



Association Between the Awareness of Antiretroviral Drugs-Related Services and Drug Accessibility During the COVID-19 Pandemic Among Patients Undergoing Antiretroviral Therapy: A Cross-Sectional Study

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Abstract

In a cross-sectional survey from 21 February to 6 March, 2020, we analyzed the awareness and utilization of antiretroviral drugs (ARVs)-related services among people living with HIV during the COVID-19 pandemic in Guangzhou, China. In addition, a subgroup analysis was performed among those who needed to go to hospital to access their drugs, and we explored the association between the awareness of ARVs-related services and the accessibility of ARVs. Of 375 participants, 89.9% were aware of drug-borrowing service, 90.7% were aware of drug-delivery service and 86.9% were aware of information-assistance service. Knowing about the drug-borrowing service or the information-assistance service, knowing about at least two services and knowing about all of the three services were all positively associated with ARVs accessibility. In addition, 35 (39.3%) of those who had acquired their drugs on time received them via the drug-delivery service. To some extent, the three ARVs-related services have alleviated the difficulties in accessing ARVs during the pandemic, especially the drug-delivery service.

Keywords Antiretroviral drugs-related services · COVID-19 · AIDS · drug delivery

Abbreviations

ART	antiretroviral therapy.
AIDS	acquired immunodeficiency syndrome.
ARVs	antiretroviral drugs.
aOR	adjusted odds ratio.
COVID-19	coronavirus disease 2019.
CDC	Centers for Disease Control and Prevention.
CI	confidence interval.

HIV	human immunodeficiency virus.
NGO	non-governmental organization.
PLWH	people living with HIV.
SDs	standard deviations.
WHO	World Health Organization.

Introduction

Since January 2020, severe acute respiratory syndrome coronavirus 2, the causal virus of coronavirus disease 2019 (COVID-19), has spread rapidly around the world and rapidly evolved into a pandemic, as declared by the World Health Organization (WHO) on 11 March 2020 [1]. On 20 February 2020, a total of 74,677 and 1050 confirmed cases were reported in mainland China and regions outside China, respectively [2]. As of the early hours of 7 September 2021, the cumulative number of confirmed cases reported in mainland China was 95,064, and the cumulative total number of cases reported globally was more than 221 million [3, 4]. To contain the COVID-19 pandemic, countries such as China enacted a series of quarantine measures, such as travel

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restrictions, city lockdown and social distancing. While these measures have contributed to the prevention and control of the pandemic, they have affected the follow-up of human immunodeficiency virus (HIV)-positive patients who receive antiretroviral therapy (ART) at government-designated hospitals. The possible effects of this reduced follow-up attendance including a reduction in regular testing, barriers to timely treatment, and ART interruption [5]. Previous studies have suggested that ATI due to the COVID-19 pandemic has reduced adherence to ART and increased the risk of HIV transmission and related mortality [6–8]. Therefore, ensuring the maintenance of ART is an important task for HIV/acquired immunodeficiency syndrome (AIDS) prevention and control during the COVID-19 pandemic.

Due to the COVID-19 pandemic, community organizations have closed, staff serving HIV-positive patients have reduced their working hours, health workers have been reassigned to hospitals specializing in COVID-19 patient care and clinics have been unable to function normally [9]. A study conducted in 19 countries found that in three countries, health workers had reduced the number of hours working on services for HIV-positive patients. In approximately 60% of the countries in the study, infectious disease specialists were directly involved in caring for COVID-19 patients, and they were likely to be completely occupied with responding to the pandemic [10]. In another study, only 2 out of 27 HIV clinics were working normally and approximately 80% were partially interrupted or completely closed during the pandemic [11]. Additionally, the pandemic has severely affected the production and availability of antiretroviral drugs (ARVs), potentially leading to a shortage of drug supplies [12]. Therefore, people living with HIV (PLWH) who are undergoing ART are facing great challenges in maintaining their ART. The WHO and the Centers for Disease Control and Prevention (CDC) in some countries have issued a series of recommendations for ART maintenance, such as full implementation of multi-month dispensing of at least a 3-month supply of ARVs to reduce the frequency of patient visits, mail order delivery of ARVs and a delay in switching the current ART regimen [13–15]. A search of PubMed revealed only one study from China that briefly investigated the overall awareness of these measures among PLWH and described recourse measures, including official recommendations, to obtain additional ARVs [16]. However, few studies were found that explored the association between the awareness of these recommendations and the accessibility of ARVs among PLWH undergoing ART.

