

UCLA

UCLA Electronic Theses and Dissertations

Title

Antiretroviral Therapy Experience among Domestic Migrants Living with HIV in Guangdong, China

Permalink

<https://escholarship.org/uc/item/3qn1f0q1>

Author

Chen, Jun

Publication Date

2020

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

Los Angeles

Antiretroviral Therapy Experience
among Domestic Migrants Living with HIV
in Guangdong, China

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy
in Epidemiology

By

Jun Chen

2020

© Copyright by

Jun Chen

2020

ABSTRACT OF THE DISSERTATION

Antiretroviral Therapy Experience
among Domestic Migrants Living with HIV
in Guangdong, China

by

Jun Chen

Doctor of Philosophy in Epidemiology
University of California, Los Angeles, 2020
Professor Roger Detels, Chair

Background

This study is to comprehensively investigate antiretroviral therapy (ART) initiation and retention among domestic migrants living with HIV (DMLH) in Guangdong, China.

Methods

Mixed methods were applied in this dissertation. In-depth interviews were conducted among service providers and DMLH. Two retrospective cohort studies based on secondary data were to investigate ART initiation and retention among DMLH from July 1, 2016, to December 31, 2019.

Results

In the first study, there were four levels of barriers to ART initiation and retention. The policy-level challenges were lack of appropriate medical insurance policy for DMLH and lack of effective reward and punishment mechanism for institutions. Barriers from institutions included a lack of cooperation across different institutions and a lack of flexibility in spending government funds. At the service provider level, shortage of experienced service providers and limited career prospects and low salaries were added to the barriers. Challenges identified at the individual level comprised of lack of HIV related knowledge, side effect, inconvenience to take a leave, lack of family support, and fear of stigma.

In the second study, over half of 22,773 participants were DMLH. Inter-provincial migrants were less likely to initiate ART than that among residents (HR=0.90, 95% CI: 0.86~0.94) and intra-provincial migrants (HR=0.90, 95% CI: 0.86~0.94). Compared to those without migration during the follow-up, those moving to their hometown (HR=0.06, 95% CI: 0.05~0.07) and other cities (HR=0.22, 95% CI: 0.17~0.27) were less likely to take ART. The probability of ART initiation among those returning to their hometown was lower than that among those moving to other cities (HR=0.30, 95% CI: 0.22~0.40).

In the third study, the probability of attrition among inter-provincial migrants (HR=1.15, 95% CI: 1.00~1.33) and intra-provincial migrants (HR=1.20, 95% CI: 1.00~1.43) tended to be higher than that among residents in Region A. In Region B, the probability of ART attrition among inter-provincial migrants (HR=0.88, 95% CI: 0.74~1.05) and intra-provincial migrants (HR=0.79, 95% CI: 0.57~1.09) tended to be lower than that among residents.

Conclusion

There were multifaceted barriers for ART initiation and retention among DMLH. Future policies and interventions should properly take domestic migrants' vulnerability and regional disparity into consideration to improve ART initiation and retention.

The dissertation of Jun Chen is approved.

Li Li

Chunqing Lin

Roch Arnaud Kibsa Nianogo

Roger Detels, Committee Chair

University of California, Los Angeles

2020

To my best half and dearest wife, Qianqian Fan

To my wonderful parents Xianxin Chen and Guifang Shen,

To my supportive sisters Lamei, Meigui, and Haifei Chen,

And to my beloved daughter Emilia Yuening Chen,

TABLE OF CONTENTS

LIST of FIGURES	ix
LIST of TABLES	x
LIST of ABBREVIATIONS	xi
Acknowledgement	xii
Vita	xiv
Chapter I	1
Introduction.....	1
Migration and HIV epidemic around the world.....	1
HIV epidemic in China.....	2
Progress of antiretroviral therapy in China	3
Process of management from HIV diagnosis to antiretroviral therapy.....	5
Domestic migrants and health care in China.....	7
Domestic migrants and HIV epidemic in China.....	8
Study aims.....	10
Study site.....	10
Reference.....	15
Chapter II	23
Barriers to ART Initiation and Retention among Domestic Migrants Living with HIV in Guangdong, China: A Qualitative Study.....	23
Abstract.....	23
Introduction.....	25
Methods.....	27
Results.....	30
Discussion.....	44
Reference.....	52
Chapter III	57
Antiretroviral Therapy Initiation among Domestic Migrants Living with HIV in Guangdong, China: A Retrospective Cohort Study.....	57
Abstract.....	57
Introduction.....	59

Methods.....	61
Results.....	65
Discussion.....	68
Appendix.....	82
Reference.....	85
Chapter IV	89
Antiretroviral Therapy Attrition among Domestic Migrants Living with HIV in Guangdong, China: A Retrospective Cohort Study.....	89
Abstract.....	89
Introduction.....	91
Methods.....	93
Results.....	96
Discussion.....	98
Appendix.....	110
Reference.....	113
Chapter V	117
Summary.....	117

LIST OF FIGURES

Figure 1.1 The simplified management system for patients from HIV diagnosis to ART program.....	13
Figure 1.2 Framework for the multilevel determinants of ART initiation and retention.....	14
Figure 1.3 Location of Guangdong Province in China.....	14
Figure 3.1 Flow chart for the cohort study development.....	72
Figure 3.2 The distribution of domestic migrants living with HIV (DMLH) who were newly diagnosed with HIV from July 1, 2016 to December 31, 2018 in Guangdong province.....	73
Figure 3.3 Plots of cumulative probability of ART initiation during the study period.....	78
Figure 4.1 Flow chart for the cohort study development.....	102
Figure 4.2 The distribution of domestic migrants living with HIV (DMLH) who were newly diagnosed with HIV and initiated ART from July 1, 2016 to December 31, 2018 in Guangdong province.....	103
Figure 4.3 Plots of cumulative probability of ART attrition during the study period.....	108

LIST OF TABLES

Table 2.1	Characteristics of service providers in this qualitative study	49
Table 2.2	Characteristics of patients in this qualitative study	50
Table 2.3	Barriers to ART initiation and retention at each level.....	51
Table 3.1	Distribution of participants in this cohort study at the time of HIV diagnosis.....	74
Table 3.2	Characteristics of participants in Region A and Region B.....	75
Table 3.3	Characteristics of participants in this cohort study at the time of HIV diagnosis.....	76
Table 3.4	Cumulative probabilities of ART initiation at specific timepoints.....	77
Table 3.5	Comparison of ART initiation between migration patterns at the baseline.....	79
Table 3.6	Characteristics of domestic migrants with migrations during the follow-up.....	80
Table 3.7	Comparison of ART initiation between migration patterns during the follow-up.....	81
Table S3	Categorization and rationale of variables for ART initiation analysis.....	84
Table 4.1	Distribution of participants and ART clinics across cities in this cohort study.....	104
Table 4.2	Characteristics of participants in Region A and Region B.....	105
Table 4.3	Characteristics of participants in this cohort study at the time of ART initiation....	106
Table 4.4	Cumulative probability of ART attrition at some specific timepoints.....	107
Table 4.5	Comparison of ART attrition between migration patterns at the baseline	109
Table S4	Categorization and rationale of variables for ART attrition analysis.....	112

LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral Therapy
CDC	Center for Disease Control and Prevention
CHC	Community Health Center
DMLH	Domestic Migrants Living with HIV
HIV	Human Immunodeficiency Virus
PLH	People Living with HIV
NCAIDS	National Center for AIDS/STD Control and Prevention
UCLA	University of California, Los Angeles
UNAIDS	The Joint United Nations Programme on HIV/AIDS

Acknowledgement

It is one of the best presents for me to complete this dissertation in such a difficult time of COVID-19. Throughout my doctoral study, I have received a great deal of support and assistance. My thanks go out to all who have helped me complete this dissertation.

I wish to express my sincere appreciation to my supervisor, Dr. Roger Detels, who has convincingly guided and encouraged me to be an independent researcher during my whole doctoral study. He is also a perfect role model for me in keeping a balance between the career and family.

I would like to thank my committee members, Drs. Li Li, Chunqing Lin, and Roch A. Nianogo, for their valuable guidance and insightful feedback throughout my project. Your wonderful expertise helps me bring my dissertation to a higher level. I would like to pay my special regards to Drs. Li Li, Chunqing Lin, and Li-Jung Liang who provide rigid academic training for me when I was hired as a graduate student researcher in Dr. Li Li's team. Drs. Li Li and Chunqing Lin also served as my life coach to guide me to seek the secrets of happiness in study and life. I also appreciate Julie Hsieh, Nan Feng, and Chiao-Wen Lan who were all members of Dr. Li Li's team at UCLA Wilshire Center, for your guidance in my daily life.

I wish to express my deepest gratitude to Dr. Zunyou Wu, the Chief Epidemiologist of the Chinese Center for Disease Control and Prevention (CDC) and my master advisor, for recommending me to UCLA and supporting me to finish my Ph.D. program all the way. I also wish to appreciate Dr. Yan Li, the deputy director of Guangdong provincial CDC and an

outstanding alumnus of UCLA, for helping me to coordinate the fielding work in my project without hesitation. I also want to thank other colleagues in National Center for AIDS/STD Control and Prevention and Guangdong provincial CDC who supported me in my doctoral project.

I would like to acknowledge Roberta Malmgren, Wendy Aft, Joy Miller, and Lorin Chak for helping me with all the administrative issues during my doctoral study.

I am so lucky that I am surrounded by excellent, friendly, and inspiring faculties and students at the UCLA Fielding School of Public health. I wish to show my gratitude to all family members at UCLA for your contributions to this outstanding community. I want to show my special regards to Dr. Ron Brookmeyer, Dr. Onyebuchi A. Arah, Dr. Judea Pearl, and Dr. Sander Greenland for their insightful lectures to help me enjoy the advanced theory and great wisdom.

I wish to show my deepest gratitude to my dearest parents, wife, daughter, parents-in-law, and other family members for their great care and selfless love during my whole study. I cannot imagine where I am without their fullest support. I owe my appreciation to a special person, my wife, Qianqian Fan, for her continued love, understanding, and support during my pursuit of the Ph.D. degree that made the dissertation possible. I heartfelt regard goes to my beloved little daughter, Emilia Yuening Chen, for being such a cute and nice girl always cheering me up.

Lastly, I would like to appreciate the support from the UCLA/Fogarty AIDS International Training and Research Program. I am also indebted to all participants in my doctoral project for their participation, advice, and great contributions.

Vita

- 2008 - 2013 Bachelor of Medicine in Preventive Medicine
- 2013 - 2016 Master of Medicine in Epidemiology and Medical Statistics
- 2016 - 2017 Research Assistant in National Center for AIDS/STD Control and Prevention
Chinese Center for Disease Control and Prevention
- 2017 - 2019 Graduate Student Researcher
Semel Institute Center for Community Health, UCLA
- 2017 - 2020 Doctoral Candidate in Epidemiology
Fielding School of Public Health, UCLA

Publications and Conferences

Li, L., Lin, C., Liang, L. J., **Chen, J.**, Feng, N., & Nguyen, A. T. (2020). HIV-and Drug Use–
Related Stigma and Service Provision Among Community Health Workers in
Vietnam. *AIDS Education and Prevention*, 32(2), 169-179.

Chen, J., Lin, C., Cao, W., Wu, Z., & Li, L. (2020). Turnover intention among service providers
in Chinese methadone maintenance treatment clinics. *Journal of Public Health*, 1-6.

Dong, W., Zhou, C., Rou, K. M., Wu, Z. Y., **Chen, J.**, Scott, S. R., ... & Chen, X. (2019). A
community-based comprehensive intervention to reduce syphilis infection among low-fee
female sex workers in China: a matched-pair, community-based randomized
study. *Infectious diseases of poverty*, 8(1), 97.

- Li L., Lin C., Liang L. J., **Chen J.**, Feng N., Nguyen A. T. (2019). Stigma toward PLH and PWUD: Exploring Layers and Relations to Service Provision (*oral session*). *AIDS Impact 14th International Conferences*. London, United Kingdom.
- Chen J.**, Li L. (2017). Factors associated with job satisfaction among service providers from methadone maintenance treatment clinics (*post session*). *CHIPTS Next Generation Conference*. Los Angeles, California, United States.
- Chen J.** (2016). Preliminary analysis of the feasibility of “90-90-90” in county-level in China (*oral session*). *Symposium on Methodology Evaluation on HIV/AIDS Prevention and Control*. Kunming, China.
- Chen, J.**, Cao, X., Zhang, B., Wu, L., Yan, G., & Wu, Z. (2016). Factors influencing access to methadone maintenance treatment among injecting drug users attending antiretroviral treatment clinics in two counties, Yunnan province. *Chinese Journal of Epidemiology*, 37(1), 68-71.
- Chen, J.**, Cao, X., & Wu, Z. (2015). Research progress in job burnout among HIV-related health care workers. *Chinese Journal of Epidemiology*, 36(9), 1020.

Chapter I

Introduction

Migration and HIV epidemics around the world

There were approximately 272 million international migrants in 2019, accounting for about 3.5% of the whole population (International Organization for Migration [IOM], 2020). Nearly two-thirds of these migrants were labor migrants (United Nations, 2019). Most of these individuals were living in the Middle East, sub-Saharan Africa, and North America (IOM, 2020). Migrants contributed a lot to the HIV epidemics around the world due to their disruption of social networks, unprotected sex, migration patterns, and lack of access to health care (Bowsher et al., 2015; Rechel et al., 2013). They even accounted for over half of new HIV cases in some European countries (Hernando et al., 2015). Extensive research found that majority of migrants were infected with HIV after the migration (Ross et al., 2018). A study in Uganda showed that the risk of HIV acquisition increased in the first two years and then decreased afterward (Olawore et al., 2018). Migrants living with HIV were more likely associated with poor outcomes in HIV treatment compared to residents living with HIV (Ross et al., 2018). A large cohort study from Europe indicated that CD4 cell count at presentation to care was much lower than that among residents (De Coul et al., 2016). Migrants were nearly three times than residents to be lost-to-follow-up in ART care. They were also at higher risk of experiencing viral failure (Reyesruena et al., 2017; Sheehan et al., 2017).

Over the past four decades, a wide variety of efforts had been mounted on to address the increasing epidemics, and significant achievements have been made (Piot & Quinn, 2013). Intervention strategies evolved from behavioral change programs (e.g., condom use, syringe

exchange) to biomedical preventions (e.g., male circumcision, preexposure prophylaxis). In 2014, the Joint United Nations Programme on HIV/AIDS (UNAIDS) set the targets of “90-90-90” for 2020, which was to end the HIV epidemic by 2030 (UNAIDS, 2015). The targets were to achieve “90% of people living with HIV (PLH) knowing their HIV status; 90% of people who know their HIV-positive status on treatment; and 90% of people on treatment with suppressed viral loads”. However, challenges continued to complicate the efforts on HIV prevention and control. By 2020, 19% of PLH did not know their status of HIV infection; 33% of people who knew their status did not access ART; 41% who accessed ART were not virally suppressed (UNAIDS, 2020). Few studies reported effective interventions towards improving HIV care among migrants. Identifying the barriers and making effective interventions among this marginalized and growing population was very urgent (Ross et al., 2018). The current pace of progress was not enough to achieve the goals by 2030 (Kaiser Family Foundation, 2019).

HIV epidemic in China

China, as the most populated country with over 1.4 billion population, has always been facing a threat from HIV transmission. There were over 750,000 PLH by the end of 2017, including nearly 430,000 HIV infectors and 320,000 AIDS patients (National Center for AIDS/STD Control and Prevention [NCAIDS], 2018). HIV epidemics were generally divided into four phases in China: the introduction phase (1985-1988), the spreading phase (1989-1994), the expansion phase (1995-2002), and the stable phase (2003-present) (Sun et al., 2010; Wu et al., 2004). In the introduction phase, there were very few reported cases. The first HIV case was reported in 1985, and a total of 22 HIV cases were identified by 1988. Most patients were foreigners or Chinese residents returning from overseas. During the spreading phase, HIV spread among the high-risk populations, especially injecting drug users. The first outbreak of HIV cases

was among injecting drug users in the bordering areas between China and Myanmar in 1989. About 22 provinces, autonomous regions, and municipalities had reported HIV cases by 1994. In the third phase, HIV spread throughout the whole country. In the mid-1990s, an outbreak of the HIV epidemic was reported among paid plasma donors in several central provinces. During the stable phase, the epidemic remained stable and concentrated among high-risk populations. Sexual transmission including homosexual and heterosexual transmission had accounted for over 90% of newly reported cases since 2013 (NCAIDS, 2013).

To monitor the dynamic epidemic of HIV, China initiated sentinel surveillance since 1995 and developed a comprehensive, national, web-based HIV/AIDS information system since 2008 (Mao et al., 2010; Wu, 2015). China initiated 42 sites for sentinel surveillance in 1995 and expanded to 1888 sites across the whole country by 2010 (Wu, 2015). Except for sentinel surveillance, there were other data collection venues to monitor the effectiveness of HIV prevention and treatment. Data were collected by questionnaires and submitted by e-mail separately before the integration. After the integration in 2008, the unified system had improved the efficiency of data collection and analysis, as well as data security and quality (Mao et al., 2010). There were a total of eight web-based data collection subsystems including i) *HIV/AIDS Case Reporting*; ii) *HIV Testing and Counseling*; iii) *ART for Adults*; iv) *ART for Children*; v) *Behavioral Interventions for High-risk Groups*; vi) *Methadone Maintenance Treatment*; vii) *Sentinel and Behavioral Surveillance*, and viii) *Local County Background Information*.

Progress of antiretroviral therapy in China

To respond to the HIV epidemic, China launched “Four Frees and One Care” in 2003, which provided all PLH access to free HIV testing, free ART, free prevention of HIV mother-to-

child transmission, and free education for HIV-infected children (Zhang et al., 2007). A multilevel management system was constructed to promote free ART program across the country. National Health Commission supervised the management of ART programs, including the development of guidelines, training, and technical guidance. The Division of Treatment and Care in NCAIDS was constructed in 2001 to provide technical guidance for ART care. Provincial Health Commissions were responsible for ART programs within the provinces, including the supervision of the Center for Disease Prevention and Control (CDC), and ART clinics that were affiliated to the prefecture-level or county-level hospitals. Workers from county-level or prefecture-level CDC provided health consultation and transferred PLH to enter the ART program. Clinicians from ART clinics addressed ART initiation, serious opportunistic infections, adverse reactions, and other complications. Doctors from hospitals at the village or township level provided routine follow-up, monitoring, and care (Zhang et al., 2007).

With growing evidence to support the benefits of earlier treatment, China adjusted the treatment criteria for four times to recruit more patients to enter the ART program. The initial implementation of the ART program focused on blood or plasma donors who were infected in the 1990s from the central parts of China, with treatment criteria of CD4 cell count ≤ 200 cells/ μ L. The treatment criteria were gradually turned to CD4 cell count ≤ 350 cells/ μ L in 2008, CD4 cell count ≤ 500 cells/ μ L in 2014, and universal treatment regardless of CD4 cell count in 2016 (Wu, 2015). The ART coverage increased from 10% in 2005 to 68% in 2015 with these adjustments (Zhang & Ma, 2019). The national ART coverage increased to 83.4% by 2018, and the rate of viral failure among PLH receiving ART decreased from 17.6% in 2010 to 11.8% in 2014 (Dou et al., 2015).

Despite the great achievements of the ART program, China was still facing several challenges in the implementation of the strategy “treatment as prevention”. First, an estimated 30% of PLH who were not diagnosed in 2015 would restrict the effectiveness of the “90-90-90” strategy (Ma et al., 2018). Second, there were only eight ART drugs available for adults and adolescents by 2016 (Zhang & Ma, 2019). The first-line regimen included only tenofovir/zidovudine, efavirenz/nevirapine, and lamivudine, but no emtricitabine and dolutegravir. The second-line regimen available contained only protease inhibitor but lacked atazanavir and darunavir. There were no third-line regimens for the ART program. PLH would have no free drugs when they encountered drug resistance to these eight drugs. The estimated incidence of drug resistance in China was 3.4-4.6 per 100 person-years (Zhao et al., 2013). Drug resistance will be a huge challenge because of the expansion of the ART program. Third, there were limited experienced doctors in ART clinics (Zhang & Ma, 2019). With the rapid increase of patients after the universal treatment, a lack of experienced doctors would affect the quality of service provision and thus influence ART retention. All these challenges can interplay against the goal of ending the HIV epidemic by 2030 in China.

Process of management from HIV diagnosis to antiretroviral therapy

To ensure the efficiency of the HIV care continuum, a complete management system had been constructed. The management system was adjusted according to local conditions in each city, but the basic structure for the system was similar (NCAIDS, 2016). Figure 1.1 presented that adult patients would experience three phases, from HIV diagnosis to ART program.

In the first phase, when patients were diagnosed with HIV in an institution, usually a healthcare institution, this institution was the reporting institution where service providers would

be responsible to collect basic information by paper questionnaires and provide the first consultation to inform the verified results to patients. At the same time, the reporting institution submitted paper questionnaires to local county-level CDC which was in the same county or district with the reporting institution. Staff in local county-level CDC inputted patients' questionnaires into the *HIV/AIDS case reporting system* as the baseline information.

In the second phase, service providers from county-level CDC whose address was the same with patients' current residence contacted patients and provided follow-up service for them when service providers found that there were new patients diagnosed with HIV in the region under their jurisdiction from the *HIV/AIDS case reporting system*. In some cities, instead of CDC, service providers from the community health center (CHC) or township hospitals in the same address were responsible for the follow-up. In the second phase, service providers were responsible for providing CD4 testing once a year, encouraging patients to take ART, and providing face-to-face consultations at least once a year. The potential outcomes for patients in this phase included death, loss-to-follow-up, refusing to take ART, and initiating ART. Once patients were transferred from the CDC to ART clinics to initiate ART, they had entered the third phase.

In the third phase, service providers in ART clinics were responsible for providing ART care to patients. All the treatment information should be documented and inputted into the *ART for adults system*. The potential outcomes may include death, transferring to other ART clinics, and attrition. Once patients dropped out of ART care, their information of attrition appeared in the *HIV/AIDS case reporting system*, and then service providers from CDC were responsible to recontact these patients and encourage them to re-initiate ART. In general, the process from HIV

diagnosis to ART program involved several phases and institutions and each link could affect the efficiency of service provision. The electronic system was the platform for service providers to receive information from other institutions. Given the complexity and importance of the HIV care continuum, a more interactive and unified platform was necessary for the current management system.

Domestic migrants and health care in China

With rapid development in the economy, the size of Chinese domestic migrants increased at the same pace. In China, domestic migrants were individuals moving within the country (King & Skeldon, 2010), defined as people who lived in the current residence for more than six months without a local permanent registered residence (also called “hukou”). China initiated a new policy called “Reform and Opening-up” in 1978. The urban areas provided a great number of job opportunities through many private companies (L. Zhao et al., 2018). Meanwhile, productivity increased essentially in rural areas with the new policy of the household responsibility system (Lin, 1992). To develop the national economy, the government encouraged rural workers to find jobs in urban areas. The size of domestic migrants increased from 30 million in the late 1980s to almost 250 million in 2017 (Migrant Population Service Center [MPSC], 2019).

Domestic migration is generally divided into two categories, intra-provincial, and inter-provincial migration, according to the spatial boundaries (Su et al., 2018). Intra-provincial migrants refer to people migrating across cities within the same province, and the inter-provincial migrants are individuals migrating across provinces. According to the sixth national census in 2010 (Ma & Chen, 2012), intra-provincial migrants were the majority, accounting for nearly 70% of domestic migrants. Most inter-provincial migrants moved from western and

central provinces to the eastern ones. Nearly 77% of inter-provincial migrants clustered in eight provinces and metropolises, including Guangdong, Zhejiang, Shanghai, Jiangsu, Beijing, Fujian, Tianjin and Shandong. Compared to the intra-provincial migrants, inter-provincial migrants were much younger, more likely to be male, and shorter in the migration period (Su et al., 2018).

Compared to residents, domestic migrants had to face barriers to accessing local social welfare benefits, especially medical services. The system of permanent registered residence which was related to social medical insurance prevented domestic migrants from accessing the same health care as the permanent residents. The social medical insurances in China included the new rural cooperative medical system, urban resident-based basic medical insurance, and urban employee-based basic medical insurance. The social medical insurances were administrated by the local city-level governments so that it was difficult for domestic migrants to transfer their insurance directly across provinces or cities and the reimbursement rate was also very low (Qiu et al., 2011). A study in 2014 reported that most domestic migrants joined the new rural cooperative medical system in their hometowns. 15% of domestic migrants were insured by the urban employee-based basic medical insurance in host cities. Only 5.5% were enrolled in urban resident-based basic medical insurance in the host cities (Yang, 2018). The policy of off-site medical insurance was available for domestic migrants with social medical insurance to receive medical treatment across cities and provinces. However, the reimbursement rate for domestic migrants was lower than that for residents. Many domestic migrants often returned to their hometown for medical care due to low reimbursement in the host city and lack of family care (Qiu et al., 2011; Song et al., 2017).

