shanghai: A pilot workplace intervention." *BMC Health Serv Res*. 2007; **7**: 77.
103. Lin DH, Li XM, Stanton B, Fang XY, Lin XY, Xu XYN, et al. "Theory-based HIV-related sexual risk reduction prevention for Chinese female rural-to-urban migrants." *AIDS Educ Prev*. 2010; **22**(4): 344-55.
104. Chen R. [Study on Health Education and Behavioral Intervention Mode for Preventing AIDS among Male Migrants in Rural North Anhui] Master: Anhui Medical University; 2009.Chinese.
105. Ji GP, Hong T, Dong H, Wang HD, Leng J, Pan HP. ["Developing and utilizing IEC materials in migrant workers in Anhui."] *Chinese Journal of Disease Control & Prevention*. 2011; **1**: 16-9. Chinese.
106. Jiang X, Ren S, Hou L, He D, Pang C, Cheng Y. ["Intervention effects of promoting the use of contraceptives in migrant population working in factory."] *Wei Sheng Yan Jiu*. 2011; **40**(1): 82-5. Chinese.
107. Chen JX, Xia TS, Hu XX, He ZB, Zhou ZM, Peng J, et al. ["Analysis on the utilization and influence factors of the community health services of the floating population in Shenzhen City."] *Chinese General Practice*. 2005; (19): 1638-40.Chinese.
108. Zhao DH, Rao KQ, Zhang ZR. "Coverage and utilization of the health insurance among migrant workers in Shanghai, China." *Chinese Medical Journal*. 2011; **124**(15): 2328-34.
109. Tucker J, Ren X, Sapio F. "Incarcerated sex workers and HIV prevention in China: Social suffering and social justice countermeasures." *Soc Sci Med*. 2010; **70**(1): 121-9.
110. Hong Y, Li X, Yang H, Fang X, Zhao R. "HIV/AIDS-related sexual risks and migratory status among female sex workers in a rural Chinese county." *AIDS Care*. 2009; **21**(2): 212-20.

111. Li X, Zhang L, Stanton B, Fang X, Xiong Q, Lin D. "HIV/AIDS-related sexual risk behaviors among rural residents in China: potential role of rural-to-urban migration." *AIDS Educ Prev*. 2007; **19**(5): 396-407.
112. Li X, Zhang H, Jiang S, Wang J, Liu X, Li W, et al. "Active pulmonary tuberculosis case detection and treatment among floating population in China: an effective pilot." *J Immigr Minor Health*. 2010; **12**(6): 811-5.