As of October 2019, there were approximately 958,000 PLWH in China, with an ART coverage rate of 86.6% [17]. In December 2020, the ART coverage rate in Guangzhou, China, reached 91.3% [18]. Chinese New Year is the most important festival in China, many people need to leave their

place of residence to return home during this time. The original dispensing policy requires PLWH to obtain ARVs almost exclusively from government-designated hospitals or institutions, and therefore, they are only able to obtain a 1 or 3 months of supply of ARVs from a designed hospital with records of their treatment before returning home [19, 20]. Therefore, PLWH in China are more likely than those in other countries, to have drug shortages during times when movement is restricted. COVID-19 outbreak near the Chinese New Year holiday. This has prompted an examination of the circumstances of ART maintenance for PLWH undergoing ART during the COVID-19 pandemic in China. A national survey in China found that 32.6% of PLWH reported that ARVs were difficult to obtain due to restricted movement, and 64% of the surveyed patients needing ARVs had difficulty accessing ARVs because of travel restrictions within the city [21]. Another survey found that 22.8% of respondents had ATI and 35.1% were at risk of ATI [22]. To alleviate this situation, the Chinese CDC issued a statement on 26 January 2020, proposing ARVs-related services, such as drug-borrowing, drug-delivery and information assistance, to help AIDS patients overcome these difficulties [23]. The Guangzhou Eighth People's Hospital, the largest receiving hospital for HIV-positive patients in South China, also publicized this document on 27 January 2020. However, few studies in China analyzed the awareness and utilization of ARVs-related services in sufficient detail. There is a lack of exploration of the correlation between the awareness of ARVs-related services and the accessibility of ARVs in China.

The present cross-sectional study aimed to investigate the availability, awareness situation, awareness pathways and utilization of ARVs-related services among PLWH undergoing ART in Guangzhou during the COVID-19 pandemic. Additionally, we further aimed to investigate the association between the awareness of ARVs-related services and the accessibility of ARVs among these PLWH, to evaluate the effect of Chinese ARVs-related services during the COVID-19 pandemic, and to provide suggestions for ART maintenance in the future for China and other countries.

Methods

Study design

This cross-sectional survey was conducted from 21 February to 6 March 2020, at the Guangzhou Eighth People's Hospital, Guangdong province, China. As of 21 February 2020, Guangdong province was one of the four provinces other than Hubei province that reported more than 1,000 confirmed cases of COVID-19. Guangzhou reported 339

confirmed cases of COVID-19, which was the second highest number of reported cases in Guangdong province [24]. At the end of October 2019, Guangdong province had reported a cumulative total of more than 66,000 surviving HIV-positive cases, ranking fourth in the country [25]. The Guangzhou Eighth People's Hospital has admitted a cumulative total of approximately 20,000 HIV-positive cases, and it was the first authoritative hospital for ART provision in Guangdong.

Population recruitment

Patients were eligible to participate in this study if they (1) were aged > 18 years, (2) were HIV-positive, (3) regularly attended follow-up clinic visit for ARVs at the Guangzhou Eighth People's Hospital during the past 6 months, (4) had access to WeChat and (5) agreed to participate in the survey after providing informed consent. Those who were not sure if they were under-medicated were excluded. Recruitment was performed using convenience sampling, and case managers in the clinic sent a link to an electronic questionnaire via WeChat to the patients they contacted for participation in the survey. WeChat is the most commonly used social media platform in China. In the Guangzhou Eighth People's Hospital, each HIV/AIDS patient is managed by a case manager. Before completing the survey, participants were informed of the purpose of the survey, the anonymity of the survey and that their participation was voluntary and the results would not affect their existing services. The survey took approximately 10 min to complete, and those who completed the survey received RMB 10 (approximately US\$1.54) as compensation for their time. The case managers sent a link to the questionnaire to 600 patients, 436 of whom completed the survey. Of these, 375 submitted valid questionnaires, resulting in an effective response rate of 86%. This study received ethical approval from the School of Public Health, Sun Yat-sen University, Guangzhou, China.