Domestic migrants and HIV epidemic in China

Domestic migrants, especially rural-to-urban migrants, were considered as ‘bridging population’ of HIV transmission in terms of their high rates of unprotected sexual behaviors and high mobility (Zhang et al., 2013). Due to the high living expense, most male domestic migrants lived alone and left wives and children in their hometowns. Nearly 70% of them aged 20 to 50 within the sexually active age range (MPSC, 2019). Previous studies showed that domestic migrants had more sexual partners and engaged in more commercial sex compared to residents (Hu et al., 2006; Wang et al., 2007). The HIV prevalence among domestic migrants (0.15%), was higher than the overall prevalence (0.057%). Most domestic migrants traveled between their homes and working places, especially during the spring festival (Y. Zhao et al., 2018). The wives of HIV positive domestic migrants were at high risk of HIV infection.

The Chinese government had established several HIV care programs towards domestic migrants to prevent HIV transmission. Male domestic migrants were included as one of the eight key populations to receive national sentinel surveillance to monitor the dynamic HIV epidemic (Ge et al., 2017). CDC workers and doctors of ART clinics in the permanent registered residences can provide transferring service for domestic migrants to the CDC and ART clinics in host cities. Despite the convenient HIV services, the HIV testing rate was only 6% among this population, much lower than 20% in the general population (Wang et al., 2010). It was still far from the target of 90% testing rate. Among DMLH, nearly 70% received ART, which was also lower than the rate of 90% (Gan et al., 2018). To our best knowledge, there were few studies about the rates of ART retention and viral suppression among DMLH. It seemed that ART service was being neglected among DMLH. There was an urgent need to evaluate the effectiveness of the ART program and identify barriers to ART service among DMLH.

Study aims

This study applied a socio-ecological model (Babalola et al., 2017), to describe the multilevel determinants of ART initiation and retention. The influencing factors of ART initiation and retention operated at multiple levels, including policy, institution, service provider, and individual levels. The framework was presented in Figure 1.2.

Based on the conceptual framework, the specific aims in this study were:

- 1) To identify multilevel barriers to initiate and retain in ART programs among DMLH in the setting of universal treatment.
- 2) To describe ART initiation and attrition among domestic migrants in the setting of universal treatment.
- 3) To compare ART initiation and attrition between inter-provincial migrants, intra-provincial migrants, and residents in the setting of universal treatment.

Study site

Guangdong province was chosen as the study site. Figure 1.3 showed that it was in the southeast of China, with a population of nearly 110 million (China, 2018). It was the first province to initiate the policy of “Reform and Opening-up” in China in 1978. The economy has ranked the first of China since 1989. With the rapid economic development in Guangdong province, a great number of people migrated into Guangdong province. In the sixth national census of 2010, one-third of inter-provincial migrants moved into Guangdong province, which ranked top in China (Census Office of the State Council [COSC], 2010). In Guangdong province, there were approximately 30 million domestic migrants, accounting for 30% of its total

population. The ratio of inter-provincial migrants to intra-provincial ones was 2 to 1. Most domestic migrants (83%) were rural workers and nearly 80% of domestic migrants were aged younger than 45 years old. Almost one-third received education for more than nine years. 60% of domestic migrants lived together with their families in Guangdong province, and 80% came to Guangdong province for job opportunities, and over 80% worked in factories or engaged in commercial service. Almost half of the inter-provincial migrants lived in current cities less than two years, on the contrary, nearly one-third of intra-provincial migrants lived in the current cities for more than five years (COSC, 2010). However, economic development was not balanced in Guangdong province. The economy in Guangdong developed much faster in cities around the Pearl River Delta (including nine cities: Guangzhou, Dongguan, Foshan, Shenzhen, Zhuhai, Zhongshan, Huizhou, Jiangmen, and Zhaoqing) than that in other cities. Highly developed economy in cities around the Pearl River Delta lead to more sufficient healthcare resources and higher salaries and attracted nearly 90% of domestic migrants in Guangdong to cluster in this region (Liang, 2013).

There were approximately 60,000 PLH and 75 ART clinics in Guangdong province in 2018, which ranked fourth in China (Feng & Yue, 2018). Besides, cities around the Pearl River Delta contributed more than 60% to HIV epidemics in Guangdong province (Li et al., 2015; Zhang et al., 2018). Out of the current PLH, nearly 40% were domestic migrants (Li et al., 2015). Among domestic migrants, nearly 60% were intra-provincial migrants (Peilong Li et al., 2014). Among inter-provincial migrants living with HIV across the country in 2013, Guangdong province accounted for 20% in China. ART coverage among DMLH was nearly 70% in Guangdong province, which was lower than the national average rate (72%). Both ART coverage among

PLH (76%) and the rate of virologic testing (80%) in Guangdong province in 2018 were lower than the target rates (at least 90% for ART coverage, 95% for virologic testing).

Given the heavier HIV epidemic and poorer ART performance among domestic migrants, Guangdong can be an ideal study site for identifying barriers to ART initiation and retention among domestic migrants in China. Guangdong can also be an ideal site for pilot implementation of interventions and the results can be generalized to other sites with similar situations.

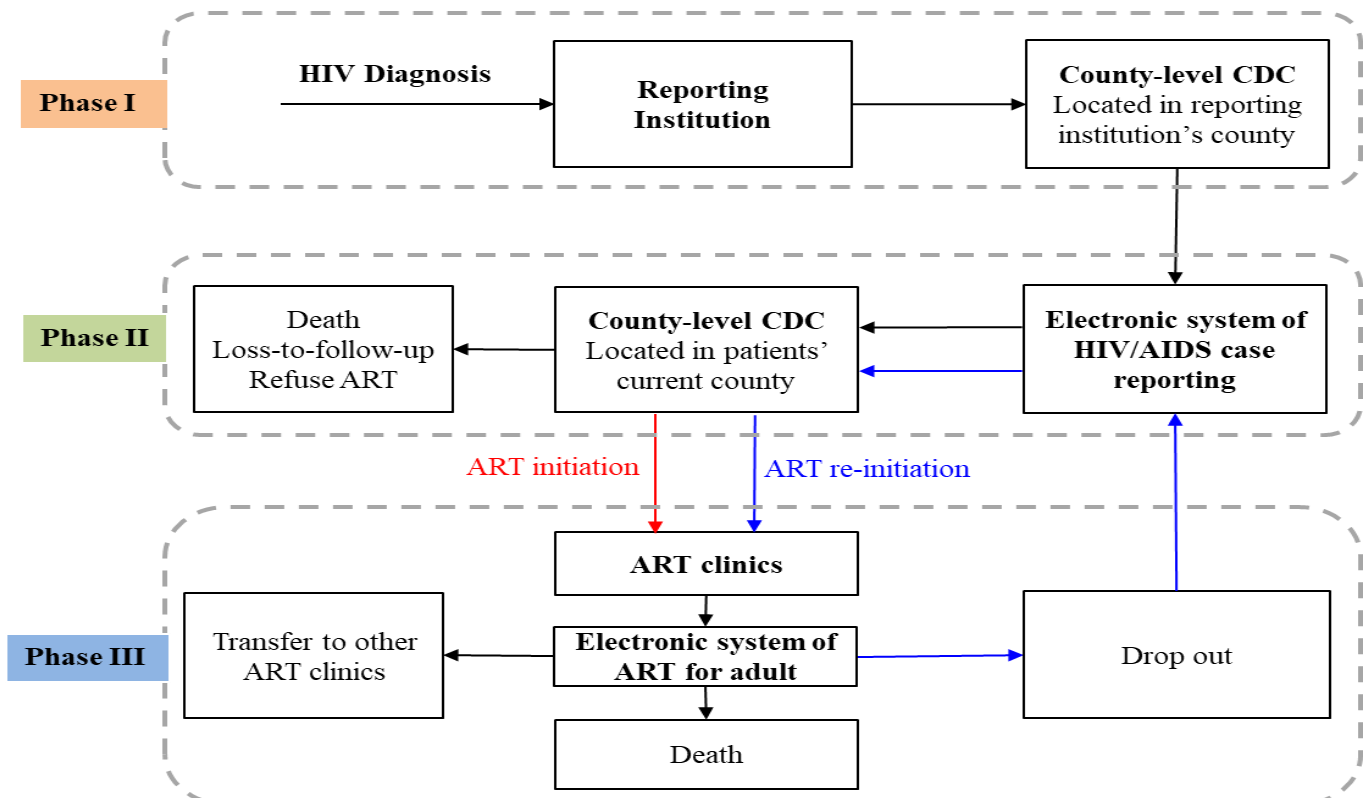


Figure 1.1 The simplified management system for patients from HIV diagnosis to ART program

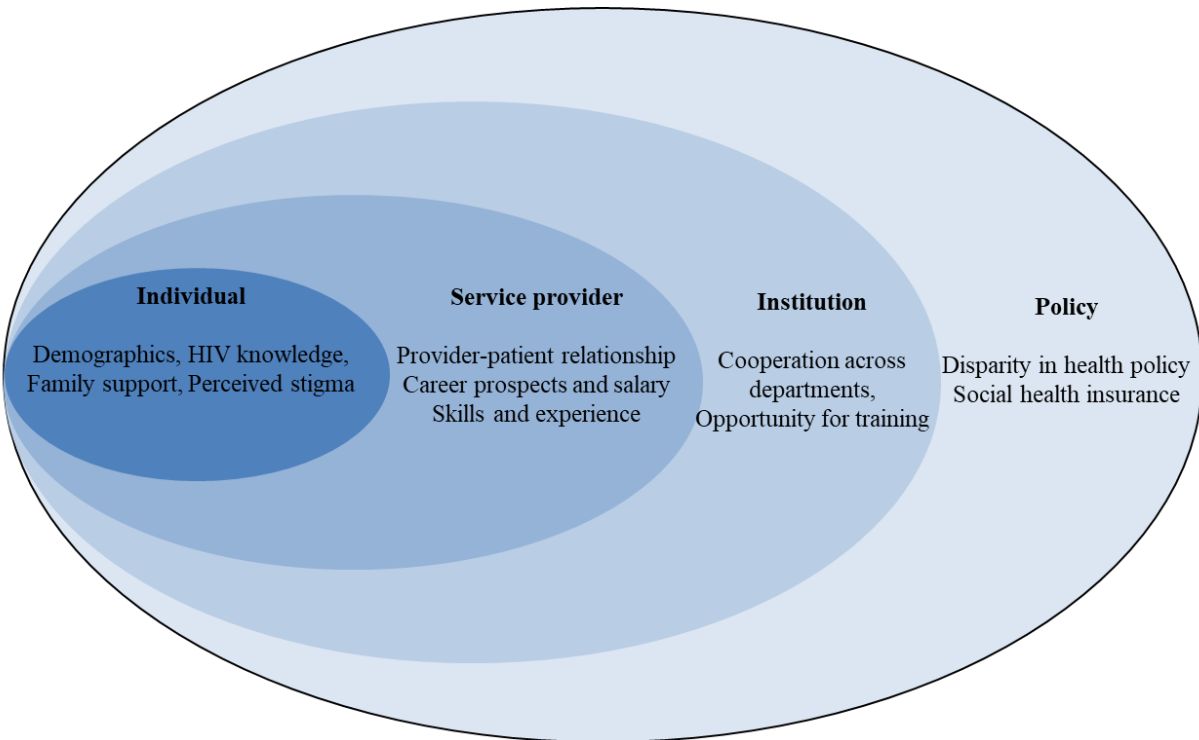


Figure 1.2 Framework for the multilevel determinants of ART initiation and retention



Figure 1.3 Location of Guangdong Province in China (China Highlights, 2020)

Reference

- Babalola, S., Van Lith, L. M., Mallalieu, E. C., Packman, Z. R., Myers, E., Ahanda, K. S., Harris, E., Gurman, T., & Figueroa, M.-E. (2017). A framework for health communication across the HIV treatment continuum. *Journal of acquired immune deficiency syndromes* (1999), 74(Suppl 1), S5.
- Bowsher, G. M., Krishnan, R. A., Shanahan, T. A., & Williams, S. K. (2015). Immigration Act 2014 challenges health of migrants in the UK. *Lancet*, 385(9971), 852-853.
- China Highlights (2020). Guangdong province map.
<https://www.chinahighlights.com/guangzhou/map.htm>
- Migrant Population Service Center (MPSC). (2015). Report on China's migrant population development 2015.
- Chinese National Bureau of Statistics (2018, December 31). National data.
<http://data.stats.gov.cn/english/easyquery.htm?cn=E0103>.
- Census Office of the State Council (COSC). (2010, December 31). National census of China in 2010. <http://www.stats.gov.cn/tjsj/pcsj/rkpc/6rp/indexch.htm>.
- De Coul, E. L. M. O., Van Sighem, A., Brinkman, K., Van Benthem, B. H. B., Der Ende, M. E. V., Geerlings, S. E., & Reiss, P. (2016). Factors associated with presenting late or with advanced HIV disease in the Netherlands, 1996–2014: results from a national observational cohort. *BMJ Open*, 6(1).

- Dou, Z., Zhang, F., Zhao, Y., Jin, C., Zhao, D., Gan, X., & Ma, Y. (2015). Progress on China's national free antiretroviral therapy strategy in 2002-2014. *Chin j Epidemiol*, 36(12), 1345-1350.
- Feng, X., & Yue, W. (2018, December 1). Sexual transmission is the major mode among 9011 newly reported HIV cases in Guangdong. http://news.ycwb.com/2018-12/01/content_30143486.htm.
- Kaiser Family Foundation (n.d.). The global HIV/AIDS Epidemic in 2019. <https://www.kff.org/global-health-policy/fact-sheet/the-global-hivaids-epidemic/#footnote-262241-5>.
- Gan, X., Ma, Y., Dou, Z., Zhao, D., Wu, Y., Zhao, Y., & Yu, L. (2018). Current status of national free antiretroviral therapy in interprovincial migrating people living with HIV/AIDS and influencing factors, China, 2011-2015. *Chinese Journal of Epidemiology*, 39(9), 1234-1238.
- Ge, L., Li, D., Li, P., Guo, W., & Cui, Y. (2017). Population specific sentinel surveillance for HIV infection, syphilis and HCV infection in China, during 2010-2015. *Dis Surveill*, 32(2), 111-117.
- Hernando, V., Arco, A. D., Alejos, B., Monge, S., & Amo, J. D. (2015). HIV Infection in Migrant Populations in the European Union and European Economic Area in 2007-2012: An Epidemic on the Move. *J Acquir Immune Defic Syndr*, 80(2).

- Hu, Z., Liu, H., Li, X., Stanton, B., & Chen, X. (2006). HIV-related sexual behaviour among migrants and non-migrants in a rural area of China: role of rural-to-urban migration. *Public health*, 120(4), 339-345.
- International Organization for Migration (IOM). (n.d.) World migration report, Geneva.
https://publications.iom.int/system/files/pdf/wmr_2020.pdf
- King, R., & Skeldon, R. (2010). 'Mind the gap!' Integrating approaches to internal and international migration. *Journal of Ethnic and Migration Studies*, 36(10), 1619-1646.
- Li, P., Wang, L., Guo, W., Qin, Q., Ding, Z., & Cui, Y. (2014). Mobility of HIV/AIDS and affecting factors analysis in 2013, China. *Zhonghua yu fang yi xue za zhi [Chinese journal of preventive medicine]*, 48(11), 934-937.
- Li, Y., Lin, P., Wang, Y., Fu, X.-b., Ye, R., Li, J.-r., Feng, M.-y., Yu, G.-l., Yang, F., Yan, J., Long, Q.-s., & Deng, h.-h. (2015). HIV/AIDS surveillance in Guangdong Province, 2000-2013. *South China J Prev Med*, 41(2), 101-106.
- Liang, H. (2013). Characteristics and Changes of Floating Population in Guangdong Province. *Population & Development*.
- Lin, J. Y. (1992). Rural reforms and agricultural growth in China. *The American economic review*, 34-51.
- Ma, H., & Chen, Z. (2012). Patterns of inter-provincial migration in China: Evidence from the sixth population census. *Population Research*, 36(6), 87-99.

- Ma, Y., Dou, Z., Guo, W., Mao, Y., Zhang, F., McGoogan, J. M., Zhao, Y., Zhao, D., Wu, Y., Liu, Z., & Wu, Z. (2018). The Human Immunodeficiency Virus Care Continuum in China: 1985-2015. *Clin Infect Dis*, 66(6), 833-839. <https://doi.org/10.1093/cid/cix911>
- Mao, Y., Wu, Z., Poundstone, K., Wang, C., Qin, Q., Ma, Y., & Ma, W. (2010). Development of a unified web-based national HIV/AIDS information system in China. *International journal of epidemiology*, 39.
- Migrant Population Service Center. (n.d.). Migrant population data platform.[http://www.chinaldrk.org.cn/wjw/#/data/classify/visualization?currentMapIndex=.](http://www.chinaldrk.org.cn/wjw/#/data/classify/visualization?currentMapIndex=)
- National Center for AIDS/STD Prevention and Control (NCAIDS), China CDC (2013). Update on the AIDS/STD epidemic in China in December 2012. *Chin J AIDS STD*, 19(2), 85.
- National Center for AIDS/STD Prevention and Control (NCAIDS), China CDC. (2016). Guidelines for follow-up of HIV infected individuals in China.
- National Center for AIDS/STD Prevention and Control (NCAIDS), China CDC. (2018). Update on the AIDS/STD epidemic in China in December 2017. *Chin J AIDS STD*, 24(2), 111.
- Olawore, O., Tobian, A. A. R., Kagaayi, J., Bazaale, J., Nantume, B., Kigozi, G., Nankinga, J., Nalugoda, F., Nakigozi, G., & Kigozi, G. (2018). Migration and risk of HIV acquisition in Rakai, Uganda: a population-based cohort study. *The Lancet HIV*, 5(4).
- Piot, P., & Quinn, T. C. (2013). Response to the AIDS pandemic--a global health model. *N Engl J Med*, 368(23), 2210-2218. <https://doi.org/10.1056/NEJMra1201533>

- Qiu, P., Yang, Y., Zhang, J., & Ma, X. (2011). Rural-to-urban migration and its implication for new cooperative medical scheme coverage and utilization in China. *BMC Public Health*, 11(1), 520.
- Rechel, B., Mladovsky, P., Ingleby, D., Mackenbach, J. P., & Mckee, M. (2013). Migration and health in an increasingly diverse Europe. *The Lancet*, 381(9873), 1235-1245.
- Reyesuruena, J., Campbell, C. N. J., Hernando, C., Vives, N., Folch, C., Ferrer, L., Fernandezlopez, L., Esteve, A., & Casabona, J. (2017). Differences between migrants and Spanish-born population through the HIV care cascade, Catalonia: an analysis using multiple data sources. *Epidemiology and Infection*, 145(08), 1670-1681.
- Ross, J., Cunningham, C. O., & Hanna, D. B. (2018). HIV outcomes among migrants from low-income and middle-income countries living in high-income countries: a review of recent evidence. *Current Opinion in Infectious Diseases*, 31(1), 25-32.
- Sheehan, D. M., Fennie, K. P., Mauck, D. E., Maddox, L. M., Lieb, S., & Trepka, M. J. (2017). Retention in HIV Care and Viral Suppression: Individual- and Neighborhood-Level Predictors of Racial/Ethnic Differences, Florida, 2015. *AIDS patient care and STDs*, 31(4), 167-175.
- Song, X., Zou, G., Chen, W., Han, S., Zou, X., & Ling, L. (2017). Health service utilisation of rural-to-urban migrants in Guangzhou, China: does employment status matter? *Tropical Medicine & International Health*, 22(1), 82-91.
- Su, Y., Tesfazion, P., & Zhao, Z. (2018). Where are the migrants from? Inter-vs. intra-provincial rural-urban migration in China. *China Economic Review*, 47, 142-155.

- Sun, X., Lu, F., Wu, Z., Poundstone, K., Zeng, G., Xu, P., Zhang, D., Liu, K., & Liau, A. (2010). Evolution of information-driven HIV/AIDS policies in China. *International journal of epidemiology*, 39.
- UNAIDS. (2015, August 15). 2016-2021 Strategy. https://www.unaids.org/en/resources/documents/2015/UNAIDS_PCB37_15-18.
- UNAIDS. (2020, July 6). 2020: Seizing the moment - Tackling entrenched inequalities to end epidemics. <https://reliefweb.int/report/world/global-aids-update-2020-seizing-moment-tackling-entrenched-inequalities-end-epidemics>.
- United Nations (n.d.). International migration 2019. Retrieved 2020, August 25 from https://www.un.org/en/development/desa/population/migration/publications/migrationreport/docs/InternationalMigration2019_Report.pdf.
- Wang, B., Li, X., Stanton, B., Fang, X., Lin, D., & Mao, R. (2007). HIV-related risk behaviors and history of sexually transmitted diseases among male migrants who patronize commercial sex in China. *Sex Transm Dis*, 34(1), 1-8. <https://doi.org/10.1097/01.olq.0000222668.95038.03>
- Wang, B., Li, X., Stanton, B., & McGuire, J. (2010). Correlates of HIV/STD testing and willingness to test among rural-to-urban migrants in China. *AIDS Behav*, 14(4), 891-903. <https://doi.org/10.1007/s10461-008-9482-1>
- Wu, Z. (2015). Achievement of HIV/AIDS program in the past 30 years and challenges in China. *Chin j Epidemiol*, 36(12), 1329-1331.

- Wu, Z., Rou, K., & Cui, H. (2004). The HIV/AIDS epidemic in China: history, current strategies and future challenges. *AIDS Educ Prev*, 16(3 Suppl A), 7-17.
<https://doi.org/10.1521/aeap.16.3.5.7.35521>
- Yang, Y. (2018). The floating population participates in urban health insurance research at in-flow locations. (Publication No. 2.1018.225461) [Master's thesis, University of Jilin].
Chinese National Knowledge Infrastructure.
- Zhang, F., Haberer, J. E., Wang, Y., Zhao, Y., Ma, Y., Zhao, D., Yu, L., & Goosby, E. P. (2007). The Chinese free antiretroviral treatment program: challenges and responses. *Aids*, 21 Suppl 8, S143-148. <https://doi.org/10.1097/01.aids.0000304710.10036.2b>
- Zhang, F., & Ma, Y. (2019). Progress and challenges in China's free ART programme. *The Lancet HIV*, 6(1), e8-e9.
- Zhang, K., Fu, X., Liu, J., Lin, Q., Xu, Y., & Li, Y. (2018). Spatiotemporal characteristics of HIV/AIDS in Guangdong province, 2007-2017. *Chinese Journal of Disease Control & Prevention*.
- Zhang, L., Chow, E. P. F., Jahn, H. J., Kraemer, A., & Wilson, D. (2013). 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*, 40(2), 136-147.
- Zhao, D., Ma, Y., & Zhang, F. (2013). Drug resistance among HIV-infected adults receiving long term first-line antiretroviral treatment in China. *Chinese J Exp Clin Infect*, 7, 204-209.

Zhao, L., Liu, S., & Zhang, W. (2018). New trends in internal migration in China: Profiles of the New-generation migrants. *China & World Economy*, 26(1), 18-41.

Zhao, Y., Wu, Z., McGoogan, J. M., Shi, C. X., Li, A., Dou, Z., Ma, Y., Qin, Q., Brookmeyer, R., Detels, R., & Montaner, J. S. G. (2018). Immediate Antiretroviral Therapy Decreases Mortality Among Patients With High CD4 Counts in China: A Nationwide, Retrospective Cohort Study. *Clin Infect Dis*, 66(5), 727-734. <https://doi.org/10.1093/cid/cix878>

Chapter II

Barriers to ART Initiation and Retention among Domestic Migrants Living with HIV in Guangdong, China: A Qualitative Study

Abstract

Background Early ART initiation and long-term ART retention have been proven to be beneficial to both treatment outcomes and HIV prevention. DMLH was facing tremendous barriers to ART service. This study was to identify multilevel barriers towards ART initiation and retention among DMLH.

Methods In-depth interviews were conducted in Guangdong province from two perspectives, one from 25 service providers and the other from 27 DMLH. The interview was based on a semi-structured guide with open-ended probes. The in-depth interview lasted for about 60 minutes and was audio-recorded.

Results Barriers to ART initiation and retention among DMLH included four levels. The policy-level challenges were lack of appropriate medical insurance policy for DMLH and lack of effective reward and punishment mechanism for institutions. Barriers from institutions included lack of cooperation across different institutions and lack of flexibility in spending government funds. In the service provider level, shortage of experienced service providers and limited career prospects and low salaries were added to the barriers. Challenges identified at the individual level comprised of lack of HIV related knowledge, side effect, inconvenience to take a leave, lack of family support, and fear of stigma.

Conclusion This study comprehensively identified the multifaceted barriers towards ART initiation and retention among DMLH. The findings suggested that structural adjustments should take domestic migrants' specificity and vulnerability into consideration for improving ART initiation and retention among DMLH.