Measurements

Sociodemographic and HIV/AIDS-related variables

Sociodemographic variables included gender, age, current residence, educational level, employment status, monthly income, marital status and movement restrictions status (completely restricted, partially restricted, and no/unknown). HIV/AIDS-related variables included route of transmission, duration of ART, ART regimen, CD4 cell count, viral load, access to medication during the pandemic, and 7-day medication adherence.

Awareness of ARVs-related services

The ARVs-related services included *drug-delivery*, *drug-borrowing* and *information-assistance*. If patients undergoing ART had insufficient drugs and could not return to their original treatment hospital due to travel restrictions, they could use the *drug-delivery service* to contact the hospital or institution to request the delivery of a 1-month supply of ARVs. Patients only need to pay postage (approximately US\$ 4) for using drug-delivery service. If the lack of drugs could not be solved by the delivery service, patients could use the *drug-borrowing service* to apply for free ARVs to be borrowed from the designed hospital or institution in which they were staying without extra pay. The borrowed ARVs were replaced later by the original hospital. If patients had difficulties in obtaining ARVs, the original hospital could use the *information-assistance service* to send information about the patient's previous treatment regimen to the local hospital or institution to assist them in providing the appropriate ARVs. The information-assistance service was free. Participants were asked if they knew about each service, at least one service, at least two services or all three services. Each question was answered with either 'yes' or 'no'.

Awareness pathways of ARVs-related services

In this study, the awareness pathways mainly included the official WeChat account of the clinic, information through the healthcare workers at the clinic, WeChat group discussions with peers, bulletin boards at the clinic, Red Ribbon (a non-governmental organization [NGO] cooperating with clinics), and others (i.e., Dr. Almond, WeChat moments and Micro. blog).

The need for ARVs

Survey data were analyzed to determine whether patients needed to go to hospital for ARVs and whether they succeeded in accessing ARVs. If patient's scheduled appointment date was at the period between the outbreak of COVID-19 and the survey date, the patient was defined as the group needed to go to hospital for ARVs. Participants who needed to go to hospital for ARVs were our target population to explore the relationship between service awareness and successful ARVs access. The successful ARVs access was determined by asking the participants 'Have you accessed ARVs since the outbreak of COVID-19?'

Utilization of ARVs-related services

Data regarding the utilization of ARVs-related services were collected by investigating the methods of access to ARVs

among those who needed and successfully accessed them before the survey. The methods included returning to the original hospital to access ARVs, choosing a drug-delivery service and accessing ARVs at the local treatment institution or hospital.

Statistical analysis

Sociodemographic data, HIV/AIDS-related variables, awareness of ARVs-related services, awareness pathways were described using frequencies (percentages) or means (and standard deviations [SDs]). A *chi-square* test, Student's *t*-test was used to assess differences in basic characteristics between the subgroup that needed to go to hospital for ARVs and the subgroup that successfully accessed ARVs during the COVID-19 pandemic. Among those who needed to go to the hospital for their ARVs, binary logistic regression was used to explore the association between the awareness of ARVs-related services and the accessibility of ARVs, while adjusting for the sociodemographic and HIV/AIDS-related factors with a *p* value less than 0.1 in univariate analysis. R software 4.0.3 was used for data analysis. Significance was indicated by *p* values less than 0.05.