Key words: Antiretroviral therapy, initiation, retention, domestic migrants, China

Introduction

Early ART initiation and long-term ART retention have been proven to be beneficial to both treatment outcome and HIV prevention, including lower viral load, less AIDS-related symptoms, prolonged survival, and reduced transmission risk to other individuals (Joint United Nations Programme on HIV/AIDS [UNAIDS], 2014). UNAIDS set a goal of ending the AIDS epidemic by 2030 through achieving the strategy of 90-90-90 which meant that 90% of people living with HIV (PLH) would be diagnosed, 90% of those diagnosed would initiate ART, and 90% of those on ART would achieve viral suppression by 2020 (UNAIDS, 2014). Although great progress was being made around the world, huge gaps were still there. However, by 2020, only 81% of PLH globally were diagnosed, 67% of those diagnosed were on ART, and 59% of those were on ART with viral suppression. There were still 1.7 million new infections, which left the world far off the anticipated number of 0.5 million by 2020 (World Health Organization, 2019). Reaching the goal of ending the AIDS epidemic depended on the progress of closing the gaps to care cascade among key vulnerable populations, such as ART initiation and retention among migrants (UNAIDS, 2019).

Migrants contributed to a large proportion of PLH across the world, but the care cascade in this population was worse than that among non-migrants (Marukutira et al., 2020).

Migrants even accounted for over half of new HIV cases in some European countries (Hernando et al., 2015). Migrants were more likely associated with poor treatment performance compared to residents, such as later ART initiation, and lower ART retention rate (Ross et al., 2018). In some European countries, the average CD4 cell count at presentation to care among migrants was much lower than that among residents (De Coul et al., 2016). The attrition rate of ART among migrants was nearly three times higher than that among residents, and the risk of experiencing

viral failure was worse as well (Reyesuruena et al., 2017; Sheehan et al., 2017). It was reported that migrants were being ‘left behind’ when we were working toward the goal of ending the AIDS epidemic (UNAIDS, 2018).

Migrants were facing tremendous barriers to ART service globally, including sociocultural differences, inappropriate medical insurance, low socioeconomic status, disrupted social network, stigma, migration pattern, and other individual factors (Levison et al., 2017). Given the geographic and cultural differences, it was important to understand the variation of subpopulations among migrants across countries and cultures. The major contribution to limited ART service in Australia was medical insurance restrictions (Marukutira et al., 2020). In western European countries, the main limitation of HIV service among migrants was the lack of HIV knowledge (European CDC, 2017). In Kazakhstan, undocumented migrant workers were not allowed to access HIV services in host sites (Davis et al., 2017). However, irrespective of the extensive research on migrants across the world, there were limited studies to comprehensively investigate the structural and individual barriers among migrants in China.

As the economy developed very fast with the implementation of “Reform and Opening-up” in China, the size of domestic migrants increased from 30 million in the late 1980s to almost 250 million in 2017 (L. Zhao et al., 2018). Guangdong province was the first site to initiate the policy of “Reform and Opening-up” in China. In the sixth national census of 2010, one-third of inter-provincial migrants moved into Guangdong province, which ranked top in China (Census Office of the State Council [COSC], 2010). In Guangdong province, there were approximately 30 million domestic migrants, accounting for 30% of its total population. There were approximately 60,000 PLH in Guangdong province in 2018, which ranked fourth in China (Feng

& Yue, 2018). Out of these PLH, nearly 40% were domestic migrants (Li et al., 2015). Among domestic migrants, nearly 60% were intra-provincial migrants (P Li et al., 2014). Guangdong province accounted for 20% of inter-provincial migrants living with HIV across China. ART coverage among DMLH was nearly 70% in Guangdong province, which was lower than the national average rate (72%). There were limited data on ART retention about DMLH. Given the heavier HIV epidemic and poor ART performance among domestic migrants, Guangdong can be an ideal fielding site for identifying barriers to ART programs among domestic migrants in the setting of universal treatment in China.

The present study was to comprehensively identify the multilevel barriers for DMLH to initiate and retain in ART. The data were collected from two perspectives, one from service providers and the other from patients. In-depth interviews with service providers focused on the structural barriers towards ART service provision and interviews with patients drew attention to their perceived individual barriers to ART initiation and retention.

Methods

Participants and recruitment

In-depth interviews with service providers and patients were conducted in Guangdong province from 2020. The recruitment of service providers and patients were independent. Service providers were recruited from three cities including Guangzhou, Dongguan, and Qingyuan, and patients were recruited in Guangzhou and Dongguan.

Service providers were mainly from three institutions, including the Center for Disease Prevention and Control (CDC), Community Health Centers (CHC), and ART clinics. The

inclusion criteria were: i) aged 18 years or above; ii) being a service provider familiar with the medical service in HIV/AIDS prevention and treatment; iii) providing oral informed consent. Gatekeepers from these institutions were given a recruitment flyer with contact information of principal investigators and invited to recommend appropriate potential service providers to participate in this study.

Patients were all DMLH and were recruited from ART clinics and CDC. We intentionally recruit individuals with different ART status: not receiving ART, dropping out of ART, and retaining in ART. The inclusion criteria were: i) aged 18 years or above; ii) for inter-provincial domestic migrants, the current residence was in Guangdong province, and the registered residence was in the other province; iii) for intra-provincial domestic migrants, the current and registered residences were both in Guangdong province, but in different cities; iv) providing oral informed consent. Printed recruitment flyers with inclusion criteria were posted at the entrance of ART clinics and CDCs. Potential participants were able to contact research team members if they were interested in this study. Potential participants who were referred by the other patients were also allowed to participate in this study.

Data collection

All interviews were conducted by the principal investigator in a private room. Before the interview, the principal investigator briefly introduced the study and obtained permission to do the interview. The interview was based on a semi-structured guide with open-ended probes. The in-depth interview lasted for about 60 minutes and was audio-recorded. Notes were also taken by the interviewer to record the interviewees' body language and mood during the interview. Each participant will receive 200RMB (approximately 30 USD) for their time and effort.

The in-depth interview with service providers focused on i) social demographics and professional background; ii) ART initiation service including HIV diagnosis, local specific policy to ART initiation among domestic migrants, cooperation across different institutions and barriers of improving ART initiation; iii) ART retention service including policy to improve ART retention, the number of local ART clinics, interaction with patients and structural barriers to ART retention; iv) suggestions to improve ART initiation and retention service.

The in-depth interview with patients focused on i) demographic information and migration experience; ii) perceptions to ART care; iii) experience of ART initiation; iv) experience of ART dropout; v) barriers to initiate and retain ART; vi) health care needs related with ART initiation and retention.

Data analyses

The audiotaped in-depth interviews were transcribed verbatim by four trained local staff. Each transcript was double-checked to ensure no misunderstandings. The transcripts were imported into the software of ATLAS.ti (Version 5.0). A set of prior codes were created based on the interview guides and used to label the words in the transcripts. The preliminary codes were modified, and some new codes were added as analysis continued. Themes were identified in the content of transcripts provided by participants. After several rounds of revision, the codes were organized and summed up to each theme. All transcripts and codes were in Chinese first, and the key findings were translated into English.

Ethics

The study protocol was reviewed and approved by the Institutional Review Boards (IRB) of the University of California, Los Angeles (UCLA), and the National Center for AIDS/STD Control and Prevention (NCAIDS), China Center for Disease Control and Prevention. All participants provided oral informed consent for all interviews.

Results

A total of 25 service providers and 27 patients were recruited and interviewed in this study. As Table 2.1 showed, these service providers were from CDC, CHC, and ART clinics. Most service providers had a degree of college or above. Table 2.2 showed the characteristics of patients. Nearly half currently were married and over two-thirds received education less than nine years. The barriers to ART initiation and retention among DMLH were summarized into four levels: policy-level, institution-level, provider-level, and individual-level. Table 2.3 presented barriers to ART initiation and retention at each level.

Policy-level Barriers

1) Lack of appropriate medical insurance policy for DMLH

DMLH without stable jobs did not buy any medical insurances in Guangdong province for themselves, and they were unable to buy any commercial insurances due to HIV infection. What they had was the medical insurance bought in their hometown. The policy of off-site medical insurance was available for domestic migrants to receive medical treatment across cities and provinces. But the reimbursement rate of medical insurance for domestic migrants was lower than that for residents. When they got sick and needed to be hospitalized in Guangdong such as surgery, the out-of-pocket fees were too high to afford. These patients would choose to go back

to the hospitals in their hometown and then stay at home for several months to have a rest. This process can delay the ART initiation for newly diagnosed patients and lead to the ART attrition for patients who had been in ART care.

“I was diagnosed with HIV at Nanfang Hospital (located in Guangdong province) due to the symptom of fever. The doctor advised me to be hospitalized and do some further testing. I knew the fees were too high and the reimbursement of my insurance was very low in Guangdong. I refused and went back to my hometown to do the inpatient examinations. Then I came back to Guangdong to take ART. That was why the initiation was delayed.” (P3, female, inter-provincial migrants, 30 years old, middle school, divorced)

“Last year I took surgery for my stomach. Regarding the rents and out-of-pocket fees, I quit my job and returned to my hometown to do the surgery. It took about seven months for the surgery and the recovery. During this period, I stayed at home and stopped taking drugs for HIV. The doctor said the number of drugs was limited for each patient and refused to prescribe drugs for half a year. I had no other choices until I came back to Guangdong to continue my treatment.” (P14, female, inter-provincial migrants, 40 years old, middle school, married)

“Some patients told me that they wanted to go back home to take surgery for several months and would come back later. They did not plan to transfer their treatment to local ART clinics. However, according to our rules, I cannot prescribe too many drugs to them. Sometimes the storage of drugs was limited, we must set restrictions for drugs to take home. We also worried that some patients sold the drugs to make money.” (S6, female, college degree, working in ART clinic, doctor)

2) Lack of effective reward and punishment mechanism for institutions

Service providers pointed out that although there were some work assessment indicators to evaluate the quality and quantity of the work, the assessment results failed to influence the allocation of government funding to institutions. The health administrative departments always circulated a notice of criticism according to assessment results, but lack of additional punishment to these institutions. Therefore, service providers in CDCs, CHCs, and ART clinics did not have pressure and incentive to improve ART initiation and retention among patients.

“This month I just heard that in our city the assessment indicators of HIV/AIDS prevention and control were removed from the service package of public health. Several years ago, we tried very hard to negotiate with other departments to include the assessment of HIV/AIDS into the public health package. Although it was regarded as the additional indicator, not the major one, it was still helpful to deliver pressure to staff in CHCs, county-level CDCs, or ART clinics. I can predict in the next few years, the work of HIV/AIDS prevention and control, including ART initiation and retention among domestic migrants, were not valued in CHC or county-level CDC.” (S4, 50, female, bachelor degree, working in CDC, manager)

“Every year we need to report the rate of viral load suppression among patients who had received viral load testing during this year. This indicator showed our work efficiency. Although the retention was important to the treatment outcome, we did not try very hard to improve the retention rate. It was not directly related to our assessment indicator. Up to now, the adherence was dependent on patients themselves. Our doctors and nurses did not have to follow each patient.” (S7, female, college degree, working in ART clinic, nurse)

“The assessment indicators were created by leaders in the CDC. We CDC did not have the administrative power to punish the institutions with poor efficiency. What they can do was to write a report and provide some suggestions to the health administrative departments. Policymakers must adjust the assessment system, or service providers would not care about the quality of ART service.” (S18, female, college degree, working in CDC, manager)

Institution-level Barriers

1) Lack of cooperation across different institutions

From HIV diagnosis to ART initiation, then to ART attrition, the patients’ management involved several departments, and the lack of cooperation across these institutions destroyed the efficiency of ART service. Once patients were diagnosed with HIV in a medical institution, generally named case reporting institution, such as a hospital or a voluntary consultation and testing (VCT) clinic, this institution should notify the results to patients, and provide consultations. Once the information of patients was inputted into the electronic system, CDC, or CHC whose addresses were the same as the patients’ current address would be responsible to follow up patients until patients initiated ART. When patients were transferred to take ART, ART clinics should take over the management, including regular ART care. When patients dropped out of ART, the management was transferred back to the CDC or CHC whose addresses were the same as the patients’ current address. The handover of patients’ management at each link was automatically according to the electronic system without oral or written announcements. Lack of cooperation across different institutions could delay ART initiation and destroy ART retention.

“I am responsible to follow up patients who were diagnosed with HIV and recommend them to initiate ART. Every morning when I arrived at the office room, I would log in to the system and check the list of patients to see whether there are new names. If there are some new names, I would call these patients according to the information from the system. I always feel embarrassed that the patients suspect my identity. I need to spend a lot of time to explain why I know his cell phone number. If the patient trusts me, I can make an appointment for face-to-face consultation in my office. It always takes at least a month during the process. If the staff at the reporting institution tell the patients that I will contact them later and provide my contact information to them, it will be easier to finish the handover of patients’ management.” (S12, male, college degree, working in CHC, follow-up specialist)

“Sometimes, the information collected from the case reporting institution was not correct. It was very difficult for me to recontact these patients. One way was to visit their apartments according to the recorded current address. Unlike residents, their current addresses were not stable and accurate. If I cannot contact them for more than a year, I would change their current address to their hometown and then staff from CDC in their hometown would try to contact them by visiting their homes. I know it is inappropriate, but I have no other better choices.” (S3, female, college degree, working in CDC, follow-up specialist)

“We told patients the date for next time when they came to take drugs. But we did not remind them in advance and we even did not notice they dropped out. The system can automatically remind us that some patients did not come to take drugs as required. We seldom took the initiative to contact these patients who dropped out of ART. Also, we seldom contracted

service providers in CHC or the county-level CDC to inform them of the information of patients.” (S22, male, college degree, working in ART clinic, doctor)

“For patients’ attrition, we are very passive. Every day I needed to check the system and documented whether some patients were dropping out of treatment. If some patients dropped out of ART, I should contact them and encourage them to reenter ART. However, it was odd to call patients and they often had migrated to other cities and refused to answer my call for the second time. I think it was the responsibility of ART clinics to contact the patients. They can contact these patients in advance to avoid attrition.” (S15, female, college degree, working in CHC, follow-up specialist)

2) Lack of flexibility in spending government funds

Every year a certain amount of government HIV/AIDS funding was allocated to CHCs, county-level CDCs, and ART clinics. However, it is very difficult to spend the funding in promoting HIV related service according to the financial audit rules. Some service providers wanted to enhance ART initiation and retention among domestic migrants, but they worried to get punished when spending the funding inappropriately and then gave up. The audit rules of government funding restricted the spending of the funding and the implementation of the intervention services.

“This is a huge disadvantage of current audit policy. The audit rules are too rigid and detailed. Every yuan should be spent as required. But these rules are contrary to real-world settings. If we spend the money as the requirements, the intervention activities would be difficult to implement. If not, we would be punished. In this situation, we would rather not spend the money. Another important point is that our staff, who are within the establishment, cannot get

any subsidy from the intervention activities according to the audit rules. It hurts our enthusiasm.” (S5, male, bachelor degree, working in CDC, follow-up specialist)

“When I tried to recommend some domestic migrants to enroll ART, some of them were facing financial difficulties. I wanted to help them and provided some financial support from the funding of HIV/AIDS prevention and control. But the audit rules required that the money can only be transferred by bank account and cash was not allowed. Some patients worried about the disclosure of privacy by providing the bank account information. The result was I wanted to help them but the audit rules restricted the support service” (S15, female, college degree, working in CHC, follow-up specialist)

Provider-level Barriers

1) Shortage of experienced service providers

There were not enough experienced service providers in some CHCs and ART clinics. Service providers in CHCs undertook the main work of ART initiation. Currently, only one or two service providers were responsible to follow up patients and transfer them to initiate ART. The work was time-consuming and required much experience and effort. However, these service providers in CHCs undertook multiple tasks of public health at the same time, and ART initiation was one of these tasks. They did not have enough time to provide consultation and transfer them to initiate ART.

The size of patients increased rapidly since the implementation of universal treatment, but the increase of experienced staff in ART clinics cannot catch the pace. There were hundreds of patients each day coming to the clinics on average. Since some physical testing was only

accepted in the morning and most patients came in the morning, doctors in ART clinics can only prescribe some lab testing and medicine without further communication within the limited time. Without enough experienced doctors and nurses, the service quality was poor.

“I am the only one staff to take charge of the work of following up patients and transferring them to ART in my institution. Meanwhile, I still assist my colleagues to deal with other tasks. Sometimes, when my work is too urgent, they would come to help me. For face-to-face consultations, only I can do it. Since it needs a lot of knowledge and communication skills, no colleagues can help me to do the consultation. Patients only trust me, but I cannot spend enough time and effort to talk with each of them.” (S12, male, college degree, working in CHC, follow-up specialist)

“I have 120 patients to follow up and 20 of them do not initiate ART. Besides, there are about hundreds of patients coming to do HIV testing in my VCT clinic every year. I need to provide face-to-face consultation for at least half an hour. I also need to participate in other work. It is a huge workload for me to deal with this work. The consultation requires a lot of knowledge since the patient can ask any questions. You see, many service providers in CHCs only take three years of medical training and some of them do not have any medical background. Therefore, it’s very difficult for these colleagues to provide comprehensive consultation to patients.” (S15, female, college degree, working in CHC, follow-up specialist)

“The shortage of experienced doctors in my hospital is very serious. We have only two experienced doctors in the clinic, but so many patients come each day, especially in the morning. We do not have time to drink water. Sometimes I want to encourage some patients to continue

the treatment. However many patients are waiting outside, I have to focus on the major issues.”
(S23, male, college degree, working in ART clinic, doctor)

2) Limited career prospects and low salary

Service providers from both CHC and ART clinics complained about the limited career prospects and low salary. Staff from CHC thought the skills in this job were not competitive and it was not helpful for them to find another job. They always spent a lot of energy to encourage patients, especially domestic migrants, to initiate and retain ART, however, the feedback was always suspicion. Compared to other colleagues in hospitals, staff from ART clinics did not feel optimistic about their careers. Salary in ART clinics was higher than that in CHC, but it was lower than that in other divisions of the hospital. Limited career prospects and low salary dampened service providers' enthusiasm and motivation, which resulted in less interaction with patients and more turnover.

“I have been working in this position for more than 20 years. In the early phase, I worked very hard and had a sense of accomplishment. My salary was not related to the work quality and quantity. I needed to work very hard to complete the work very well, but my salary was still very low. The reason why I insisted on doing this job was that I did not want to be the worst and lose my face in front of my colleagues.” (S16, male, college degree, working in CHC, follow-up specialist)

“I have worked for this job for about two years. My major was psychology in university. I know this job is very important. But the salary (4,000 Yuan per month) is not enough for me to

marry a woman and have a baby. I plan to quit this job when I find an appropriate one.” (S14, male, bachelor, a social worker in CDC, social worker)

“As a young doctor, I was assigned to work in ART clinics. At first, I did not know too much about this job. Several years later, I knew this was a bad choice for me. I know in some ART clinics, some old doctors were willing to come to this department. They were waiting to retire. But for myself, I cannot tolerate the pessimistic career prospects and salary. I hope to transfer to other departments one day.” (S23, male, college degree, working in ART clinics, doctor)

Individual-level barriers

1) Lack of HIV related knowledge

Some domestic migrants did not have much knowledge about HIV/AIDS and delayed their ART initiation or quit HIV treatment. Generally, service providers would provide some basic knowledge to these patients when they were diagnosed with HIV and enrolled in ART. However, if the consultation was too brief or the patients accepted incorrect information from the internet or friends, it was easier to misunderstand the efficacy of ART.

“In the first two years when I was diagnosed with HIV, I cannot accept the truth. I thought it was impossible to get infected with HIV. I did not trust the results and refused to retake the testing. During this period, I stayed at home for one year and moved to some other cities to find temporary jobs. When I consulted with my trusted friend who was a doctor in my hometown, he told me that I should take ART as soon as possible. Then I came back to the CDC.” (P13, male, 43 years old, middle school, married)

“Currently I feel very healthy. You see, I have much strong muscle. I insist on doing exercise. I do annual testing for CD4 cell count. And I have known that the side effects of drugs are harmful to our health. I will not initiate my treatment until I find that my CD4 cell count drops a lot.” (P11, male, 35 years old, high school, single)

“I want to quit the treatment because my physical testing is fine each time. I want to stop for a while and see what will happen. I haven’t tried but will have a try.” (P30, male, 30 years old, college degree, single)

2) Side effects

Side-effects of ART drugs were very strong in the first six months. Different drugs have different side effects. Patients who cannot tolerate the side effects would easily lose their confidence and drop out of ART. The number of free drugs was limited and they cannot afford the other self-paying drugs. They had no other potential choices if they cannot tolerate the side effects. Due to low salary and no other financial support, domestic migrants cannot afford the fees for additional testing and treatment for addressing side effects and then decided to quit the treatment.

“When I first took the drug, I felt painful at my stomach. You cannot imagine the pain. I cannot eat, work, and sleep. I told the doctor and he helped change the drug. However, this time the drug caused me dizzy. And it also affected my job and life. I have already tried every drug. You may suppose that I was too weak. Anyway, I cannot tolerate the side effects. I quit the treatment finally. I may take it again in the future when I can make enough money to buy self-paying drugs.” (P2, female, 23 years old, middle school, single)

“I still took the drug every three months. My wife pushed me to take it. I did not want to let my family down, especially my wife. But I did not eat them because of the side effects. I vomited each time when I took the drug. I told doctors, and they prescribed more tests for me. The fees were so high. But the problems were still there. I cannot tolerate it anymore. The side effects affected my life. I still had to work to make money.” (P8, male, 50 years old, middle school, married)

3) Inconvenience to take a leave

Domestic migrants with stable jobs in factories had to work from Monday to Friday or even weekends. The working time was overlapped with the opening time of ART clinics. And also the waiting time was always several hours so that patients had to spend the whole day taking drugs. If they wanted to go to the clinic, they had to provide the proof including medical records from doctors, which would disclose their privacy. And if they took a leave for another reason, the bonus for that month would be deducted. Due to the inconvenience to take a leave, patients tended to delay or quit the treatment.

“I worked in a factory for making shoes. According to the rules, I can only take a rest two days a month. And the two days are both within weekends. So that I have no time to come to take drugs. I took the medicine for only one month. The doctor asked me to come frequently at the beginning. I found it was too troublesome for me and decided to drop out.” (P12, male, 39 years old, middle school, married)

“I can take leave to come to see doctors. However, I have to provide the materials from hospitals to prove that I get diseased. I worried about the disclosure of my HIV status and

caused stigma from colleagues. If I took a leave for other reasons, the bonus would be deducted.” (P24, male, inter-provincial migrants, 28 years old, college, single)

4) Lack of family support

Some domestic migrants moved to Guangdong to find a job and make money alone without family’s accompany. When diagnosed with HIV, they dared to inform their families and cannot find others to help them face this difficulty together. Without family support, the patients did not have the courage and willingness to live. They often refused to take any suggestions of ART initiation and retention from service providers from CHC or CDC at the early phase.

“When I heard that I get infected with HIV, I did not tell any family members for three years and hoped to die as soon as possible. I dared to tell my wife and worried she would divorce me. However, when I went back home and lived together with my wife, children, and parents, I recognized that I was so important to this family. I cannot die so early. I told my wife and my parents. Surprisingly, they encouraged me to take ART, and then I came back to Guangdong to make money. Currently, my wife also found a job and lived together with me in this city.” (P20, male, 39 years old, middle school, married)

“I had one sister and one brother. My mother lived together with my brother. I once had a girlfriend but broke up when I got diagnosed with HIV. Now I am living alone, and I have no other concerns. My family members do not know about my HIV status. Sometimes I feel very desperate and imagine one day I would die alone. I do not care about anybody and anything. Please do not advise me to take drugs again. You are nice but you do not understand me.” (P19, male, 30 years old, high school, single)

5) Fear of stigma

Patients worried that their personal information will be disclosed since the waiting area was open and overcrowded in ART clinics, and it would induce stigma from their surrounding people. They worried to meet some relatives, friends or colleagues in hospitals. They also had a potential concern that they would finally go back to their hometown and then their treatment would be transferred back to the ART clinics in the hometown. They had wide social networks in their hometown and worried to meet relatives or friends in the hospital. Even some patients worried about the disclosure of privacy from local doctors. This was a potential barrier for domestic migrants to drop out of ART in the future when they had to move back to their hometown.

“I have worked in this city for more than ten years. Many colleagues would go to the same hospital to see other doctors. I can meet some familiar colleagues. I want to choose another hospital which is very far and then I do not need to worry about running into my friends. But currently, it’s not convenient for me to take a bus there. I am even thinking to change another job.” (P25, male, 46 years old, high school, divorced)

“I was diagnosed when I went back home for surgery. The local doctor told me the result. I did not choose to take ART immediately in my hometown. I stayed at home for recovery at least a year. When I could walk by myself, my wife and I came back to Guangdong for jobs and ART initiation. I worry about the stigma of my relatives. My wife and I hope to live in Guangdong for the rest of our lives. My son has bought an apartment here. We have no plan to return home, especially when I get diagnosed with HIV.” (P26, male, 46 years old, high school, divorced)

“Now I can find a job and make money in Guangdong province. One day I will go back to my hometown. At that time, I have to face many relatives and friends. I worried about the disclosure of privacy. This can cause stigma and discrimination. I cannot live in that environment. I suppose if that occurs, I would choose not to transfer my treatment back to my hometown. I will come to Guangdong to take drugs or just quit ART.” (P21, male, 35 years old, middle school, married)

Discussion

This study comprehensively identified the multifaceted barriers towards ART initiation and retention among DMLH in Guangdong province. These barriers were not only related to ART service but also associated with general health care among domestic migrants. The findings indicated that ART initiation and retention shared some common barriers with general populations but different mechanisms to individuals. It provided further understanding of these multilevel barriers and how these barriers affected ART initiation and retention among domestic migrants.