Results

Characteristics of all participants

Of the 375 participants, 66.1% were homosexual males. 33.6% and 53.3% were under full and partial movement restrictions, respectively. The mean duration of ART was 20.5 (SD=25.8) months, and 161 (42.9%) participants accessed ARVs during the COVID-19 pandemic. Of the 375 participants, 89.9% were aware of the drug-borrowing service, 90.7% were aware of the drug-delivery service and 86.9% were aware of the information-assistance service. Furthermore, 92.8% knew about at least one service, 90.1% knew about at least two services and 84.5% knew about all of the three services. The sociodemographic and HIV/AIDS-related data of the participants are detailed in Table 1.

One hundred and ninety-six of the 375 participants had a planned need to access ARVs (52.3%). Those who needed to access ARVs had a shorter duration of ART (16.8 ± 23.0 vs. 24.6 ± 27.9 ; $t=2.944$, $p=0.003$) and lower CD4 counts (456 ± 188 vs. 519 ± 222 ; $t=2.936$, $p=0.003$) than those who did not need to access ARVs (Table 1).

Characteristics of those who needed ARVs during the pandemic

Of the 196 people who needed to go to hospital for ARVs, 67.9% were homosexual males, 43.4% were aged 25–34 years, 55.1% resided in Guangzhou and 28.6% had a Bachelor's degree or higher. Of the study population, 30.1% and 55.6% were under full and partial movement restrictions, respectively. The mean duration of ART was 16.8 (SD=23) months, and 80.1% of ART regimens were first-line regimens. The mean CD4 cell count was 456 (SD=188), 85.0% (N=80) of participants were virally unsuppressed and 89.3% had no missed drug doses in the last 7 days. Compared to those who successfully accessed drugs, those who did not were more likely to be homosexual males (72.0% vs. 62.9%; $\chi^2=9.811$, $p=0.020$) and have higher CD4 counts (481 ± 186 vs. 427 ± 186 ; $t=1.983$, $p=0.049$). The remaining variables were not statistically different between the subgroups (Table 2).

Among those who needed to access ARVs, 89.3%, 90.3% and 86.2% were aware of the drug-borrowing, drug-delivery and information-assistance services, respectively; furthermore, 92.3%, 89.8% and 83.7% knew about at least one service, knew about at least two services and knew about all of the three services, respectively (Table 3).

Association between awareness of ARVs-related services and accessibility of ARVs

The rate of awareness of ARVs-related services was above 90% among participants who successfully accessed drugs. The rates of awareness of the drug-borrowing service and of all services were significantly lower among those who did not access drugs than among those who successfully accessed drugs in univariate analysis. Only 77.6% of those who did not access ARVs knew about all of the ARVs-related services, compared to 91.0% of those who successfully obtained the drugs. After adjusting for covariates (including gender, movement restrictions during the COVID-19 pandemic and CD4 cell count), awareness of the drug-borrowing service (adjusted odds ratio [aOR] 3.86; 95% confidence interval [CI] 1.31–13.58), the information-assistance service (aOR 3.62; 95% CI 1.32–11.82), at least two ARVs-related services (aOR 3.24; 95% CI 1.10–11.31) and all services (aOR 5.25; 95% CI 1.95–16.97) were positively associated with the accessibility of ARVs (Table 3).

Of the 89 participants who successfully obtained their ARVs, 56.2% did so by returning to their original hospital, 39.3% chose the drug-delivery service and only 4.5% accessed ARVs at their local hospital.

Table 1 Profiles of all participants and by subgroups based on the need to go to hospital for ARVs during the COVID-19 pandemic