This study found that policies not directly related to DMLH can still have an impact on ART initiation and retention among DMLH. The policy about off-site social health insurance was designed to help people to receive inpatient service across cities or provinces (Qiu et al., 2011). But given the shortage of family support and financial difficulties among many DMLH, DMLH would rather go back to their hometown to receive inpatient service. This finding was consistent with studies in the United States and Germany that lack of appropriate medical insurance was a barrier to initiate and retain ART among migrants (Saag et al., 2018). This result reminded policymakers to emphasize the specific characteristics of DMLH when implementing the policy

towards general populations. A reasonable approach to deal with this issue could be increasing the reimbursement rate of off-site social health insurance for DMLH. The other barrier was lack of the reward and punishment mechanism that was especially for institutions providing ART related service. Reward and punishment mechanisms had been proven to be effective to promote employees' performance in work (Balliet et al., 2011). Lack of effective reward can also discourage providers' motivation from providing high-quality service to patients. Regarding the huge size of DMLH in Guangdong, DMLH were extensively influenced by providers' low-quality service. This finding suggested that adjusting the reward mechanism may encourage providers to improve service provision to patients and increase the efficiency of the ART program.

Institution-level barriers contributed significant challenges to the efficacy of ART services towards DMLH. Effective cooperation across different departments can help exchange information immediately to improve ART initiation and retention (Mao et al., 2017). The handover of patients' management in the current system mainly depended on the electronic system, without enough direct interactions between service providers from different institutions (Wu et al., 2015). It was easy to miss some important information during the process of transferring patients across different institutions. The care continuum could be easily broken in any link without information exchange between service providers. One possible solution was to construct a platform or channel for service providers from different institutions to exchange information immediately. Also, the inflexibility of spending government funding caused the shortage of funding and restricted institutions to implement intervention services. Other studies had reported that the inflexibility of funding use harmed work efficiency in HIV prevention in

China (Luo, 2019). Regarding the limitation of audit rules to service provision, the audit rules could be modified to be more compatible with current ART related services.

This study highlighted that provider-level barriers brought challenges to the provider-patient relationship. Experienced service providers were very vital to health care treatment by enhancing service provision (Li et al., 2019). The work of ART initiation and retention required a bunch of professional knowledge and demanded much patience for service providers. Lack of experienced service providers in CHCs and ART clinics hindered the provider-patient interaction and reduced the quality of ART related service. This finding called for recruiting enough service providers and providing professional training to each provider to ensure their abilities to service provision. Furthermore, regarding the uncertain career prospects and low salary, more institutional support was required to provide more advanced training and incentives to service providers. The salary can be allocated according to the workload and set multilevel bonuses to motivate service providers. This result suggested that sustainable career education and an incentive wage system were essential in CHCs and ART clinics.

This study identified that several individual barriers contributed to the challenges of ART initiation and retention, which were consistent with other studies (Colvin et al., 2014; Kagee et al., 2011). Financial difficulties can be one of the root causes of these individual barriers among DMLH, including lack of family support, unalleviated side effects of drugs, and inconvenience to take a leave. Disruption of social networks was a universal challenge to migrants, and it brought subsequent issues for migrants' health care (Chen et al., 2019; Torres & Casey, 2017). Without immediate support from families, DMLH feared to face the result of HIV infection, hesitated to take ART immediately, and eventually quit ART. This study also found that fear of

stigma from surrounding friends, colleagues, and relatives was a huge barrier to access ART service. Stigma had been reported as one of the widest barriers to ART service (Hodgson et al., 2014). Except for the fear of stigma from people in their working place and service providers, many DMLH worried about the disclosure of privacy in their hometown. Providing more private waiting areas in hospitals and implementing stigma reduction interventions among the general population were still required in current times. Future interventions could encourage patients to disclose their status to their families and invite family members to participate in ART initiation and retention. Multiple possible interventions could be considered in the future, such as inviting family members to participate in ART initiation and retention, extending the opening time during weekends in ART clinics, and providing additional financial support to help DMLH take additional treatment and testing to alleviate the side effects of drugs.

Several limitations should be considered when interpreting the findings in this study. The study may not be simply generalized to other provinces in China because the policy to domestic migrants and migrants' characteristics may be different from that in Guangdong province. Furthermore, social desirability bias was unavoidable in this study. Service providers may have other concerns and did not report some sensitive challenges and difficulties in work. Lastly, some DMLH who dropped out of ART were hard to reach, so the barriers to ART retention among these patients were not identified. Despite the limitations discussed above, the findings in this study still provided a comprehensive and profound understanding of the multilevel barriers towards ART initiation and retention among DMLH.

This study had identified multilevel barriers towards ART initiation and retention among DMLH from the perspectives of service providers and patients. Policymakers and service

providers can take into these findings into consideration to address these barriers and implement effective interventions to improve ART initiation and ART retention.

Table 2.1 Characteristics of service providers in this qualitative study

	N	%
City		
Guangzhou	7	28.0
Dongguan	14	56.0
Qingyuan	4	16.0
Age		
20-29	6	24.0
30-39	8	32.0
40-60	11	44.0
Gender		
Male	13	52.0
Female	12	48.0
Marital status		
Married	21	84.0
Single	4	16.0
Education		
Associate college	3	12.0
College or above	22	88.0
Institution		
CDC	12	48.0
CHC	3	12.0
ART Clinics	10	40.0
Profession		
Manager	6	24.0
Doctor	6	24.0
Nurse	2	8.0
Follow-up specialist	7	28.0
Social worker	2	8.0
Data administrator	2	8.0
Working years in the position		
≤5 years	9	36.0
5-10 years	6	24.0
> 10 years	10	40.0

Table 2.2 Characteristics of patients in this qualitative study

	N	%
City		
Guangzhou	14	51.9
Dongguan	13	48.1
Age		
20-29	3	11.1
30-49	18	66.7
≥ 50	6	22.2
Gender		
Male	20	74.1
Female	7	25.9
Marital status		
Married	13	48.1
Divorced	4	14.8
Single	10	37.0
Education		
≥ 9 years	7	25.9
< 9 years	20	74.1
Employment		
Unstable job	5	18.5
Stable job	22	81.5
Migration status		
Inter-provincial migrants	24	88.9
Intra-provincial migrants	3	11.1

Table 2.3 Barriers to ART initiation and retention at each level

Level	Barriers to ART initiation and retention
Policy	1) Lack of appropriate medical insurance policy for DMLH 2) Lack of effective reward and punishment mechanism for institutions
Institution	1) Lack of cooperation across different institutions 2) Lack of flexibility in spending government funds
Provider	1) Shortage of experienced service providers 2) Limited career prospects and low salary
Individual	1) Lack of HIV related knowledge 2) Side effect 3) Inconvenience to take a leave 4) Lack of family support 5) Fear of stigma

Reference

- Balliet, D., Mulder, L., & Van Lange, P. A. M. (2011). Reward, Punishment, and Cooperation: A Meta-Analysis. *Psychological Bulletin*, 137(4), 594-615.
- Census office of the state council, Population and employment statistics division of the national bureau of statistics (2010, December 31). National census of China in 2010. Retrieved from <http://www.stats.gov.cn/tjsj/pcsj/rkpc/6rp/indexch.htm>.
- Chen, W., Wu, S., Ling, L., & Renzaho, A. M. N. (2019). Impacts of social integration and loneliness on mental health of humanitarian migrants in Australia: evidence from a longitudinal study. *Australian and New Zealand Journal of Public Health*, 43(1), 46-55.
- Colvin, C. J., Konopka, S., Chalker, J. C., Jonas, E., Albertini, J., Amzel, A., & Fogg, K. (2014). A systematic review of health system barriers and enablers for antiretroviral therapy (ART) for HIV-infected pregnant and postpartum women. *PloS one*, 9(10), e108150. <https://doi.org/10.1371/journal.pone.0108150>
- Davis, A., Terlikbayeva, A., Terloyeva, D., Primbetova, S., & Elbassel, N. (2017). What Prevents Central Asian Migrant Workers from Accessing HIV Testing? Implications for Increasing HIV Testing Uptake in Kazakhstan. *AIDS and Behavior*, 21(8), 2372-2380.
- De Coul, E. L. M. O., Van Sighem, A., Brinkman, K., Van Benthem, B. H. B., Der Ende, M. E. V., Geerlings, S. E., & Reiss, P. (2016). Factors associated with presenting late or with advanced HIV disease in the Netherlands, 1996–2014: results from a national observational cohort. *BMJ Open*, 6(1).

European center for disease prevention and control. (2017, April 1). Monitoring implementation of the dublin declaration on partnership to fight HIV/AIDS in Europe and Central Asia: 2017 progress report.

<https://www.ecdc.europa.eu/sites/portal/files/documents/HIV%20and%20migrants.pdf>.

Feng, X., & Yue, W. (2018, December 1). Sexual transmission is the major mode among 9011 newly reported HIV cases in Guandong. Retrieved from http://news.ycwb.com/2018-12/01/content_30143486.htm.

Hernando, V., Arco, A. D., Alejos, B., Monge, S., & Amo, J. D. (2015). HIV Infection in Migrant Populations in the European Union and European Economic Area in 2007-2012: An Epidemic on the Move. *J Acquir Immune Defic Syndr*, 80(2).

Hodgson, I., Plummer, M. L., Konopka, S. N., Colvin, C. J., Jonas, E., Albertini, J., Amzel, A., & Fogg, K. P. (2014). A Systematic Review of Individual and Contextual Factors Affecting ART Initiation, Adherence, and Retention for HIV-Infected Pregnant and Postpartum Women. *PloS one*, 9(11).

Kagee, A., Remien, R. H., Berkman, A., Hoffman, S., Campos, L., & Swartz, L. (2011). Structural barriers to ART adherence in Southern Africa: Challenges and potential ways forward. *Global Public Health*, 6(1), 83-97.

Levison, J. H., Bogart, L. M., Khan, I. F., Mejia, D., Amaro, H., Alegria, M., & Safren, S. A. (2017). "Where It Falls Apart": Barriers to Retention in HIV Care in Latino Immigrants and Migrants. *AIDS patient care and STDs*, 31(9), 394-405.

- Li, L., Liang, L., Lin, C., Feng, N., Cao, W., & Wu, Z. (2019). An intervention to improve provider-patient interaction at methadone maintenance treatment in China. *Journal of substance abuse treatment*, 99, 149-155.
- Li, P., Wang, L., Guo, W., Qin, Q., Ding, Z. W., & Cui, Y. (2014). Mobility of HIV/AIDS and affecting factors analysis in 2013, China. *Chinese journal of preventive medicine*, 48(11), 934-937.
- Li, Y., Lin, P., Wang, Y., Fu, X.-b., Ye, R., Li, J.-r., Feng, M.-y., Yu, G.-l., Yang, F., Yan, J., Long, Q.-s., & Deng, h.-h. (2015). HIV/AIDS surveillance in Guangdong Province, 2000-2013. *South China J Prev Med*, 41(2), 101-106.
- Mao, Y., Wu, Z., Mcgoogan, J. M., Liu, D., Gu, D., Erinoff, L., Ling, W., Vanveldhuisen, P. C., Detels, R., & Hasson, A. (2017). Care cascade structural intervention versus standard of care in the diagnosis and treatment of HIV in China: a cluster-randomized controlled trial protocol. *BMC health services research*, 17(1), 397.
- Marukutira, T., Gray, R., Douglass, C., Elhayek, C., Moreira, C., Asselin, J., Donovan, B., Vickers, T., Spelman, T., & Crowe, S. M. (2020). Gaps in the HIV diagnosis and care cascade for migrants in Australia, 2013-2017: A cross-sectional study. *PLOS Medicine*, 17(3).
- Qiu, P., Yang, Y., Zhang, J., & Ma, X. (2011). Rural-to-urban migration and its implication for new cooperative medical scheme coverage and utilization in China. *BMC Public Health*, 11(1), 520.

- Reyesuruena, J., Campbell, C. N. J., Hernando, C., Vives, N., Folch, C., Ferrer, L., Fernandezlopez, L., Esteve, A., & Casabona, J. (2017). Differences between migrants and Spanish-born population through the HIV care cascade, Catalonia: an analysis using multiple data sources. *Epidemiology and Infection*, 145(08), 1670-1681.
- Ross, J., Cunningham, C. O., & Hanna, D. B. (2018). HIV outcomes among migrants from low-income and middle-income countries living in high-income countries: a review of recent evidence. *Current Opinion in Infectious Diseases*, 31(1), 25-32.
- Saag, L., Tamhane, A., Batey, D. S., Mugavero, M. J., & Eaton, E. F. (2018). Mental health service utilization is associated with retention in care among persons living with HIV at a university-affiliated HIV clinic. *Aids Research and Therapy*, 15(1), 1-10.
- Sheehan, D. M., Fennie, K. P., Mauck, D. E., Maddox, L. M., Lieb, S., & Trepka, M. J. (2017). Retention in HIV Care and Viral Suppression: Individual- and Neighborhood-Level Predictors of Racial/Ethnic Differences, Florida, 2015. *AIDS patient care and STDs*, 31(4), 167-175.
- Torres, J. M., & Casey, J. A. (2017). The centrality of social ties to climate migration and mental health. *BMC Public Health*, 17(1), 1-10.
- UNAIDS. (n.d.). 90-90-90 An ambitious treatment target to help end the AIDS epidemic. Retrieved 2020, August 25 from https://new.pancap.org/pc/pcc/media/pancap_document/90-90-90_Targets.pdf.
- UNAIDS. (2019, July 16). UNAIDS DATA 2019. <http://rstes.unaids.org/publications/global-publications/2019/item/208-unaid-data->

Chapter III

Antiretroviral Therapy Initiation among Domestic Migrants Living with HIV in Guangdong, China: A Retrospective Cohort Study

Abstract

Background ART initiation has been highly recommended for all people living with HIV regardless of CD4 cell counts. It was reported migrants were left behind in ART initiation. This study was to investigate ART initiation among domestic migrants living with HIV and identify the impact of migration patterns during the follow-up on ART initiation.

Methods The data were extracted from the electronic system of HIV/AIDS case reporting in Guangdong province. All participants with confirmed HIV diagnosis from July 1, 2016, to December 31, 2018, were extracted from the baseline and were followed until December 31, 2019. Migration status at the time of HIV diagnosis and during the follow-up was documented as the exposure of interest, and ART initiation was measured as the outcome of interest. Cumulative probabilities of ART initiation were calculated by the product-limit method. The frailty model considering the clustering effect from cities and adjusting covariates was performed in the analysis to assess the impact of migration status on ART initiation.

Results Among the total of 22,773 participants, over half were domestic migrants, including 9749 (42.8%) for inter-provincial migrants and 2684 (11.8%) for intra-provincial migrants, and the rest were residents. Approximately 92% of DMLH clustered in seven cities from Region A. Once participants were diagnosed with HIV, ART initiation rate increased fast during the first six months and then maintained slow growth afterward. There were no heterogeneities of ART initiation among residents, intra-provincial migrants and inter-provincial migrants between

Region A and Region B. In the overall analysis, the probability of ART initiation was lower among PLH in Region B than that in Region A (HR=0.74, 95%CI: 0.62~0.88). Inter-provincial migrants were less likely to initiate ART than that among residents (HR=0.90, 95%CI: 0.86~0.94) and intra-provincial migrants (HR=0.90, 95%CI: 0.86~0.94). Compared to those without migration the probabilities of ART initiation were lower among those moving to their hometown (HR=0.06, 95%CI: 0.05~0.07) and other cities (HR=0.22, 95%CI: 0.17~0.27). Compared to those migrating to other cities, the probability of ART initiation among those who returning to their hometown was lower as well (HR=0.30, 95%CI: 0.22~0.40).

Conclusion This study demonstrated that inter-provincial migrants were less likely to initiate ART compared to residents and intra-provincial migrants. Migration during the follow-up reduced the probability of ART initiation. Domestic migrants returning to their hometown were less likely to initiate ART. Future interventions to promote ART initiation among domestic migrants should focus on inter-provincial migrants and stigma reduction intervention needed to be continuously strengthened to reduce barriers for domestic migrants taking ART in their hometown.

Key words: Antiretroviral therapy, initiation, domestic migrants, China

Introduction

Early and extensive ART initiation has been highly recommended for all PLH regardless of CD4 cell counts, due to its benefits to the increased probability of viral suppression, prolonged survival, and reduced transmission risk (Emery et al., 2015; Lima et al., 2009). Therefore, ART initiation was an important link in the HIV care cascade. UNAIDS set a goal that 90% of all people with diagnosed HIV infection can receive sustained antiretroviral therapy by 2020. However, in real-world settings, 38% of diagnosed PLH did not initiate ART, which was far from the target (UNAIDS, 2020). Those PLH without ART initiation contributed a lot to new infections. It was thought that closing the gap for ART initiation depended on vulnerable subpopulations across the world including migrants.

Migrants were facing difficulties in accessing HIV treatment globally. ART coverage rate among migrants was lower than that among non-migrants in Australia and more than twenty countries in Europe and Central Asia did not provide ART to undocumented migrants (Marukutira et al., 2020; European CDC, 2017). Barriers to ART initiation had been broadly identified among the general population in previous studies including age, gender, occupation, HIV-related knowledge, HIV transmission route, physical conditions, and perceived stigma from the surrounding environment (Dovel et al., 2020; Fox et al., 2010; Hodgson et al., 2014; Kebaabetswe et al., 2019). Migration itself was not a barrier to HIV related service, but their characteristics restricted their HIV treatment seeking. Apart from the common barriers towards ART initiation, migrants were facing some specific barriers such as social-cultural differences, inappropriate medical insurance, lack of social and family support, and high mobility (Levison et al., 2017). The major barrier for migrants to access ART in Australia was medical insurance

restrictions (Marukutira et al., 2020). In western European countries, the main limitation of HIV treatment among migrants was a certified identity (European CDC, 2017). In Kazakhstan, undocumented migrant workers were not allowed to access HIV services in host sites (Davis et al., 2017). A bunch of research had been conducted globally to identify barriers to ART initiation among migrants. However, there were limited studies to comprehensively investigate ART initiation among domestic migrants in China. Given the huge heterogeneities of the management system and social culture, it was necessary to investigate the ART initiation among domestic migrants in China.

The size of Chinese domestic migrants increased rapidly from 30 million to 250 million during the last thirty years (Zhao et al., 2018). Most domestic migrants moved to south-east cities, and nearly one-third of inter-provincial migrants migrated into Guangdong province according to the sixth national census of 2010 (Census Office of the State Council, 2010). In Guangdong province, 30 million domestic migrants accounted for about 30% of its total population. However, the economic development was not balanced in Guangdong province. The economy in Guangdong developed much faster in cities around the Pearl River Delta (including nine cities: Guangzhou, Dongguan, Foshan, Shenzhen, Zhuhai, Zhongshan, Huizhou, Jiangmen, and Zhaoqing) than that in other cities. Highly developed economy in cities around the Pearl River Delta lead to more sufficient healthcare resources and higher salaries and attracted nearly 90% of domestic migrants in Guangdong to cluster in this region (Liang, 2013). PLH from cities around the Pearl River Delta contributed more than 60% to total PLH in Guangdong province (Zhang et al., 2018). PLH lived in cities not around the Pearl River Delta were facing multiple challenges including shortage of HIV knowledge, limited HIV care source and stigma from relatives (Ma, 2008). Out of 60,000 PLH, over half were domestic migrants (Li et al., 2014;

Li et al., 2015). ART coverage among DMLH in Guangdong province was merely 70%, less than the national average rate of 72% (Li et al., 2014; Li et al., 2015). The ART initiation among DMLH played an important role in the success of ART services in Guangdong province. Given the huge size and vital role of DMLH in Guangdong, it was necessary to examine the ART initiation among DMLH in Guangdong province.

The present study investigated ART initiation among domestic migrants in Guangdong, China. We hypothesized that there was heterogeneity for ART initiation across regions among PLH with different migration patterns at the time of HIV diagnosis, and the migration patterns during the follow-up also affected ART initiation

Methods

Data source

China developed a comprehensive, national, web-based HIV/AIDS information system that contained eight subsystems (Mao et al., 2010; Wu, 2015). In this study, the data were extracted from *the HIV/AIDS Case Reporting System* in Guangdong province. The system included two data sets, the baseline and the follow-up. The baseline data set were mostly collected at the first investigation with PLH when they were diagnosed with HIV. The follow-up data were collected at each follow-up by service providers from CDC or CHC. Every PLH should be followed up with surveys at least once a year after they were diagnosed with HIV and the surveys were inputted into the follow-up data set. Each PLH had one record at the baseline data set and many records in the follow-up data set. The baseline and follow-up data sets can be linked by the unique code in the dataset. The merged data set can provide longitudinal

information from HIV diagnosis to patients' latest records. Appendix 3.1 (Simplified questionnaire for people newly diagnosed with HIV) presented the simplified questionnaire in the baseline dataset and the main information was 1) residence: the administrative code of registered residence, and the administrative code of current residence; 2) demographics: age, gender, education, occupation, and marital status; 3) HIV diagnosis information: transmission route, HIV diagnosis venue, HIV diagnosis date; 4) physical examination: CD4 cell count at diagnosis, AIDS-related symptoms, and AIDS stages. Appendix 3.2 (*Simplified questionnaire for people living with HIV during follow-up*) showed the questionnaire for the follow-up data set and the contents included current residences, demographics, CD4 cell count, ART initiation date, AIDS-related symptoms, and death-related information.

Inclusion criteria for participants

The study period was conducted from July 1, 2016, to December 31, 2019. All participants with confirmed HIV diagnosis from July 1, 2016, to December 31, 2018, were extracted from the data sets. To ensure that each alive participant can be followed up at least one year, we chose the date of December 31, 2019, as the end of the study period. The inclusion criteria for participants were: 1) aged 18 or above; 2) current residence was in Guangdong at the time of diagnosis; 3) Diagnosed with HIV between July 1, 2016, and December 31, 2018.

The selection process for participants was presented in Figure 3.1. In this study, the baseline data set and follow-up data set were merged by a unique code. Each participant was assessed according to the inclusion criteria. Observations with logic errors such as inconsistent gender were excluded from the analyses. The complete data set included the information at the

timepoint of HIV diagnosis, migration pattern during the follow-up, and the potential results by the end of the studies.

Measurements

Variables of interest in the merged data sets were recoded with a reasonable type and rename for analysis. The main exposure of interest was the residence status at the baseline and follow-up period. The definition of residence was 1) for inter-provincial migrants, the administrative code of current residence was in Guangdong province, but the administrative code of registered residence was in other provinces; 2) for intra-provincial migrants, the administrative code of current residence and the registered residence were both in Guangdong, but in different cities; 3) for residents, the administrative codes of current residence and the registered residence were both in Guangdong, and the same cities. The change of current residence during the follow-up was also documented and categorized into 1) returning to the hometown; 2) migrating to other cities; 3) no migration.

ART initiation was the outcome of interest for this cohort study. Patients with confirmed ART treatment code and ART initiation date in the data sets were categorized as individuals with ART initiation. If patients did not take ART during the study period, then their potential outcomes included death, loss-to-follow-up, migrating outside to other cities, and not taking ART by the end of the study. The start point of the cohort was the date of HIV diagnosis and the endpoints of the cohort included ART initiation, death, loss-to-follow-up, migrating outside to other cities, and not taking ART by the end of the study, whichever came first.

21 cities were categorized into Region A and Region B regarding the economic development level, city's location, and proportion of DMLH accounting for PLH. Seven cities with highly developed economy, around the Pearl River Delta, and a larger proportion of DMLH were categorized into Region A including Guangzhou, Foshan, Dongguan, Shenzhen, Zhuhai, Zhongshan, and Huizhou. The rest of the 14 cities were categorized into Region B.

Covariates were also recategorized and presented in this study, including demographics, HIV transmission route, venue of diagnosis, address of HIV reporting institution, and CD4 cell count at the time of diagnosis. The categorization and rationale for each variable were presented in Appendix 3.3 (*Table S3*).

Statistical analysis

The distribution of DMLH was presented on the map. The frequency of patients' characteristics was presented and compared between different residence status. The product-limit method was applied to estimate the probability of ART initiation at some specific time points. A log-rank test was used to compare the probability of ART initiation between subpopulations. The frailty model was performed in the analysis. There were two levels, one for the city and the other for the individual. Since the management system for ART initiation was similar in the same city, the clustering effect from cities was treated as random effects in the model. Covariates previously identified as confounders for the relationship between residence status and ART initiation either in China or other countries were included to adjust in this study.

In the main analysis, death, loss-to-follow-up, migrating outside to other cities, and not taking ART at the end of the study period were treated as censored. The person time for

individuals in the cohort was the difference between the date of HIV diagnosis and the date of endpoints including ART initiation, death, loss-to-follow-up, migrating outside to other cities, or the end of the study, whichever came first.