Characteristic	Total (N = 375) N (%)	Needed to go to hospital for ARVs		χ^2/t	P
		No (N = 179) N (%)	Yes (N = 196) N (%)		
		Sociodemographic status			
Gender				0.977	0.807
Homosexual male	248 (66.1)	115 (64.2)	133 (67.9)		
Heterosexual male	50 (13.3)	27 (15.1)	23 (11.7)		
Bisexual male	56 (14.9)	27 (15.1)	29 (14.8)		
Female	21 (5.6)	10 (5.6)	11 (5.6)		
Age				2.091	0.554
18–24	99 (26.4)	42 (23.5)	57 (29.1)		
25–34	173 (46.1)	88 (49.2)	85 (43.4)		
35–44	72 (19.2)	33 (18.4)	39 (19.9)		
≥45	31 (8.3)	16 (8.9)	15 (7.7)		
Current place of residence				1.061	0.303
Guangzhou	217 (57.9)	109 (60.9)	108 (55.1)		
Non-Guangzhou	158 (42.1)	70 (39.1)	88 (44.9)		
Educational level				3.966	0.265
Junior school or below	62 (16.5)	29 (16.2)	33 (16.8)		
Senior school	78 (20.8)	34 (19.0)	44 (22.4)		
Post-secondary school	111 (29.6)	48 (26.8)	63 (32.1)		
Undergraduate college or above	124 (33.1)	68 (38.0)	56 (28.6)		
Employment status				0.001	0.971
Full-time	213 (56.8)	101 (56.4)	112 (57.1)		
Part-time/unemployed/student	162 (43.2)	78 (43.6)	84 (42.9)		
Monthly personal income (RMB)				4.850	0.183
No fixed income	86 (22.9)	38 (21.2)	48 (24.5)		
1,000–2,999	34 (9.1)	15 (8.4)	19 (9.7)		
3000–9,999	205 (54.7)	95 (53.1)	110 (56.1)		
≥10,000	50 (13.3)	31 (17.3)	19 (9.7)		
Marital status				1.938	0.585
Currently single	215 (57.3)	97 (54.2)	118 (60.2)		
Have boyfriend/girlfriend	90 (24.0)	44 (24.6)	46 (23.5)		
Married	58 (15.5)	31 (17.3)	27 (13.8)		
Divorced	12 (3.2)	7 (3.9)	5 (2.6)		
Movement restriction				2.362	0.307
Yes, completely restricted	126 (33.6)	67 (37.4)	59 (30.1)		
Yes, partially restricted	200 (53.3)	91 (50.8)	109 (55.6)		
No/unknown	49 (13.1)	21 (11.7)	28 (14.3)		
HIV/AIDS-related status					
Route of HIV transmission				4.968	0.291
Homosexual sexual behavior	283 (75.5)	128 (71.5)	155 (79.1)		
Heterosexual sexual behavior	40 (10.7)	21 (11.7)	19 (9.7)		
Bisexual sexual behavior	19 (5.1)	9 (5.0)	10 (5.1)		
Other ^a	8 (2.1)	6 (3.4)	2 (1.0)		
Unknown	25 (6.7)	15 (8.4)	10 (5.1)		
Duration of ART in months (mean [SD])	20.5 (25.8)	24.6 (27.9)	16.8 (23.0)	2.944	0.003
ART regimen ^b				0.678	0.713
First line	306 (81.6)	149 (83.2)	157 (80.1)		
Second line	31 (8.3)	14 (7.8)	17 (8.7)		
Other	38 (10.1)	16 (8.9)	22 (11.2)		
CD4 cell count (mean [SD])	487 (207)	519 (222)	456 (188)	2.936	0.003
Viral load suppression (N = 169)	152 (89.9)	84 (94.3)	68 (85.0)	3.127	0.077
Accessed ARVs during the COVID-19 pandemic	161 (42.9)	72 (40.2)	89 (45.4)	0.826	0.363

Table 1 (continued)

Characteristic	Total (N = 375) N (%)	Needed to go to hospital for ARVs		χ^2/t	P
		No (N = 179) N (%)	Yes (N = 196) N (%)		
		7-day ARV drug adherence	335 (89.3)		
Awareness of ARV-related services					
Drug-borrowing service	337 (89.9)	162 (90.5)	175 (89.3)	0.048	0.827
Drug-delivery service	340 (90.7)	163 (91.1)	177 (90.3)	0.005	0.941
Information-assistance service	326 (86.9)	157 (87.7)	169 (86.2)	0.074	0.785
Knew about at least one of the above services	348 (92.8)	167(93.3)	181 (95.3)	0.024	0.877
Knew about at least two of the above services	338(90.1)	162 (90.5)	176 (89.8)	0.003	0.955
Knew about all of the above services	317 (84.5)	162 (90.5)	175 (89.3)	0.115	0.735
The awareness pathways^c(N = 348)				4.377	0.497
The official WeChat account of the clinic	197 (56.6)	88 (52.7)	109 (60.2)		
Information through the healthcare workers at the clinic	82 (23.6)	40 (24.0)	42 (23.2)		
WeChat group discussions with peers	34 (9.8)	20 (12.0)	14 (7.7)		
Bulletin board at the clinic	4 (1.1)	2 (1.2)	2 (1.1)		
Red Ribbon (NGO)	23 (6.6)	14 (8.4)	9 (5.0)		
Other ^d	8 (2.3)	3 (1.8)	5 (2.8)		