In the subgroup analysis for assessing the influence of migration during the follow-up on ART initiation, migrating outside to other cities was treated as time-dependent exposure not the endpoint of follow-up (Allison, 2010). Migration during the follow-up was coded as 0 for “no migration”, and 1 for “returning to hometown”, and 2 for “migrating to other cities”. Before “returning to hometown”, the status was coded as “0” and then coded as “1”. Before “migrating to other cities”, the status was coded as “0” and then coded as “2”.

SAS software windows version 9.4 (SAS Institute, Cary, NC, USA) and R software windows version 3.5.1 (R Core Team, 2019) was applied in the whole analysis process.

Ethics

The study protocol was reviewed and approved by the IRBs of UCLA and NCAIDS, China Center for Disease Control and Prevention.

Results

Characteristics of participants

In total 22,773 PLH were finally included in the cohort study. All participants were diagnosed with HIV from July 1, 2016, to December 31, 2018, and followed up to December 31, 2019. Figure 3.1 showed that over sixty percent of participants from Region A. In Region A, about 80% of inter-provincial migrants and 88% of intra-provincial migrants initiated ART in current residence. In Region B, nearly 60% of inter-provincial migrants and 70% of intra-

provincial migrants initiated ART in current residence. Figure 3.2 and Table 3.1 presented the distribution of DMLH across cities in Guangdong province. Among these participants, over half were DMLH, including 9749 (42.8%) for inter-provincial migrants and 2684 (11.8%) for intra-provincial migrants. Approximately 92% of DMLH clustered in seven cities from Region A. The remaining 8% of DMLH distributed in the other fourteen cities. DMLH accounted for over 60% of PLH in each city in Region A. Table 3.2 suggested that compared to participants in Region B, a higher proportion of participants in Region A were male, younger than 30 years old, unmarried, higher education level, homosexual transmission, inter-provincial, and intra-provincial migrants.

Table 3.3 presented the distribution of characteristics among all participants and three subpopulations. Most participants were Han ethnicity and infected with HIV through sexual transmission route including heterosexual and homosexual transmission. Most DMLH were younger than 60 years old. However, almost 30% of residents living with HIV were older than 60. Among DMLH, less than 30% had stable jobs, and about one third were married. Nearly 11% of inter-provincial migrants were diagnosed with HIV and reported outside of Guangdong province. During the follow-up, most participants did not migrate outside to other cities, and about 9% inter-provincial migrants and 5% intra-provincial migrants migrated during the follow-up.

ART initiation among domestic migrants and residents

Table 3.4 and Figure 3.3 presented the cumulative probabilities of ART initiation at specific timepoints during the study period. The median of follow-up months for the cohort was 21.3 (Interquartile Range (IQR):13.7, 31.6). In the overall analysis, At the end of the first month, nearly 55% inter-provincial migrants, 62% intra-provincial migrants, and 48.5% of residents

initiated ART care. Once participants were diagnosed with HIV, ART initiation rate increased fast during the first six months and then maintained slow growth after six months. Nearly 83.3% inter-provincial migrants initiated ART which was higher than that among residents (73.5%) by the end of the study. However, the univariate analysis in Region A showed that ART initiation probability was lower among inter-provincial migrants (84.7%) compared to residents (90.7%) at the end of the study. In Region B, inter-provincial migrants (65.7%) had similar ART initiation probability than that among residents (66.0%).

Table 3.5 showed there were no heterogeneities of ART initiation among residents, intra-provincial migrants, and inter-provincial migrants between Region A and Region B. In the overall analysis, the probability of ART initiation among PLH was lower in Region B than that in Region A (HR=0.74, 95%CI: 0.62~0.88). Inter-provincial migrants were less likely to initiate ART than that among residents (HR=0.90, 95%CI: 0.86~0.94) and intra-provincial migrants (HR=0.90, 95%CI: 0.86~0.94). In Region A, the probability of ART initiation among inter-provincial migrants was lower than that among residents (HR=0.90, 95%CI: 0.86~0.94) and intra-provincial migrants (HR=0.90, 95%CI: 0.86~0.95). In Region B, the probability of ART initiation among inter-provincial migrants was lower than that among residents (HR=0.88, 95%CI: 0.80~0.98) and intra-provincial migrants (HR=0.81, 95%CI: 0.68~0.98).

Subgroup analysis-ART initiation among domestic migrants with different migrations

In the subgroup analysis, the impact of migration patterns during the follow-up on ART initiation among domestic migrants was assessed. Table 3.6 showed the characteristics of different migration patterns. Among 12,433 domestic migrants, 854(6.9%) returned to hometowns, and 171 (1.4%) migrated to other cities. 11,408 (91.8%) did not migrate to other

places during the follow-up of this study. Table 3.7 presented that after adjusting the covariates the probabilities of ART initiation were lower among those moving to their hometown (HR=0.06, 95%CI: 0.05~0.07) and other cities (HR=0.22, 95%CI: 0.17~0.27) than that among those without migration. Compared to those migrating to other cities, the probability of ART initiation among those who returning to their hometown was also lower (HR=0.30, 95%CI: 0.22~0.40).

Discussion

This study was one of the earliest longitudinal studies to assess the impact of migration on ART initiation in China. The median of follow-up months in this cohort was nearly 20 months which was sufficient to examine the association between migration status and ART initiation. We found that most domestic migrants initiated ART in host cities which were their current residence at the time of HIV diagnosis. No specific policies were inhibiting domestic migrants to initiate ART in Guangdong province. Most DMLH in Guangdong province had jobs to make money in host cities (Liang, 2013). However, job opportunities in their hometown were limited. If they moved back to their hometown to take ART then they had to quit the jobs. Besides, DMLH perceived less stigma in host cities than that in their hometown. Most DMLH preferred to take ART in Guangdong province until they had to move back to their hometowns.

The finding suggested that the growth of ART initiation was rapid in the first month and then relatively flat among both the overall population and three subpopulations. The ART initiation proportion (52.8%) in the first month was higher than the reported proportion (23.4%) in the previous nationwide cohort study from 2011 to 2015 in China (Zhao et al., 2019). It can be explained that the national guideline had recommended newly diagnosed PLH to immediately

initiate ART regardless of CD4 cell count only since 2016 (National Health and Family Planning Commission, 2016). Emphasis on immediate ART initiation from the national guideline and expansion of the “one-stop” service promoted the rapid increase of ART initiation in the first month (Wu et al., 2015). However, after the first month, especially six months later, the increase in ART initiation was getting decreased over time. By the end of the study, the overall ART initiation was only 79.8%, which was still far from the target of 90%. Given that if the ART coverage continued to be lower, individuals without ART initiation contributed to the increase of HIV epidemics.

Consistent with previous findings (Marukutira et al., 2020), our study suggested that inter-provincial migrants had a larger gap in ART initiation compared to residents. Financial difficulty and lack of family support possibly explained the differences between inter-provincial migrants and residents. Most inter-provincial migrants did not have social medical insurance in host cities, which hindered them to pay outpatient fees by insurance. Moreover, inter-provincial migrants were not eligible for subsidies to ART care which were only available for residents. Without sufficient financial support, inter-provincial migrants were not able to afford the additional ART fees and refused to take ART in host cities. Inter-provincial migrants were migrating across provinces and far away from their hometown which resulted in the disrupted social network. The results of HIV verification cannot be accepted rapidly by themselves. Without timely support from families or close friends, inter-provincial migrants lacked the courage to face the sudden challenge. Then ART initiation was delayed or even unaccepted by inter-provincial migrants. Although intra-provincial migrants were facing the financial barrier as well, the disruption of the social network was worse among inter-provincial migrants. Intra-provincial migrants migrated

within Guangdong province, the distance to hometown was closer and the social culture in host cities was similar to that in their hometown. They can communicate with service providers in Cantonese, which can help them build a reliable relationship with service providers. On the contrary, inter-provincial migrants did not have such advantages as intra-provincial migrants. This finding called on that it was essential to provide specific financial support towards inter-provincial migrants to alleviate their economic burden. Besides, inviting the family members of inter-provincial migrants to participate in the ART initiation promotion program can be integrated into future interventions to help them improve family support.

We also found both migration patterns during the follow-up affected ART initiation among domestic migrants. Individuals staying in the current city without any migration were more likely to take ART compared to those migrating outside of the current cities. This finding accorded with previous studies in Spain that migration adversely affected HIV treatment (Reyesuruena et al., 2017). In China, the adverse effect of migration during follow-up was associated with the patients' management system. The management among PLH depended on patients' current residency. The migration would cause the handover of patients' management from one CDC in the former county to another institution in the current county. However, the transferring system was passive and low efficiency. Therefore, the migration would break the constructed provider-patient relationship and then reduce the probability to take ART. Moreover, compared to those migrating to other cities, individuals returned to their hometown were less likely to take ART. Most domestic migrants' hometowns were in the rural areas and their social network was wide in their hometown. It was easy to meet some acquaintances when they were visiting ART clinics to take drugs. Individuals returned to their hometown hesitated to take ART due to their fear of

HIV status disclosure and stigma from relatives and friends. The findings had an important implication that it was necessary to construct an efficient communication platform to transfer patients across counties, cities, and provinces. Regarding that most domestic migrants would finally return to their hometown, this finding added additional necessities that the stigma reduction intervention should be continuously strengthened towards the general population to improve domestic migrants to access ART care.

There were some limitations to this study. This data was collected originally for administrative purpose, so the data set did not contain some important variables which can reflect the characteristics of domestic migrants, such as family support and perceived stigma. Also, variables in the data set were all at the individual level. Lack of structural-level variables restricted the further analysis of factors from institutions and service providers. Furthermore, the electronic system was closed from 2016 to 2018 and the records were supplemented later, which caused many missing variables in physical examinations.

Despite the above limitations, this study demonstrated that inter-provincial migrants were less likely to initiate ART. Moreover, the findings added additional information that migration patterns during the follow-up affected the probability of ART initiation. Future interventions to promote ART initiation among domestic migrants should focus on inter-provincial migrants and stigma reduction intervention needed to be continuously strengthened to reduce barriers for domestic migrants taking ART in their hometown.

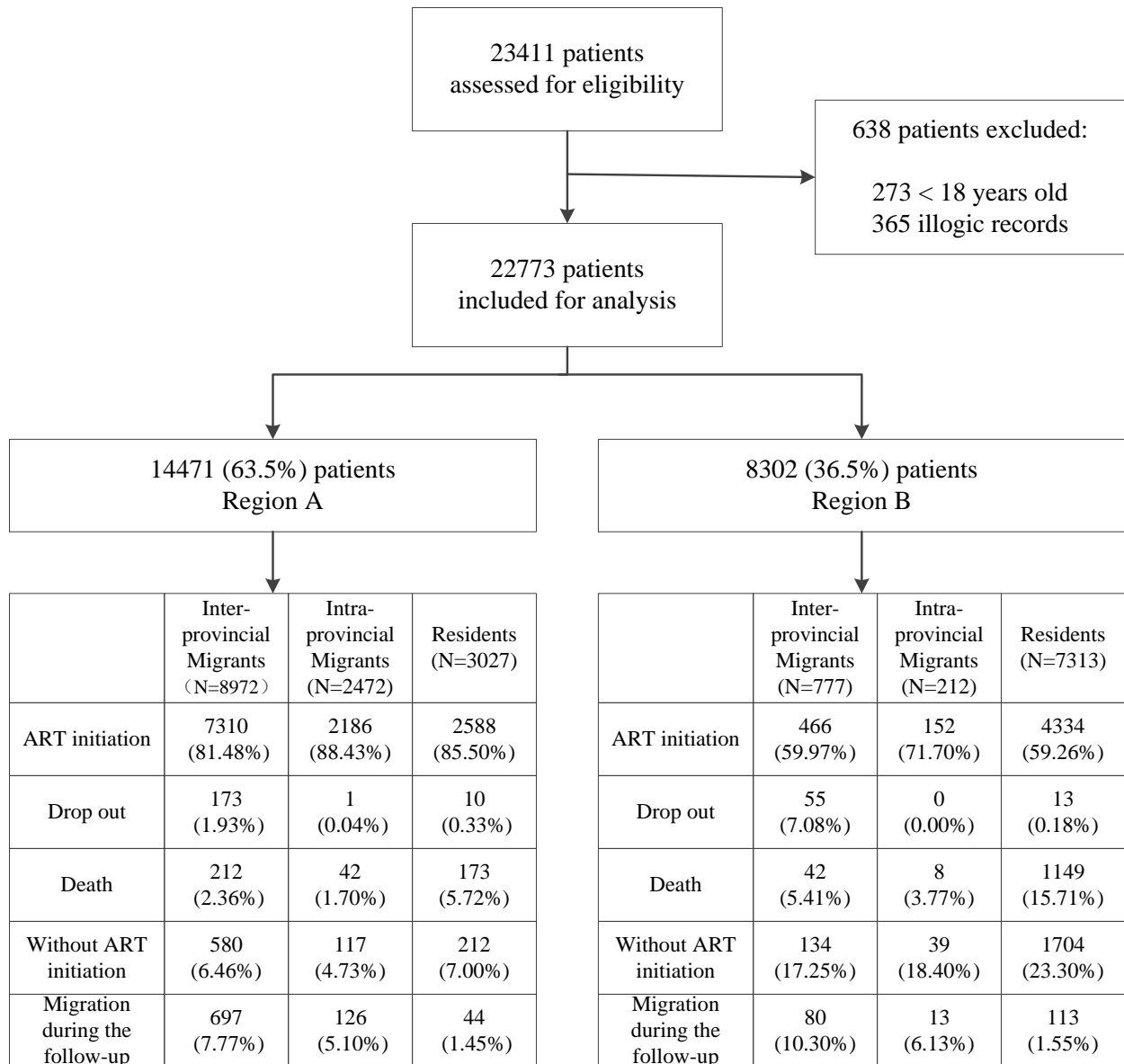


Figure 3.1 Flow chart for the cohort study development. All individuals were newly diagnosed HIV from July 1, 2016, to December 31, 2018, in Guangdong province. Region A included seven cities, Guangzhou, Foshan, Dongguan, Huizhou, Zhongshan, Zhuhai, and Shenzhen. The rest cities were categorized as Region B.

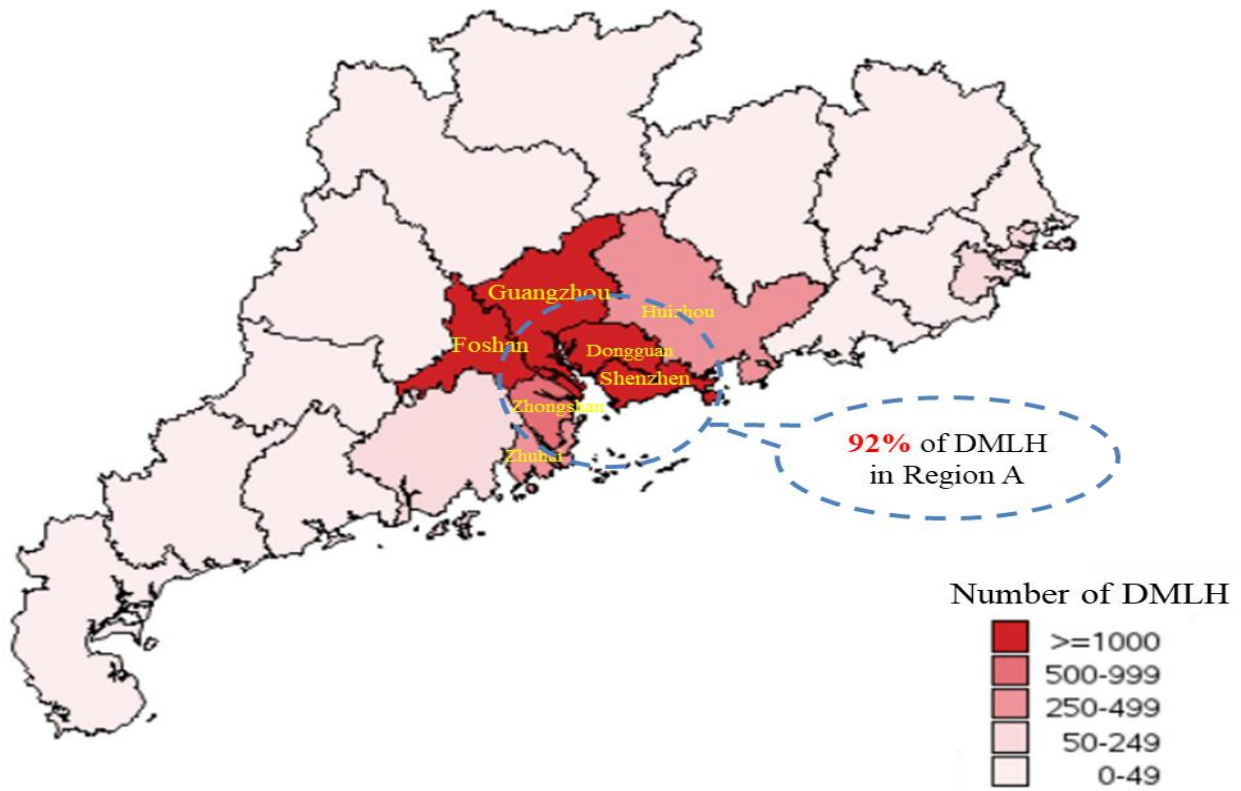


Figure 3.2 The distribution of domestic migrants living with HIV (DMLH) who were newly diagnosed with HIV from July 1, 2016, to December 31, 2018, in Guangdong province. 92% of these newly diagnosed individuals were living in the cities (Guangzhou, Foshan, Dongguan, Huizhou, Zhongshan, Zhuhai, Shenzhen) from Region A.

Table 3.1 Distribution of participants in this cohort study at the time of HIV diagnosis

Cities in Guangdong province	Total	Domestic migrants living with HIV N (%)	Residents living with HIV N (%)
Region A	14471	11444 (79.1)	3027 (20.9)
Guangzhou	4166	3043 (73.0)	1123 (27.0)
Shenzhen	4496	3735 (83.1)	761 (16.9)
Zhuhai	425	310 (72.9)	115 (27.1)
Foshan	1802	1376 (76.4)	426 (23.6)
Huizhou	644	396 (61.5)	248 (38.5)
Dongguan	2173	1954 (89.9)	219 (10.1)
Zhongshan	765	630 (82.4)	135 (17.6)
Region B	8302	989 (11.9)	7313 (88.1)
Jiangmen	637	204 (32.0)	433 (68.0)
Zhaoqing	507	76 (15.0)	431 (85.0)
Shaoguan	356	64 (18.0)	292 (82.0)
Shantou	679	178 (26.2)	501 (73.8)
Zhanjiang	1121	51 (4.5)	1070 (95.5)
Maoming	811	34 (4.2)	777 (95.8)
Meizhou	182	17 (9.3)	165 (90.7)
Shanwei	449	44 (9.8)	405 (90.2)
Heyuan	378	47 (12.4)	331 (87.6)
Yangjiang	637	47 (7.4)	590 (92.6)
Qingyuan	1040	81 (7.8)	959 (92.2)
Chaozhou	207	46 (22.2)	161 (77.8)
Jieyang	691	74 (10.7)	617 (89.3)
Yunfu	607	26 (4.3)	581 (95.7)

Table 3.2 Characteristics of participants in region A and region B

	Region A		Region B		<i>P</i> value
	(N=14471)	%	(N=8302)	%	
Gender					<0.001
Male	12798	88.4	6566	79.1	
Female	1673	11.6	1736	20.9	
Occupation					<0.001
Stable jobs	658	4.6	343	4.1	
Unstable jobs	7994	55.2	4866	58.6	
Other jobs	2202	15.2	1061	12.8	
Unemployed	3617	25.0	2032	24.5	
Age group (years)					<0.001
<30	5725	39.6	1562	18.8	
30-40	3775	26.1	1163	14.0	
40-50	2881	19.9	1529	18.4	
50-60	1255	8.7	1507	18.2	
>=60	835	5.8	2541	30.6	
Marriage					<0.001
Married	4903	33.9	4601	55.4	
Divorce/Widowhood	1757	12.1	1554	18.7	
Unmarried	7811	54.0	2147	25.9	
Ethnics					<0.001
Han	13423	92.8	8109	97.7	
Others	1048	7.2	193	2.3	
Education Level					<0.001
<= 9 years	7084	49.0	6528	78.6	
> 9 years	7387	51.0	1774	21.4	
Venue of diagnosis					<0.001
Diagnosis in supervision institutions	493	3.4	230	2.8	
Diagnosis in healthcare institutions	8531	59.0	6165	74.3	
Diagnosis in CDCs	5447	37.6	1907	23.0	
Transmission route					<0.001
Homosexual	6869	47.5	993	12.0	
Heterosexual	7191	49.7	6619	79.7	
Blood and others	411	2.8	690	8.3	
CD4 cell count (cells/ μ L)					<0.001
<200	3259	22.5	1958	23.6	
200~500	7850	54.3	2939	35.4	
>=500	2688	18.6	1157	13.9	
untested	674	4.7	2248	27.1	
Address of reporting institution					<0.001
Same with the current living county	9229	63.8	4403	53.1	
Different from the current living county	3376	23.3	2095	25.2	
Different from the current living city	771	5.3	1414	17.0	
Different from the current living province	1095	7.6	390	4.7	
Migration status at the baseline					<0.001
Inter-provincial migrants	8972	62.0	777	9.4	
Intra-provincial migrants	2472	17.1	212	2.6	
Residents	3027	20.9	7313	88.0	

Table 3.3 Characteristics of participants in this cohort study at the time of HIV diagnosis

	Total	Inter-provincial migrants		Intra-provincial migrants		Residents		P value
	(N=22273)	(N=9749)	%	(N=2684)	%	(N=10340)	%	
Gender								<0.001
Male	19364	8492	87.1	2385	88.9	8487	82.1	
Female	3409	1257	12.9	299	11.1	1853	17.9	
Occupation								<0.001
Stable jobs	1001	247	2.5	94	3.5	660	6.4	
Unstable jobs	12860	5671	58.2	1427	53.2	5762	55.7	
Other jobs	3263	1406	14.4	458	17.1	1399	13.5	
Unemployed	5649	2425	24.9	705	26.3	2519	24.4	
Age group (years)								<0.001
<30	7287	3615	37.1	1464	54.6	2208	21.4	
30-40	4938	2815	28.9	531	19.8	1592	15.4	
40-50	4410	2173	22.3	399	14.9	1838	17.8	
50-60	2762	806	8.3	157	5.9	1799	17.4	
>=60	3376	340	3.5	133	5.0	2903	28.1	
Marriage								<0.001
Married	9504	3444	35.3	745	27.8	5315	51.4	
Divorce/Widowhood	3311	1324	13.6	209	7.8	1778	17.2	
Unmarried	9958	4981	51.1	1730	64.5	3247	31.4	
Ethnics								<0.001
Han	21532	8648	88.7	2662	99.2	10222	98.9	
Others	1241	1101	11.3	22	0.8	118	1.1	
Education Level								<0.001
<= 9 years	13612	5537	56.8	1109	41.3	6966	67.4	
> 9 years	9161	4212	43.2	1575	58.7	3374	32.6	
Venue of diagnosis								<0.001
Diagnosis in supervision institutions	723	403	4.1	84	3.1	236	2.3	
Diagnosis in healthcare institutions	14696	5657	58.03	1473	54.88	7566	73.17	
Diagnosis in CDCs	7354	3689	37.84	1127	41.99	2538	24.55	
Transmission route								<0.001
Homosexual	7862	4403	45.2	1426	53.1	2033	19.7	
Heterosexual	13810	5026	51.6	1170	43.6	7614	73.6	
Blood and others	1101	320	3.3	88	3.3	693	6.7	
CD4 cell count (cells/ μ L)								<0.001
<200	5217	2099	21.5	533	19.9	2585	25.0	
200~500	10789	5319	54.6	1462	54.5	4008	38.8	
>=500	3845	1794	18.4	547	20.4	1504	14.6	
untested	2922	537	5.5	142	5.3	2243	21.7	
Address of reporting institution								<0.001
Same with the current living county	13632	6352	65.2	1546	57.6	5734	55.5	
Different with the current living county	5471	1824	18.7	786	29.3	2861	27.7	
Different with the current living city	2185	461	4.7	304	11.3	1420	13.7	
Different with the current living province	1485	1112	11.4	48	1.8	325	3.1	
City in regions								<0.001
Region A	14471	8972	92.0	2472	92.1	3027	29.3	
Region B	8302	777	8.0	212	7.9	7313	70.7	
Migration during the follow-up								<0.001
Yes	1186	878	9.0	147	5.5	161	1.6	
No	21587	8871	91.0	2537	94.5	10179	98.4	

Table 3.4 Cumulative probabilities of ART initiation at specific timepoints

	Total	Follow-up months Median (IQR)	Number of ART initiation	Cumulative probability of ART initiation			
				1st month	6th month	12th month	By the end of the study
Overall Analysis							
Total population	22773	21.3 (13.7, 31.6)	17036	52.8%	71.8%	75.0%	79.8%
Inter-provincial migrants	9749	24.2 (14.7, 33.3)	7776	54.8%	76.0%	79.2%	83.3%
Intra-provincial migrants	2684	25.7 (16.2, 33.5)	2338	61.8%	83.1%	86.4%	90.0%
Residents	10340	19.4 (12.5, 29.9)	6922	48.5%	64.5%	67.6%	73.5%
Stratification by regions							
In Region A							
Inter-provincial migrants	8972	24.5 (14.8, 33.5)	7310	56.1%	77.6%	80.8%	84.7%
Intra-provincial migrants	2472	25.1 (16.2, 33.2)	2186	62.7%	84.3%	87.6%	91.3%
Residents	3027	14.2 (12.8, 14.9)	2588	63.6%	83.4%	86.5%	90.7%
In Region B							
Inter-provincial migrants	777	21.9 (14.0, 32.6)	466	40.0%	56.6%	60.1%	65.7%
Intra-provincial migrants	212	26.8 (16.2, 35.7)	152	51.2%	69.0%	72.1%	75.6%
Residents	7313	19.1 (12.2, 29.6)	4334	42.1%	56.6%	59.6%	66.0%

Note: IQR: interquartile range; the reverse Kaplan-Meier method was used to calculate the median follow-up time; the product-limit method was applied to estimate ART initiation probability in this study.

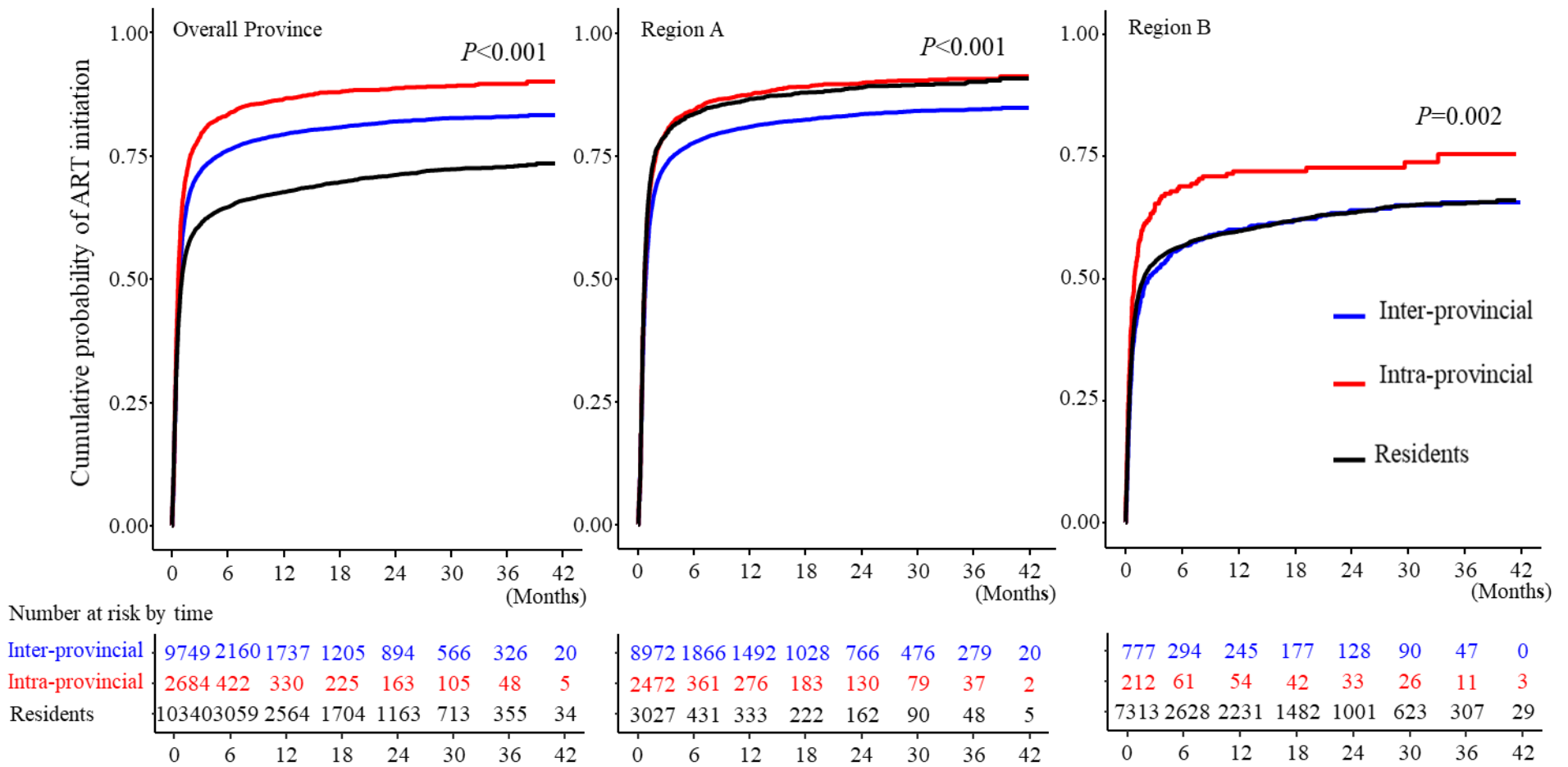


Figure 3.3 Plots of cumulative probability of ART initiation during the study period.

Table 3.5 Comparison of ART initiation between migration patterns at the baseline

	Total	ART initiation N (%)	HR (95%CI)
Overall analysis			
Cities in regions			
Region A	14471	12084 (83.5)	1.00
Region B	8302	4952 (59.6)	0.74 (0.62~0.88)
Migration status at the baseline			
Residents	10340	6922 (66.9)	1.00
Inter-provincial migrants	9749	7776 (78.8)	0.90 (0.86~0.94)
Intra-provincial migrants	2684	2338 (87.1)	1.01 (0.95~1.06)
Inter-provincial VS. Intra-provincial migrants	—	—	0.90 (0.86~0.94)
Stratification by regions			
In Region A			
Residents	3027	2588 (85.5)	1.00
Inter-provincial migrants	8972	7310 (81.5)	0.90 (0.86~0.94)
Intra-provincial migrants	2472	2186 (88.4)	0.99 (0.94~1.05)
Inter-provincial VS. Intra-provincial migrants	—	—	0.90 (0.86~0.95)
In Region B			
Residents	7313	4334 (59.3)	1.00
Inter-provincial migrants	777	466 (60.0)	0.88 (0.80~0.98)
Intra-provincial migrants	212	152 (71.7)	1.09 (0.92~1.28)
Inter-provincial VS. Intra-provincial migrants	—	—	0.81 (0.68~0.98)

Note: covariates were adjusted in the Frailty model, including age, gender, ethnicity, marital status, occupation, education, venue of diagnosis, transmission route, CD4 cell count, address of reporting institution.

Table 3.6 Characteristics of domestic migrants with different migrations during the follow-up

	Total	Migrating to other cities		Returning to hometown		No migration		P value
	(N=12433)	(N=171)	%	(N=854)	%	(N=11408)	%	
Gender								0.134
Male	10877	152	88.9	729	85.4	9996	87.6	
Female	1556	19	11.1	125	14.6	1412	12.4	
Occupation								0.016
Stable jobs	341	7	4.1	19	2.2	315	2.8	
Unstable jobs	7098	78	45.6	435	50.9	6585	57.7	
Other jobs	1864	40	23.4	144	16.9	1680	14.7	
Unemployed	3130	46	26.9	256	30.0	2828	24.8	
Age group (years)								<0.001
<30	5079	86	50.3	326	38.2	4667	40.9	
30-40	3346	43	25.2	207	24.2	3096	27.1	
40-50	2572	29	17.0	180	21.1	2363	20.7	
50-60	963	10	5.9	92	10.8	861	7.6	
>=60	473	3	1.8	49	5.7	421	3.7	
Marriage								0.022
Married	1533	22	12.9	121	14.2	1390	12.2	
Divorce/Widowhood	6711	108	63.2	438	51.3	6165	54.0	
Unmarried	4189	41	24.0	295	34.5	3853	33.8	
Ethnics								<0.001
Han	11310	153	89.5	741	86.8	10416	91.3	
Others	1123	18	10.5	113	13.2	992	8.7	
Education Level								<0.001
<= 9 years	6646	98	57.3	633	74.1	5915	51.9	
> 9 years	5787	73	42.7	221	25.9	5493	48.2	
Venue of diagnosis								<0.001
Diagnosis in supervision institutions	487	38	22.2	119	13.9	330	2.9	
Diagnosis in healthcare institutions	7130	75	43.9	521	61.0	6534	57.3	
Diagnosis in CDCs	4816	58	33.9	214	25.1	4544	39.8	
Transmission route								<0.001
Homosexual	5829	69	40.4	263	30.8	5497	48.2	
Heterosexual	6196	84	49.1	509	59.6	5603	49.1	
Blood and others	408	18	10.5	82	9.6	308	2.7	
CD4 count (cells/ μ L)								<0.001
<200	2632	18	10.5	164	19.2	2450	21.5	
200~500	6781	84	49.1	386	45.2	6311	55.3	
>=500	2341	33	19.3	138	16.2	2170	19.0	
untested	679	36	21.1	166	19.4	477	4.2	
Address of reporting institution								<0.001
Same with the current living county	7898	118	69.0	667	78.1	7113	62.4	
Different from the current living county	2610	29	17.0	133	15.6	2448	21.5	
Different from the current living city	765	18	10.5	53	6.2	694	6.1	
Different from the current living province	1160	6	3.5	1	0.1	1153	10.1	
City in regions								0.015
Region A	11444	149	87.1	774	90.6	10521	92.2	
Region B	989	22	12.9	80	9.4	887	7.8	
Migration status at baseline								<0.001
Inter-provincial migrants	9749	151	88.3	727	85.1	8871	77.8	
Intra-provincial migrants	2684	20	11.7	127	14.9	2537	22.2	

Table 3.7 Comparison of ART initiation between migration patterns during the follow-up

Migration pattern during the follow-up	Total	ART initiation N (%)	HR (95%CI)
No migration	11408	10114 (88.7)	1.00
Returning to the hometown	854	105 (12.3)	0.06 (0.05~0.07)
Migrating to other cities	171	65 (38.0)	0.22 (0.17~0.27)
Returning to the hometown VS. Migrating to other cities	—	—	0.30 (0.22~0.40)

Note: covariates were adjusted in the Frailty model, including age, gender, ethnicity, marital status, occupation, education, venue of diagnosis, transmission route, address of reporting institution, CD4 cell count, city category, and the baseline migration status.

Appendix 3.1

Simplified questionnaire for people newly diagnosed with HIV

1. Patients' name _____
2. ID for patient _____
3. Gender: Male Female
4. Date of birth _____
5. Ethnicity _____
6. Education:
illiteracy/primary school/junior school/ senior school/associate degree/college and above
7. Occupation:
teacher/healthcare workers/retired personnel/civil servant/child-care workers/peasant/fisherman/factory worker/rural migrant workers/drivers/commercial service providers/ catering attendant/ unemployed
8. Administrative code of Current residence__
9. Administrative code of Registered residence__
10. Marital status:
Unmarried Married/living with partner Divorced/Separation/ Widowed Unknown
11. Partner's HIV status: Positive Negative Unknown
12. Transmission source:
Blood transfusion Plasma collection Injecting drug use Homosexual
 Heterosexual Sex + Drug Mother-to-child Uncertain Others
13. Date of HIV diagnosis_____
14. CD4 Testing Yes (___count/uL) No
15. ART: Yes (Date ___Year ___Month ___Day) No
16. Sample source:
Women's reeducation center/ Drug rehabilitation center/ Detainees' testing/ Premarital examination/ outpatient testing/ blood product testing/ preoperative examination/ physical testing/ outpatient of sexual disease clinics/ pregnancy testing/ VCT/ testing for spouse and children of HIV positive case/ testing for entertainment staff/ occupational exposure
17. Current symptoms:
Fever Cough Dyspnea Chest pain Diarrhea
Headache Decrease vision Nausea Lymphadenopathy
18. Reporting Institution_____
19. Administrative code of reporting address_____
20. Reporting Date ___Year ___Month ___Day

Appendix 3.2

Simplified questionnaire for people living with HIV during follow-up

1. Patients' name _____ 2. Patients' ID number _____
3. Administrative code of current residence _____
4. Number of visits _____
5. Status:
 - Die Date _____ Reason _____
 - Loss-to-follow-up
 - Retain in follow-up
6. Clinical symptoms since last visit:
 - Yes (example symptoms as follows: Thrush Oral hairy leukoplakia TB)
 - No
7. ART:
 - Yes (Date ___ Year ___ Month ___ Day) No
8. Methadone Maintenance Treatment:
 - Yes (Date ___ Year ___ Month ___ Day) No
9. CD4 _____ Date _____
10. Follow-up institution _____
11. Date of follow-up _____

Appendix 3.3

Table S3 Categorization and rationale of variables for ART initiation analysis

Variables	Categorization of variables for analysis	Rationales for variable recategorization
Age	1="<30"; 2="30-40"; 3="40-50"; 4="50-60"; 5=" >=60"	According to published studies.
Gender	1=" female"; 2="male"	There were only two options in the questionnaire.
Ethnicity	1="Han ethnicity"; 2="other ethnicities"	Most domestic migrants were of Han ethnicity.
Marriage	1="unmarried"; 2="married"; 3="divorced/widowhood"	The "unknown category" in the original dataset was verified and was recategorized into the three groups.
Education	1="<=9 years" (illiteracy/primary school/junior school) 2=">9 years" (senior school/associate degree/college and above)	In China, nine-years education was compulsory.
Occupation	1="stable jobs" (teacher/healthcare workers/retired personnel/civil 2="unstable jobs" (child-care workers/peasant/fisherman/factory worker/rural migrant workers/drivers/commercial service providers/ catering attendant) 4="others" (unknown/others)	People with stable jobs have social health insurance, but people with unstable jobs do not have social health insurance. Social health insurance was paid by employment institutions.
Transmission route	1="heterosexual"; 2="homosexual"; 3="blood and others"	Heterosexual and homosexual transmission contributed to most of the new infections.
HIV testing source	1="Diagnosis in supervision institution" (Women's reeducation center/ Drug rehabilitation center/ Detainees' testing) 2="Diagnosis in healthcare institution" (Premarital examination/ outpatient testing/ blood product testing/ preoperative examination/ physical testing/ outpatient of sexual disease clinics/ pregnancy testing) 3="Diagnosis in CDC" (VCT/ testing for spouse and children of HIV positive case/ testing for entertainment staff/ occupational exposure/)	Most testing in supervision and healthcare institutions was passive, but most testing in the CDC was active.
CD4 cell count at diagnosis	1="<200"; 2="200-500"; 3=">=500"; 4="untested"	According to the definitions of late diagnosis from the published studies.
Reporting address	1=Same with the current living county 2=Different from the current living county	If the address of reporting institution was the same with the current living county, it means that the communication between CHC/CDC and reporting institution is easier than across counties or cities.
City in the region	3=Different from the current living city 4=Different from the current living province 1="Region A"; 2="Region B"	Economic development, healthcare resources and the size of domestic migrants living with HIV were different between these two regions.
Migration during the follow-up	1="Yes"; 2="No"	Patients have two statuses.
Die	1="Yes"; 2="No"	There were only two options in the questionnaire.
Loss-to-follow-up	1="Yes"; 2="No"	There were only two options in the questionnaire.

Reference

- Census office of the state council, Population and employment statistics division of the national bureau of statistics (2010, December 31). National census of China in 2010. Retrieved from <http://www.stats.gov.cn/tjsj/pcsj/rkpc/6rp/indexch.htm>.
- Davis, A., Terlikbayeva, A., Terloyeva, D., Primbetova, S., & Elbassel, N. (2017). What Prevents Central Asian Migrant Workers from Accessing HIV Testing? Implications for Increasing HIV Testing Uptake in Kazakhstan. *AIDS and Behavior*, 21(8), 2372-2380.
- Dovel, K., Phiri, K., Mphande, M., Mindry, D., Sanudi, E., Bellos, M., & Hoffman, R. M. (2020). Optimizing Test and Treat in Malawi: health care worker perspectives on barriers and facilitators to ART initiation among HIV-infected clients who feel healthy. *Global Health Action*, 13(1).
- Emery, S., Sharma, S., Fatkenheuer, G., Llibre, J. M., Moli, J., Munderi, P., Wood, R., Klingman, K. L., Collins, S., & Lane, H. C. (2015). Initiation of Antiretroviral Therapy in Early Asymptomatic HIV Infection. *The New England Journal of Medicine*, 373(9), 795-807.
- European center for disease prevention and control. (2017, April 1). Monitoring implementation of the dublin declaration on partnership to fight HIV/AIDS in Europe and Central Asia: 2017 progress report. <https://www.ecdc.europa.eu/sites/portal/files/documents/HIV%20and%20migrants.pdf>.
- Feng, X., & Yue, W. (2018, December 1). Sexual transmission is the major mode among 9011 newly reported HIV cases in Guangdong. Retrieved from http://news.ycwb.com/2018-12/01/content_30143486.htm.

- Fox, M. P., Mazimba, A., Seidenberg, P., Crooks, D., Sikateyo, B., & Rosen, S. (2010). Barriers to initiation of antiretroviral treatment in rural and urban areas of Zambia: a cross-sectional study of cost, stigma, and perceptions about ART. *Journal of the International AIDS Society*, 13(1), 8-8.
- Hodgson, I., Plummer, M. L., Konopka, S. N., Colvin, C. J., Jonas, E., Albertini, J., Amzel, A., & Fogg, K. P. (2014). A Systematic Review of Individual and Contextual Factors Affecting ART Initiation, Adherence, and Retention for HIV-Infected Pregnant and Postpartum Women. *PloS one*, 9(11).
- Kebaabetswe, P., Manyake, K., Kadima, E., Aulettayoung, C., Chakalisa, U., Sekoto, T., Dintwa, O. M., Mmalane, M., Makhema, J., & Lebelonyane, R. (2019). Barriers and facilitators to linkage to care and ART initiation in the setting of high ART coverage in Botswana. *Aids Care-psychological and Socio-medical Aspects of Aids\hiv*, 1-7.
- Levison, J. H., Bogart, L. M., Khan, I. F., Mejia, D., Amaro, H., Alegria, M., & Safren, S. A. (2017). “Where It Falls Apart”: Barriers to Retention in HIV Care in Latino Immigrants and Migrants. *AIDS patient care and STDs*, 31(9), 394-405.
- Li, P., Wang, L., Guo, W., Qin, Q., & Cui, Y. (2014). [Mobility of HIV/AIDS and affecting factors analysis in 2013, China]. *Zhonghua Yu Fang Yi Xue Za Zhi Chinese Journal of Preventive Medicine*, 48(11), 934-937.
- Li, Y., Lin, P., Wang, Y., Fu, X.-b., Ye, R., Li, J.-r., Feng, M.-y., Yu, G.-l., Yang, F., Yan, J., Long, Q.-s., & Deng, h.-h. (2015). HIV/AIDS surveillance in Guangdong Province, 2000-2013. *South China J Prev Med*, 41(2), 101-106.

- Liang, H. (2013). Characteristics and Changes of Floating Population in Guangdong Province. *Population & Development*.
- Lima, V. D., Fernandes, K. A., Rachlis, B., Druyts, E., Montaner, J. S. G., & Hogg, R. S. (2009). Migration adversely affects antiretroviral adherence in a population-based cohort of HIV/AIDS patients. *Social science & medicine*, 68(6), 1044-1049.
- Ma, S. (2008). The study on a part of rural residents from a underdeveloped place in Guangdong province about AIDS knowledge, attitude, behavior and effective factors. [Master's thesis, Sun Yat-sen University]. Chinese Wanfang Data.
- Marukutira, T., Gray, R., Douglass, C., Elhayek, C., Moreira, C., Asselin, J., Donovan, B., Vickers, T., Spelman, T., & Crowe, S. M. (2020). Gaps in the HIV diagnosis and care cascade for migrants in Australia, 2013-2017: A cross-sectional study. *PLOS Medicine*, 17(3).
- National Health and Family Planning Commission. (2016, June 15) . Notice on adjusting the standard of free antiretroviral treatment for AIDS from the General Office of National Health and Family Planning Commission. http://www.gov.cn/xinwen/2016-06/15/content_5082505.htm##3.
- Paul D. Allison. (2010). *Survival Analysis Using SAS: A Practical Guide, Second Edition*. SAS Publishing.
- Reyesuruena, J., Campbell, C. N. J., Hernando, C., Vives, N., Folch, C., Ferrer, L., Fernandezlopez, L., Esteve, A., & Casabona, J. (2017). Differences between migrants and Spanish-born population through the HIV care cascade, Catalonia: an analysis using multiple data sources. *Epidemiology and Infection*, 145(08), 1670-1681.

UNAIDS. (n.d.). 90-90-90 An ambitious treatment target to help end the AIDS epidemic.

Retrieved 2020, August 25 from https://new.pancap.org/pc/pcc/media/pancap_document/90-90-90_Targets.pdf.

UNAIDS. (2019, July 16). UNAIDS DATA 2019. [http://rstesa.unaids.org/publications/global-publications/2019/item/208-unaids-data-](http://rstesa.unaids.org/publications/global-publications/2019/item/208-unaids-data-2019#:~:text=This%20edition%20of%20UNAIDS%20data%20shows%20the%20results,analyzed%20and%20refined%20by%20UNAIDS%20over%20the%20years.)

[2019#:~:text=This%20edition%20of%20UNAIDS%20data%20shows%20the%20results,analyzed%20and%20refined%20by%20UNAIDS%20over%20the%20years.](http://rstesa.unaids.org/publications/global-publications/2019/item/208-unaids-data-2019#:~:text=This%20edition%20of%20UNAIDS%20data%20shows%20the%20results,analyzed%20and%20refined%20by%20UNAIDS%20over%20the%20years.)

UNAIDS (2018, July 18). Global AIDS Update: MILES TO GO: Closing gaps, breaking barriers, righting injustices. https://www.unaids.org/sites/default/files/media_asset/miles-to-go_en.pdf.

World Health Organization (WHO). (2019, November 15). HIV/AIDS Key facts. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/hiv-aids>.

Wu, Z., Zhao, Y., Ge, X., Mao, Y., Tang, Z., Shi, C. X., Chen, C., Li, Y., Qiu, X., & Nong, G. (2015). Simplified HIV Testing and Treatment in China: Analysis of Mortality Rates Before and After a Structural Intervention. *PLOS Medicine*, 12(9).

Zhang, K., Fu, X., Liu, J., Lin, Q., Xu, Y., & Li, Y. (2018). Spatiotemporal characteristics of HIV/AIDS in Guangdong province, 2007-2017. *Chinese Journal of Disease Control & Prevention*.

Zhao, L., Liu, S., & Zhang, W. (2018). New Trends in Internal Migration in China: Profiles of the New-generation Migrants. *China & World Economy*, 26(1), 18-41.

Chapter IV

Antiretroviral Therapy Attrition among Domestic Migrants Living with HIV in Guangdong, China: A Retrospective Cohort Study

Abstract

Background Sustained ART is vital to the success of the HIV care cascade. Migrants are facing barriers to retain in ART due to their high mobility. This study investigated ART attrition among DMLH.

Methods The data were extracted from the subsystem of ART for adults in Guangdong province. All participants with confirmed HIV diagnosis and initiating ART from July 1, 2016, to December 31, 2018, were extracted from the baseline data set and were followed until December 31, 2019. Migration status at the time of ART initiation was documented as the exposure of interest, and ART attrition was measured as the outcome of interest. Cumulative probabilities of attrition were calculated by the product-limit method. The frailty model considering the clustering effect from cities and adjusting covariates was performed in the analysis to assess the impact of migration status on ART attrition.

Results Among the total of 15, 297 participants, over 60% of these patients were domestic migrants, 7,167 (46.9%) for inter-provincial migrants and 2,209 (14.4%) for intra-provincial migrants, and the rest were residents. Nearly 94% of DMLH clustered in Region A and the rest were in Region B. At the end of this study, the cumulative probability of attrition was 38.27% among residents, which was almost two times higher than that among inter-provincial migrants (18.09%) and intra-provincial migrants (16.50%). There was heterogeneity of ART attrition between Region A and Region B. In Region A, the probability of attrition among inter-provincial

migrants (HR=1.20,95%CI: 1.00~1.43) and intra-provincial migrants (HR=1.15, 95%CI: 1.00~1.33) tended to be higher than that among residents. In Region B, the probability of ART attrition among inter-provincial migrants (HR=0.88, 95%CI: 0.74~1.05) and intra-provincial migrants (HR=0.79, 95%CI: 0.57~1.09) tended to be lower than that among residents.

Conclusion In conclusion, it is necessary to reduce ART attrition among domestic migrants and residents in the setting of universal treatment. Future policies and interventions should properly take domestic migrants' vulnerability and regional disparity into consideration to improve ART retention.

Key words: Antiretroviral therapy, attrition, domestic migrants, China

Introduction

Sustained ART is vital to the success of the HIV care cascade. Previous research has shown that PLH who had maintained regular ART care had lower viral loads and longer survival than those with even one visit missing (UNAIDS, 2014). Regular and ongoing ART care can also benefit PLH with slower progression to AIDS-related events, decreased rates of hospitalization, and lower transmission risk to others. Given the importance and benefits of sustained ART to PLH, extensive effective interventions have been implemented to reduce ART attrition among PLH (Shaw et al., 2018; Tripathi et al., 2011). However, regarding the multifaceted characteristics of populations, there are several challenges for regular, ongoing ART among some vulnerable populations including migrants.

Migrants even contributed to over half of new HIV cases in some European countries (Hernando et al., 2015). Migrants were more likely associated with poor ART retention compared to residents (Ross et al., 2018). The attrition rate of ART among migrants was nearly three times higher than that among residents, and the risk of experiencing viral failure was also worse (Reyesruena et al., 2017; Sheehan et al., 2017). It was thought that migrants were being 'left behind' when we were working toward the goal of ending the AIDS epidemic (UNAIDS, 2018).

An accumulating body of studies have reported that migrants were more likely to experience loss-to-follow-up in ART care, due to their high mobility, unfamiliarity with the host city, disrupted social network, and inequality in their health care (Camlin & Charlebois, 2019; Tanser et al., 2015)). Given the differences in social culture and health system, it was important to understand the variation of subpopulations among migrants across countries and cultures. Medical insurance restriction was the major barrier for migrants to retain in the ART program

(Marukutira et al., 2020). In western European countries, shortage of knowledge restricted migrants to access HIV service (European CDC, 2017). In Kazakhstan, undocumented migrant workers were not eligible to receive HIV related service in host sites (Davis et al., 2017). There were limited studies to comprehensively investigate ART attrition among migrants in China. However, regarding the heterogeneity of culture and management systems between China and other countries, the conclusions from other countries or settings are not appropriately generalized to China directly.

As the economy developed very fast in China, the size of domestic migrants increased from 30 million in the late 1980s to almost 250 million in 2017 (Zhao et al., 2018). In the sixth national census of 2010, Guangdong province ranked top in China with nearly one-third of inter-provincial immigrants (Census Office of the State Council [COSC], 2010). The distribution of domestic migrants was unbalanced in Guangdong province,. Most domestic migrants clustered in the cities around the Pearl River Delta where there were many factories (COSC, 2010). There was a huge heterogeneity in the distribution of health resources across the cities because of the unbalanced economic development (COSC, 2010). Domestic migrants accounted for nearly 40% of PLH in Guangdong. Inter-provincial migrants living with HIV in Guangdong accounted for 20% of inter-provincial migrants living with HIV across China (Li et al., 2014; Li et al., 2015). Although the epidemic of HIV among domestic migrants was heavy in Guangdong province, there were limited studies that reported ART attrition among domestic migrants. Regarding the huge size of domestic migrants and the heavy epidemic of HIV, Guangdong was an ideal site to understand ART attrition among domestic migrants in the setting of universal treatment in China.

Our study investigated the ART attrition among domestic migrants in Guangdong, China. We hypothesized that inter-provincial and intra-provincial migrants were more likely to drop out of ART than residents.

Methods

Data source

China constructed a comprehensive, national, web-based HIV/AIDS information system that contained eight subsystems since 2008(Mao et al., 2010). In this study, data were extracted from the *ART for Adults System* in Guangdong province. The subsystem of ART for adults included two data sets, the baseline and the follow-up datasets. The baseline information was collected at the time of ART initiation. After ART initiation, every patient was followed up at 2nd week, 1st month, 2nd month, 3rd month, and every three months thereafter. Each patient had one record in the baseline data set, and many records in the follow-up data set. The baseline and follow-up data sets of ART for adults can be linked by the unique code in the data sets.

Appendix 4.1 (*Simplified questionnaire for adults at the time of ART initiation*) presented the information in the baseline dataset 1) residence: the administrative code of registered residence, the administrative code of current residence, and the administrative code of ART clinics; 2) demographics: age, gender, education, occupation, and marital status; 3) ART care information: transmission route, date of ART initiation, time gap from HIV diagnosis to ART initiation; 5) physical examinations: CD4 cell count, viral load (at least once a year), AIDS-related symptoms, and AIDS stages. Appendix 4.2 (*Simplified questionnaire for adults retaining in ART during the follow-up*) showed the collected information at each visit: demographics, CD4 cell count, AIDS-related symptoms, AIDS stages, transferring ART to other clinics, ART attrition, and death-related information.

Inclusion criteria for participants

The study period was from July 1, 2016, to December 31, 2019. All participants with HIV diagnosis and ART initiation from July 1, 2016, to December 31, 2018, were extracted from the data set. Each participant was followed until December 31, 2019, to ensure alive patients were observed for at least one year. The inclusion criteria for participants were: 1) aged 18 or above; 2) addresses of ART clinics were in Guangdong at the time of ART initiation; 3) HIV diagnosis and ART initiation were between July 1, 2016, and December 31, 2018.

The selection process for participants was presented in Figure 4.1. The baseline and follow-up data sets in the *ART for Adults System* were merged by a unique code. Everyone was assessed according to the inclusion criteria. Observations with logic errors were deleted in the analyses. The complete data set included the information at the time of ART initiation and the potential results by the end of the study.

Measurements

The main exposure of interest was residence status at baseline. The definition of residence was 1) for inter-provincial migrants, the administrative codes of current residence for ART initiation were in Guangdong province, but the administrative codes of registered residence were in other provinces; 2) for intra-provincial migrants, the administrative code of current residence for ART initiation and the registered residence were both in Guangdong, but in different cities; 3) for residents, the administrative codes of current residence and the registered residence were both in Guangdong, and the same cities.

ART attrition was the outcome of interest for this cohort study. Patients with confirmed ART drop-out or stop information in the data sets were categorized as individuals with ART

attrition. ART attrition was automatically generated by the electronic system when patients missed two consecutive regular visits or documented by doctors by hand. Other endpoints of this study may include death, transferring to other ART clinics, and retaining in ART until the end of the study. The person-time was the difference between the date of ART initiation to the date of endpoints, including the date of ART attrition, the date of death, transferring to other ART clinics, or the end of the study, whichever came first.

21 cities were categorized into Region A and Region B regarding the economic development level, location, and proportion of DMLH accounting for PLH. Seven cities with highly developed economy, around the Pearl River Delta, and a larger proportion of DMLH were categorized into Region A including Guangzhou, Foshan, Dongguan, Shenzhen, Zhuhai, Zhongshan, and Huizhou. The rest of the 14 cities were categorized into Region B.

Covariates of interest were also recategorized and presented in this study, including age, gender, ethnicity, marriage, occupation, education, venue of diagnosis, transmission route, CD4 cell count, and the gap between diagnosis and ART initiation. The categorization and rationale for each variable were presented in Appendix 4.3 (*Table S4*).

Statistical analysis

The frequency of patients' characteristics was presented and compared between different residence status. The product-limit method was applied to estimate the probability of ART attrition at some specific time points and the log-rank test was applied to compare the probabilities of ART attrition between three subpopulations. Reverse Kaplan-Meier method was used to calculate the median follow-up months. The Frailty model was performed in the analysis to adjust the clustering effect from cities. There were two levels, one for cities and the other for

individuals. Since the management system for ART care was similar in the same city, the clustering effect from cities was treated as random effects in the model. Death, transferring to other ART clinics, and retaining in ART until the end of the study period were treated as censored. Covariates previously identified as confounders for the relationship between residence status and ART attrition either in China or other countries were included to adjust in this study. An interaction term between residence status and city category was added in the Frailty model to assess the heterogeneity of the impact of residence on ART attrition between different city categories in Guangdong province.

SAS software windows version 9.4 (SAS Institute, Cary, NC, USA) and R software windows version 3.5.1 (R Core Team, 2019) were applied in the whole analysis process.

Ethics

The study protocol was reviewed and approved by the IRB of UCLA and NCAIDS, China Center for Disease Control and Prevention.

Results

Characteristics of participants

22,773 patients were assessed for their eligibility for this study and finally, 15,297 patients were included in analysis. All participants in this study were newly diagnosed with HIV and enrolled in ART from July 1, 2016, to December 31, 2018, and were followed up until December 31, 2019. Nearly 70% of participants were from Region A. Figure 4.2 and Table 4.1 presented the distribution of DMLH at the time of ART initiation in Guangdong province. Among DMLH, 7,167 (46.9%) for inter-provincial migrants and 2,209 (14.4%) for intra-provincial migrants. Nearly 94% of DMLH clustered in Region A. The remaining 6% of DMLH spread in Region B.

There were 23 ART clinics allocated to a total of 35 counties or districts in Region A. Among these ART clinics, nearly 90% implemented the policy of one-stop service. However, only 46 ART clinics were distributed to a total of 106 counties or districts in Region B. And only 63% of these ART clinics implemented the policy of one-stop service. Five cities with subways were also in Region A. Table 4.2 indicated that compared to participants in Region A, higher proportion of participants in Region B were female, older than 60 years old, married, lower education level, heterosexual transmission, inter-provincial, and intra-provincial migrants.

Table 4.3 presented the distribution of characteristics among all participants. Most participants were infected with HIV through sexual transmission route including homosexual and heterosexual transmission, Han ethnicity, and initiated ART within one month after HIV diagnosis. Most domestic migrants were younger than 60 years old and only about one-third were married. Among residents, about 20% of residents were older than 60 and over half were married.

ART attrition among domestic migrants and residents

Table 4.4 and Figure 4.3 presented the cumulative probabilities of ART attrition at some specific time points during the study period. The median of follow-up months in this cohort study was 25.5 (IQR: 17.9, 32.8). In the overall analysis, by the end of sixth months, nearly 5.00% inter-provincial migrants and 5.12% intra-provincial migrants dropped out, but about 15.68% of residents dropped out of ART program at the same timepoint. At the end of this study, the cumulative probability of ART attrition was 38.27% among residents, which was almost two times higher than that among inter-provincial migrants (18.09%) and intra-provincial migrants (16.50%). After stratification, in Region A, ART attrition probabilities were similar between

inter-provincial migrants (16.20%) and residents (16.72%). In Region B, ART attrition probabilities among three subpopulations were higher than those in Region A.

Table 4.5 showed the comparison of ART attrition among residents, intra-provincial migrants, and inter-provincial migrants with adjusting potential confounders. In the overall analysis, PLH in Region B were more likely to drop out of the ART program than those in Region A (HR=2.60, 95%CI: 1.18~5.77). There were no significant differences in the ART attrition among residents, intra-provincial migrants, and inter-provincial migrants. However, after stratification by regions, in Region A, the probability of ART attrition among inter-provincial migrants (HR=1.15, 95%CI: 1.00~1.33) and intra-provincial migrants (HR=1.20, 95%CI: 1.00~1.43) tended to be higher than that among residents. In Region B, the probability of ART attrition among inter-provincial migrants (HR=0.88, 95%CI: 0.74~1.05) and intra-provincial migrants (HR=0.79, 95%CI: 0.57~1.09) tended to be lower than that among residents. There were no significant differences between inter-provincial migrants and intra-provincial migrants in ART attrition within each stratum.

Discussion

This retrospective cohort study was based on a province-wide PLH in Guangdong, China. This is one of the earliest studies to comprehensively investigate ART attrition among domestic migrants in China. The attrition rate in this cohort study during the first twelve months was higher than a former nationwide cohort study from 2011 to 2015 in China (Zhao et al., 2018). The attrition rate increased very fast in the first six months and later increased steadily. This finding was consistent with the studies in Kenya (Hassan et al., 2015). Given that side effects were very strong in the early phase, there were intensive follow-ups during the first six months. The follow-ups were performed at the 2nd week, 1st month, 2nd month, 3rd month, and 6th

month. However, some participants had barriers to finishing the intensive visits probably because of long transportation, inconvenience to take leave, and side effects. The finding added evidence to reinforce the intervention at the early phase. Moreover, the warning was given in this study that the attrition rate continued to increase over time. The finding collectively suggested that ART attrition remained a challenge for the ART program in the setting of universal treatment in Guangdong, China.

The finding suggested that PLH was more likely to drop out of the ART program in Region B than that in Region A. It can be explained by the unbalanced healthcare resources in the ART program across regions. In Region A, there were more ART clinics in each county or district. The service quality of the ART program was also higher in Region A. Most ART clinics implemented the policy of one-stop service in Region A, which had been proven effective in improving ART performance among patients. There were two largest hospitals for infectious diseases located in Region A. One was in Guangzhou and the other was in Shenzhen. Patients cannot only take ART care but also receive other medical treatment in these two hospitals. Besides, patients in Region A received higher education and were much younger than that in Region B. It was easier for them to accept new knowledge and communicate with doctors. All of these factors worked together to contribute to improving patients' ART adherence in Region A. More ART clinics should be approved and one-stop service policy should be promoted in Region B to decrease patients' attrition in the ART program.

This study also showed that the comparison of ART attrition between domestic migrants and residents varied across regions. Compared to residents in Region A, inter-provincial and intra-provincial migrants were more likely to drop out of the ART program. However, in Region B, inter-provincial and intra-provincial migrants were less likely to drop out of ART care than

residents. The heterogeneity may be attributed to the differences in transportation, ART service, and culture between two regions. Among seven cities from Region A, five of them had subways within the city. Among two cities without subways, Zhongshan city was small and convenient to travel across the city, and each county or district in Huizhou had one ART clinic. The transportation to ART clinics and the distribution of ART clinics in these seven cities were convenient and balanced. The number of ART clinics in these seven cities from Region A was nearly 2 times higher than that in Region B. Domestic migrants in Region B lived in the urban areas, but residents in these cities lived dispersedly. Due to the unbalanced distribution of ART clinics in Region B, transportation was a challenge for residents to retain in the ART program. Besides, the culture was less inclusive in Region B. Residents living with HIV from Region B were facing stigma from families, relatives, and friends (Ma, 2008). They worried about the disclosure of their HIV status when they went to ART clinics and hesitated to retain in ART program. The inconvenient transportation, the unbalanced distribution of ART clinics, and the culture contributed to challenges for residents to remain in the ART program in Region B. This finding reminded us that there was heterogeneity of ART attrition between Region A and Region B in Guangdong province. Regarding that most DMLH clustering in Region A, more emphasis should be paid on DMLH in this Region. Policymakers should integrate the healthcare resources and local culture into future interventions to provide precise intervention towards domestic migrants and residents living with HIV.

Several limitations should be added to this study. Because of the data originally for administrative purpose, this study did not include some important variables which were potential confounders in this analysis. Moreover, there were no structural-level variables to account for the barriers from ART clinics and service providers. Furthermore, the electronic system was shut

down nationwide from 2016 to 2018 and the records were supplemented later, which caused many missing variables in physical examinations. Lastly, due to the management system, no records were showing the status of ART care when patients were transferred outside of Guangdong province. This restricted the analysis of the impact of transferring on the ART program among domestic migrants.

In conclusion, it is necessary to reduce ART attrition among domestic migrants and residents in the setting of universal treatment. Future policies and interventions should properly take domestic migrants' vulnerability and regional disparity into consideration to improve ART retention.

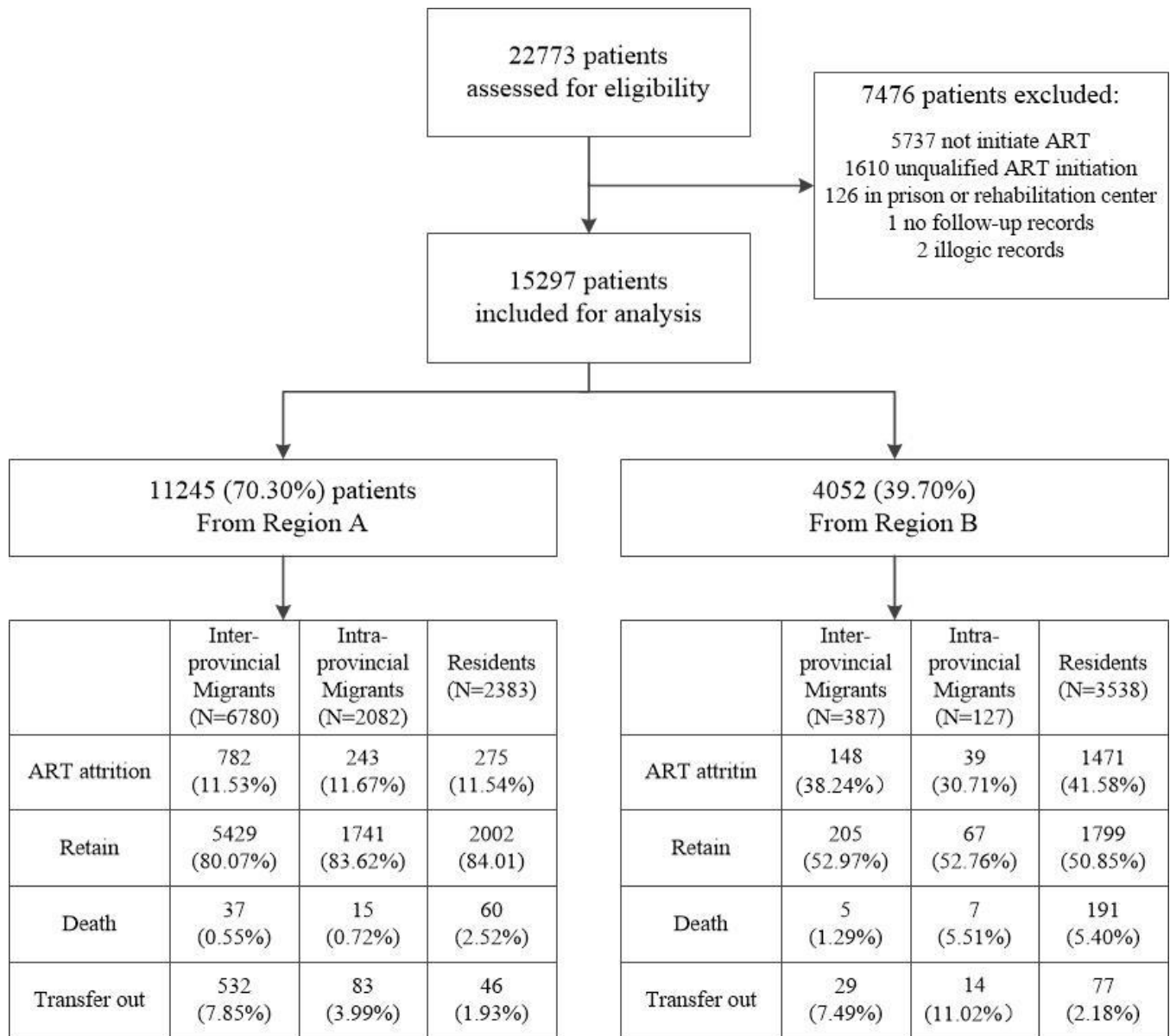


Figure 4.1 Flow chart for the cohort study development. All individuals were newly diagnosed and enrolled in ART from July 1, 2016, to December 31, 2018, in Guangdong province.

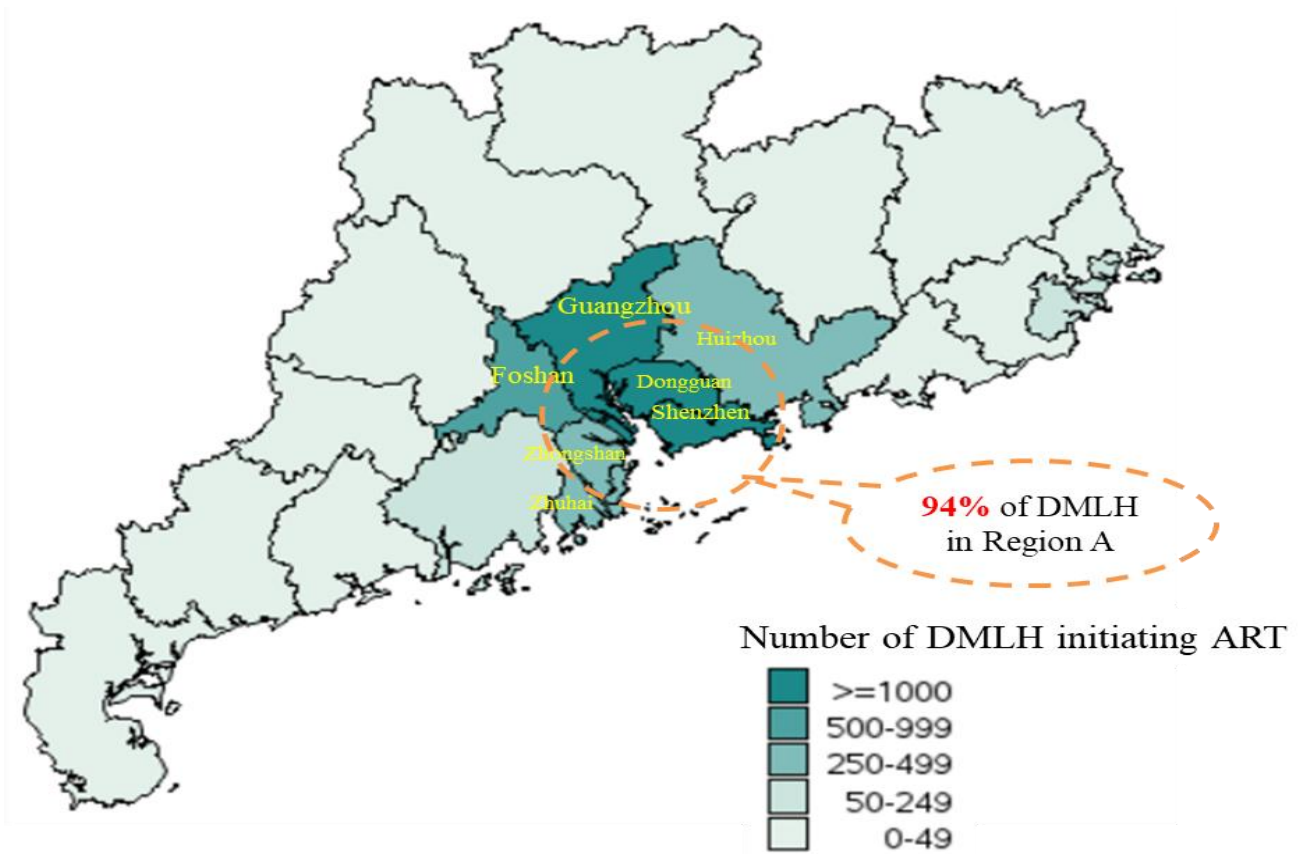


Figure 4.2 The distribution of domestic migrants living with HIV (DMLH) who were newly diagnosed with HIV and initiated ART from July 1, 2016, to December 31, 2018, in Guangdong province. 94% of these individuals were living in the cities (Guangzhou, Foshan, Dongguan, Huizhou, Zhongshan, Zhuhai, Shenzhen) from Region A.

Table 4.1 Distribution of participants and ART clinics across cities in this cohort study

	Total	Domestic migrants living with HIV N (%)	Residents living with HIV N (%)	Number of Counties or Districts	Number of ART clinics	Number of ART clinics with one-stop service N (%)	Subway in the city
Region A	11245	8862(78.8)	2383(21.2)	35	23	21 (91.0)	—
Guangzhou	3604	2662(73.9)	942(26.1)	13	4	4 (100.0)	Yes
Shenzhen	3638	2989(82.2)	649(17.8)	7	2	2 (100.0)	Yes
Zhuhai	352	256(72.7)	96(27.3)	4	2	2 (100.0)	Yes
Foshan	1158	874(75.5)	284(24.5)	3	6	4 (66.7)	Yes
Huizhou	461	287(62.3)	174(37.7)	6	6	6 (100.0)	No
Dongguan	1554	1399(90)	155(10)	1	2	2 (100.0)	Yes
Zhongshan	478	395(82.6)	83(17.4)	1	1	1 (100.0)	No
Region B	4052	514(12.7)	3538(87.3)	106	46	29 (63.0)	—
Shaoguan	195	25(12.8)	170(87.2)	12	2	1 (50.0)	No
Shantou	365	99(27.1)	266(72.9)	9	5	2 (40.0)	No
Jiangmen	442	143(32.4)	299(67.6)	8	6	5 (83.3)	No
Zhanjiang	540	20(3.7)	520(96.3)	10	3	0 (0.0)	No
Maoming	349	14(4.0)	335(96.0)	7	5	4 (80.0)	No
Zhaoqing	254	43(16.9)	211(83.1)	9	7	5 (100.0)	No
Meizhou	108	8(7.4)	100(92.6)	9	1	1 (100.0)	No
Shanwei	149	12(8.1)	137(91.9)	5	1	1 (100.0)	No
Heyuan	183	21(11.5)	162(88.5)	7	1	0 (0.0)	No
Yangjiang	386	27(7.0)	359(93.0)	5	4	3 (75.0)	No
Qingyuan	359	36(10.0)	323(90.0)	9	2	2 (100.0)	No
Chaozhou	79	12(15.2)	67(84.8)	4	1	1 (100.0)	No
Jieyang	323	37(11.5)	286(88.5)	6	3	1 (33.3)	No
Yunfu	320	17(5.3)	303(94.7)	6	5	3 (60.0)	No

Note: the distribution of participants was summarized at the time of ART initiation.

Table 4.2 Characteristics of participants in Region A and Region B

	Region A		Region B		P value
	(N=11245)	%	(N=4052)	%	
Gender					<0.001
Male	9968	88.6	3094	76.4	
Female	1277	11.4	958	23.6	
Occupation					<0.001
Stable jobs	485	4.3	172	4.2	
Unstable jobs	6356	56.5	2353	58.1	
Other jobs	1712	15.2	422	10.4	
Unemployed	2692	23.9	1105	27.3	
Age group (years)					<0.001
<30	4436	39.4	770	19.0	
30-40	3030	26.9	585	14.4	
40-50	2257	20.1	813	20.1	
50-60	960	8.5	783	19.3	
>=60	562	5.0	1101	27.2	
Marriage					<0.001
Married	3864	34.4	2356	58.1	
Divorce/Widowhood	1274	11.3	696	17.2	
Unmarried	6107	54.3	1000	24.7	
Ethnics					
Han	10530	93.6	3979	98.2	
Others	715	6.4	73	1.8	
Education Level					<0.001
<= 9 years	5125	45.6	3109	76.7	
> 9 years	6120	54.4	943	23.3	
Venue of diagnosis					<0.001
Supervision places	158	1.4	35	0.9	
Healthcare establishments	6528	58.1	2949	72.8	
Active testing	4559	40.5	1068	26.4	
Transmission route					<0.001
Homosexual	5714	50.8	544	13.4	
Heterosexual	5374	47.8	3243	80.0	
Blood and others	157	1.4	265	6.5	
CD4 count (cells/ μ L)					<0.001
<500	7887	70.1	2157	53.2	
>=500	3103	27.6	789	19.5	
untested	255	2.3	1106	27.3	
Gap between HIV diagnosis and ART (days)					0.008
<30	7970	70.9	2864	70.7	
30-60	1771	15.7	530	13.1	
60-90	476	4.2	181	4.5	
>=90	1028	9.1	477	11.8	
Migration status at the time of ART initiation					<0.001
Inter-provincial migrants	6780	60.3	387	9.6	
Intra-provincial migrants	2082	18.5	127	3.1	
Residents	2383	21.2	3538	87.3	

Table 4.3 Characteristics of participants in this cohort study at the time of ART initiation

	Total	Inter-provincial migrants		Intra-provincial migrants		Residents		<i>P</i> value
	(N=15297)	(N=7167)	%	(N=2209)	%	(N=5921)	%	
Gender								<0.001
Male	13062	6262	87.4	1963	88.9	4837	81.7	
Female	2235	905	12.6	246	11.1	1084	18.3	
Job								<0.001
Stable jobs	657	171	2.4	71	3.2	415	7.0	
Unstable jobs	8709	4276	59.7	1194	54.1	3239	54.7	
Other jobs	2134	1021	14.2	377	17.1	736	12.4	
Unemployed	3797	1699	23.7	567	25.7	1531	25.9	
Age group (years)								<0.001
<30	5206	2567	35.8	1229	55.6	1410	23.8	
30-40	3615	2175	30.3	434	19.6	1006	17.0	
40-50	3070	1657	23.1	314	14.2	1099	18.6	
50-60	1743	573	8.0	131	5.9	1039	17.5	
>=60	1663	195	2.7	101	4.6	1367	23.1	
Marriage								<0.001
Married	6220	2565	35.8	614	27.8	3041	51.4	
Divorce/Widowhood	1970	947	13.2	159	7.2	864	14.6	
Unmarried	7107	3655	51.0	1436	65.0	2016	34.0	
Ethnics								
Han	14509	6455	90.1	2191	99.2	5863	99.0	
Others	788	712	9.9	18	0.8	58	1.0	
Education Level								<0.001
<= 9 years	8234	3815	53.2	860	38.9	3559	60.1	
> 9 years	7063	3352	46.8	1349	61.1	2362	39.9	
Venue of diagnosis								<0.001
Diagnosis in supervision institutions	193	125	1.7	23	1.0	45	0.8	
Diagnosis in healthcare institutions	9477	4085	57.0	1205	54.5	4187	70.7	
Diagnosis in CDCs	5627	2957	41.3	981	44.4	1689	28.5	
Transmission route								<0.001
Homosexual	6258	3523	49.2	1234	55.9	1501	25.4	
Heterosexual	8617	3528	49.2	941	42.6	4148	70.1	
Blood and others	422	116	1.6	34	1.5	272	4.6	
CD4 cell count (cells/ μ L)								<0.001
<500	10044	4977	69.4	1463	66.2	3604	60.9	
>=500	3892	1948	27.2	676	30.6	1268	21.4	
untested	1361	242	3.4	70	3.2	1049	17.7	
Gap between HIV diagnosis and ART (days)								0.008
<30	10834	5000	69.8	1562	70.7	4272	72.1	
30-60	2301	1154	16.1	330	14.9	817	13.8	
60-90	657	327	4.6	90	4.1	240	4.1	
>=90	1505	686	9.6	227	10.3	592	10.0	
City in regions								<0.001
Region A	11245	6780	94.6	2082	94.3	2383	40.2	
Region B	4052	387	5.4	127	5.7	3538	59.8	

Table 4.4 Cumulative probability of ART attrition at some specific timepoints

	Total	Follow-up months Median (IQR)	Number of ART attrition	Cumulative probability of ART attrition			
				1st month	6th month	12th month	By the end of the study
Overall							
Total population	15297	25.5 (17.9, 32.8)	2958	0.45%	9.11%	13.32%	25.63%
Inter-provincial migrants	7167	25.6 (18.1, 32.8)	930	0.27%	5.00%	8.36%	18.09%
Intra-provincial migrants	2209	25.5 (18.1, 33.0)	282	0.41%	5.12%	8.35%	16.50%
Residents	5921	25.4 (17.6, 32.8)	1746	0.68%	15.68%	21.31%	38.27%
Stratification							
Region A							
Inter-provincial migrants	6780	25.6 (18.1, 32.8)	782	0.24%	4.20%	7.24%	16.20%
Intra-provincial migrants	2082	25.7 (18.2, 33.2)	243	0.14%	4.16%	7.28%	15.35%
Residents	2383	25.9 (18.2, 32.8)	275	0.25%	3.07%	6.22%	16.72%
Region B							
Inter-provincial migrants	387	25.3 (16.9, 31.7)	148	0.78%	19.16%	28.01%	45.22%
Intra-provincial migrants	127	14.5 (21.5, 28.1)	39	0.80%	21.54%	26.65%	36.09%
Residents	3538	25.1 (16.9, 32.9)	1471	0.97%	24.34%	31.69%	53.11%

Note: IQR: interquartile range; reverse Kaplan-Meier method was used to calculate the median follow-up months; product-limit method was applied to estimate ART attrition probability in this study.

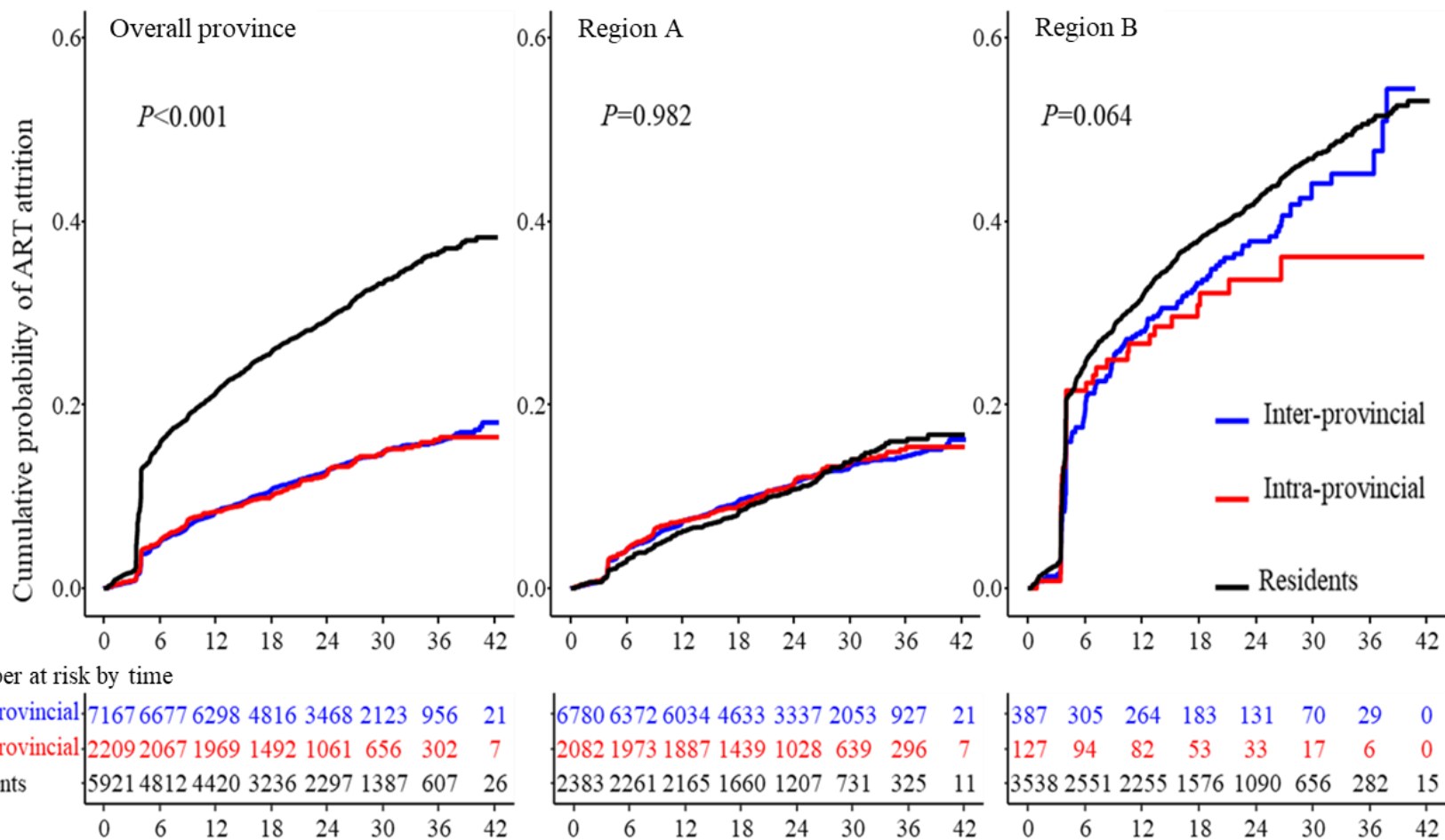


Figure 4.3 Plots of cumulative probabilities of ART attrition during the study period.

Table 4.5 Comparison of ART attrition between migration patterns at the baseline

	Total	ART initiation N (%)	HR (95%CI)
Overall analysis			
Cities in regions			
Region A	11245	1300 (11.6)	1.00
Region B	4052	1658 (40.9)	2.60 (1.18~5.77)
Migration status at the baseline			
Residents	5921	1746 (29.5)	1.00
Inter-provincial migrants	7167	930 (13.0)	1.02 (0.91~1.14)
Intra-provincial migrants	2209	282 (12.8)	1.04 (0.90~1.20)
Inter-provincial VS. Intra-provincial migrants	—	—	0.98 (0.86~1.13)
Stratification by regions			
In Region A			
Residents	2383	275 (11.5)	1.00
Inter-provincial migrants	6780	782 (11.5)	1.15 (1.00~1.33)
Intra-provincial migrants	2082	243 (11.7)	1.20 (1.00~1.43)
Inter-provincial VS. Intra-provincial migrants	—	—	0.97 (0.83~1.12)
In Region B			
Residents	3538	1471 (41.6)	1.00
Inter-provincial migrants	387	148 (38.2)	0.88 (0.74~1.05)
Intra-provincial migrants	127	39 (30.7)	0.79 (0.57~1.09)
Inter-provincial VS. Intra-provincial migrants	—	—	1.12 (0.78~1.59)

*The potential confounders were adjusted in the Frailty model, including age, gender, ethnicity, marriage, occupation, education, venue of diagnosis, transmission route, CD4 cell count, and gap between HIV diagnosis and ART initiation.

Appendix 4.1

Simplified questionnaire for adults at the time of ART initiation

1. Code for ART clinic _____
2. Ptid for patient _____
3. ART type: Adult Children
4. Patients' name _____
5. ID Number _____
6. Administrative code of Current residence _____
7. Administrative code of Registered residence _____
8. Code for infectious disease card _____
9. Date of birth _____
10. Gender: Male Female
11. Source of the ART fees: Free self-payment Public medical treatment Medical insurance Other
12. Marital status: Unmarried Married/living together with partner Divorced/Separation Widowed
13. Date of HIV diagnosis _____
14. Transmission source:
 - Blood transfusion Plasma collection Injecting drug use Homosexual
 - Heterosexual Sex + Drug Mother-to-child Uncertain Others
15. TB infection in latest one year: Yes No
- 15.1 Treatment for TB: Yes No
16. AIDS-related symptoms in latest three months:
 - Yes (example symptoms as follow: Thrush Oral hairy leukoplakia Continuous diarrhea TB Other opportunistic infection)
 - No Unsure
17. Current symptoms:
 - Yes
 - Fever Cough Dyspnea Chest pain Diarrhea
 - Headache Decrease vision Nausea Lymphadenopathy
 - No
18. WHO clinical stages: I II III IV
19. Weight _____ Height _____
20. CD4 _____ CD8 _____

Appendix 4.2

Simplified questionnaire for adults to retain in ART during the follow-up

1. Code of ART clinics _____
2. Ptid _____
3. Patients' name _____ 4. Patients' ID number _____
5. Administrative code of current residence _____
6. Number of visits _____ Date _____
7. Status:
 - Die Date _____ Reason _____
 - Transfer out Date _____
8. WHO clinical stages: I II III IV
9. AIDS-related symptoms since last visit:
 - Yes (example symptoms as follows: Thrush Oral hairy leukoplakia TB)
 - No
10. Side effects of drugs since last visit:
 - Yes (example symptoms as follows: Sleep difficulty Headache Decrease vision)
 - No
11. Weight: _____ kg
12. Times of missing to take drugs during the last seven days _____
13. CD4 _____ CD8 _____ Date _____
14. Viral load _____ C/mL Date _____
15. Clinical indicators (examples as follows):
 - White blood cell count _____ $10^9/L$
 - Platelet count _____ $10^9/L$
 - ALT _____ U/L AST _____ U/L
 - HBsAg positive negative anti-HCV positive negative
16. Regimen for treatment _____
17. Date for next visit _____

Appendix 4.3

Table S4 Categorization and rationale of variables for ART attrition analysis

Variables	Categorization of variables for analysis	Remarks
Age	1="<30"; 2="30-40"; 3="40-50"; 4="50-60"; 5=">=60"	According to published studies.
Gender	1="female"; 2="male"	There were only two options in the questionnaire.
Ethnicity	1="Han ethnicity"; 2="other ethnicities"	Most domestic migrants were of Han ethnicity.
Marriage	1="unmarried"; 2="married"; 3="divorced/widowhood"	The "unknown category" in the original dataset was verified and was recategorized into the three groups.
Education	1="≤9 years" (illiteracy/primary school/junior school) 2=">9 years" (senior school/associate degree/college and above)	In China, nine-years education was compulsory.
Occupation	1="stable jobs" (teacher/healthcare workers/retired personnel/civil 2="unstable jobs" (child-care workers/peasant/fisherman/factory worker/rural migrant workers/drivers/commercial service providers/ catering attendant) 3="unemployed" (unemployed) 4="others" (unknown/others)	People with stable jobs have social health insurance, but people with unstable jobs do not have social health insurance. Social health insurance was paid by employment institutions.
Transmission route	1="heterosexual"; 2="homosexual"; 3="blood and others"	Heterosexual and homosexual transmission contributed to most of the new infections.
HIV testing source	1="Diagnosis in supervision institution" (Women's reeducation 2="Diagnosis in healthcare institution" (Premarital examination/ 3="Diagnosis in CDC" (VCT/ testing for spouse and children of HIV positive case/ testing for entertainment staff/ occupational	Most testing in supervision and healthcare institutions was passive, but most testing in CDC was active.
CD4 cell count at ART initiation	1="<200"; 2="200-500"; 3="≥500"; 4="untested"	According to the definitions of late diagnosis from published papers.
Gap between HIV diagnosis and ART initiation	1=" <30"; 2="30-60"; 3="60-90"; 4="≥90"	According to the definitions of early ART initiation from published papers.
City in the Region	1="Region A"; 2="Region B"	Economic development, healthcare resources and the size of domestic migrants living with HIV were different between these two regions.
Transfer to other ART clinics	1="Yes"; 2="No"	There were only two statuses in the questionnaire.
Die	1="Yes"; 2="No"	There were only two options in the questionnaire.
Loss-to-follow-up	1="Yes"; 2="No"	There were only two options in the questionnaire.

Reference

- Camlin, C. S., & Charlebois, E. D. (2019). Mobility and its Effects on HIV Acquisition and Treatment Engagement: Recent Theoretical and Empirical Advances. *Current Hiv/aids Reports*, 16(4), 314-323.
- Census office of the state council, Population and employment statistics division of the national bureau of statistics (2010, December 31). National census of China in 2010. Retrieved from <http://www.stats.gov.cn/tjsj/pcsj/rkpc/6rp/indexch.htm>.
- Davis, A., Terlikbayeva, A., Terloyeva, D., Primbetova, S., & Elbassel, N. (2017). What Prevents Central Asian Migrant Workers from Accessing HIV Testing? Implications for Increasing HIV Testing Uptake in Kazakhstan. *AIDS and Behavior*, 21(8), 2372-2380.
- European center for disease prevention and control. (2017, April 1). Monitoring implementation of the dublin declaration on partnership to fight HIV/AIDS in Europe and Central Asia: 2017 progress report. <https://www.ecdc.europa.eu/sites/portal/files/documents/HIV%20and%20migrants.pdf>.
- Feng, X., & Yue, W. (2018, December 1). Sexual transmission is the major mode among 9011 newly reported HIV cases in Guangodong. Retrieved from http://news.ycwb.com/2018-12/01/content_30143486.htm.
- Hassan, A. S., Mwaringa, S. M., Ndirangu, K. K., Sanders, E. J., De Wit, T. F. R., & Berkley, J. A. (2015). Incidence and predictors of attrition from antiretroviral care among adults in a rural HIV clinic in Coastal Kenya: a retrospective cohort study. *BMC Public Health*, 15(1), 478-478.

-
- Hernando, V., Arco, A. D., Alejos, B., Monge, S., & Amo, J. D. (2015). HIV Infection in Migrant Populations in the European Union and European Economic Area in 2007-2012: An Epidemic on the Move. *J Acquir Immune Defic Syndr*, 80(2).
- Li, P., Wang, L., Guo, W., Qin, Q., & Cui, Y. (2014). [Mobility of HIV/AIDS and affecting factors analysis in 2013, China]. *Zhonghua Yu Fang Yi Xue Za Zhi Chinese Journal of Preventive Medicine*, 48(11), 934-937.
- Li, Y., Lin, P., Wang, Y., Fu, X.-b., Ye, R., Li, J.-r., Feng, M.-y., Yu, G.-l., Yang, F., Yan, J., Long, Q.-s., & Deng, h.-h. (2015). HIV/AIDS surveillance in Guangdong Province, 2000-2013. *South China J Prev Med*, 41(2), 101-106.
- Ma, S. (2008). The study on a part of rural residents from a underdeveloped place in Guangdong province about AIDS knowledge, attitude, behavior and effective factors. [Master's thesis, Sun Yat-sen University]. Chinese Wanfang Data.
- Mao, Y., Wu, Z., Poundstone, K., Wang, C., Qin, Q., Ma, Y., & Ma, W. (2010). Development of a unified web-based national HIV/AIDS information system in China. *International journal of epidemiology*, 39.
- Marukutira, T., Gray, R., Douglass, C., Elhayek, C., Moreira, C., Asselin, J., Donovan, B., Vickers, T., Spelman, T., & Crowe, S. M. (2020). Gaps in the HIV diagnosis and care cascade for migrants in Australia, 2013-2017: A cross-sectional study. *PLOS Medicine*, 17(3).
- Reyesuruena, J., Campbell, C. N. J., Hernando, C., Vives, N., Folch, C., Ferrer, L., Fernandezlopez, L., Esteve, A., & Casabona, J. (2017). Differences between migrants and

-
- Spanish-born population through the HIV care cascade, Catalonia: an analysis using multiple data sources. *Epidemiology and Infection*, 145(08), 1670-1681.
- Ross, J., Cunningham, C. O., & Hanna, D. B. (2018). HIV outcomes among migrants from low-income and middle-income countries living in high-income countries: a review of recent evidence. *Current Opinion in Infectious Diseases*, 31(1), 25-32.
- Shaw, S., Modi, R., Mugavero, M., Golin, C., Quinlivan, E. B., Smith, L. R., Roytburd, K., Crane, H., Keruly, J., & Zinski, A. (2018). HIV Standard of Care for ART Adherence and Retention in Care Among HIV Medical Care Providers Across Four CNICS Clinics in the US. *AIDS and Behavior*, 23.
- Sheehan, D. M., Fennie, K. P., Mauck, D. E., Maddox, L. M., Lieb, S., & Trepka, M. J. (2017). Retention in HIV Care and Viral Suppression: Individual- and Neighborhood-Level Predictors of Racial/Ethnic Differences, Florida, 2015. *AIDS patient care and STDs*, 31(4), 167-175.
- Tanser, F., Bärnighausen, T., Vandormael, A., & Dobra, A. (2015). HIV treatment cascade in migrants and mobile populations. *Current Opinion in Hiv & Aids*, 10(6), 430.
- Tripathi, A., Youmans, E., Gibson, J. J., & Duffus, W. A. (2011). The Impact of Retention in Early HIV Medical Care on Viro-Immunological Parameters and Survival: A Statewide Study. *AIDS Res Hum Retroviruses*, 27(7), 751-758.
- UNAIDS. (n.d.). 90-90-90 An ambitious treatment target to help end the AIDS epidemic. Retrieved 2020, August 25 from https://new.pancap.org/pc/pcc/media/pancap_document/90-90-90_Targets.pdf.

-
- UNAIDS. (2019, July 16). UNAIDS DATA 2019. <http://rstesa.unaids.org/publications/global-publications/2019/item/208-unaids-data-2019#:~:text=This%20edition%20of%20UNAIDS%20data%20shows%20the%20results,analyzed%20and%20refined%20by%20UNAIDS%20over%20the%20years.>
- UNAIDS (2018, July 18). Global AIDS Update: MILES TO GO: Closing gaps, breaking barriers, righting injustices. https://www.unaids.org/sites/default/files/media_asset/miles-to-go_en.pdf.
- World Health Organization (WHO). (2019, November 15). HIV/AIDS Key facts. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/hiv-aids>.
- Zhao, L., Liu, S., & Zhang, W. (2018). New Trends in Internal Migration in China: Profiles of the New-generation Migrants. *China & World Economy*, 26(1), 18-41.

Chapter V

Summary

This study comprehensively investigated the multifaceted barriers towards ART initiation and retention among DMLH in Guangdong, China. The findings provided more knowledge about domestic migrants' performance in ART initiation and retention and how these multilevel barriers affected ART initiation and retention among DMLH. The results of this study indicated multiple potential implications for improving ART initiation and retention among DMLH.

1) A specific health system for off-site reimbursement of social medical insurance is needed for DMLH. A possible solution would be to increase the off-site reimbursement rate to the same level as that in domestic migrants' hometown.

2) An effective reward mechanism should be created to assess the service quality in each ART related institutions. The assessment results should be related to service providers' salaries and job positions.

3) A unified platform should be constructed to provide immediate communications for service providers from different institutions, cities, and provinces. The platform would help service providers to track domestic migrants' ART care and improve the efficiency of transferring patients across institutions.

4) More flexibility in spending funds is essential to improve the effectiveness of service provision. Policymakers should adjust the current audit rules to adapt to real-world settings.

5) More professional training and higher salaries are necessary for service providers to remain in ART related service and ensure their service quality. Professional training would help

service providers to get more skills as well as competitiveness. A high salary would motivate service providers to provide high-quality service to patients.

6) Stigma reduction interventions should be continuously strengthened among the general population to reduce barriers for domestic migrants to take ART services in their hometown.

7) The bonding between service providers and family members of domestic migrants should be constructed in the future intervention. Family support would benefit service providers to encourage domestic migrants to initiate ART and retain in ART.

The findings and suggestions from this study should be interpreted with multiple limitations. First, the study may not be simply generalized to other provinces in China because the policy to domestic migrants and migrants' characteristics may be different from that in Guangdong province. Second, information bias was unavoidable in the in-depth interview due to social desirability. Service providers may have other concerns and did not report some sensitive challenges and difficulties in work. Third, some DMLH who dropped out of ART were hard to reach, so the barriers to ART retention among these patients were not identified. Forth, in retrospective cohort studies, the data were collected originally for administrative purposes, so some important variables related to domestic migrants were unavailable. Lastly, a shortage of structural level variables restricted further analysis from regions and institutions.

Even with the above limitations, this study still provided a comprehensive understanding of ART initiation and retention among domestic migrants and helped policymakers to design more proper policies and interventions towards the current barriers. Future studies can focus more on the ART experience among domestic migrants returning to their hometown.