^a: Other refers to blood transfusion, occupational exposure or mother-to-child transmission

^b: First-line: TDF (Tenofovir)/AZT (Zidovudine)+3TC (Lamivudine)+EFV (Efavirenz)/NVP (Nevirapine); second-line: TDF/AZT + 3TC + LPV/r (Lopinavir/Ritonavir), AZT + TDF + 3TC + LPV/r

^c: The awareness pathways for ARVs services were surveyed among patients who were aware of at least one ARVs service

^d: Other refers to Dr. Almond, WeChat moments, Micro.blog

Discussion

In this cross-sectional study, of the 375 patients undergoing ART at the Guangzhou Eighth People's Hospital, China, we found that more than half (52.3%, 196/375) needed ARVs during the COVID-19 pandemic, yet only 45.4% of them were successful in accessing ARVs before the survey. Awareness of ARVs-related services was high among the study participants. In addition, we found a positive correlation between the awareness of ARVs-related services and the accessibility of ARVs.

A high proportion of study participants needed to access ARVs during the COVID-19 pandemic, but only 45.4% were successful. This is similar to the findings of a national survey in China, where 32.6% of respondents reported that there were insufficient drugs available and 64.2% had difficulty obtaining ARVs due to travel restrictions [21]. ART maintenance has been affected by the COVID-19 pandemic. Although some measures, such as travel restrictions, have played a role in containing the pandemic, they have also led to a disruption in ART maintenance for PLWH. The consequences of ART interruption are serious, and therefore, the disruption of ART maintenance during the pandemic is a cause of concern. There is an urgent need to develop interventions that address maintenance interruptions due to public health emergencies.

Our survey found that awareness of ARVs services was high, with around 90% awareness of each service. Among the participants of this study, 92.8% were aware of at least one ARVs-related service during the COVID-19 pandemic, with the highest rate of awareness noted for the drug-delivery service (90.7%). The rate of awareness in our study was also higher than that reported in another Chinese study (67.1%) [16]. Among those who needed to access ARVs, awareness of ARVs-related services was similarly high. Due to the impact of the pandemic, publicity regarding these services was mainly conducted through online platforms (e.g., the official WeChat account of the clinic), and the high awareness rate also reflects the positive effect of online publicity in Guangzhou. However, in the future, more intensive measures are warranted to further increase the awareness rate among these patients.

The awareness rates for ARVs-related services were lower among those who did not access drugs than among who successfully acquired drugs. We found a positive relationship between the awareness of ARVs-related services and successful access to ARVs (aOR 3.62–5.25) among those who needed drugs. This association was significant for the awareness of the drug-borrowing service, the information-assistance service, at least two services and all services. Although this cross-sectional study was unable to determine a causal relationship [26], seeking to increase awareness of these services will be highly beneficial for patients who need to access ARVs.

Table 2 Profiles of participants who needed to go to hospital for ARVs and by subgroups related to ARVs access (success/failure) during the COVID-19 pandemic

Characteristic	Needed ARVs	Failed to access ARVs	Successfully accessed ARVs	χ^2/t	<i>P</i>
	(N= 196) N (%)	(N= 107) N (%)	(N= 89) N (%)		
Sociodemographic status					
Gender				9.811	0.020
Homosexual male	133 (67.9)	77 (72.0)	56 (62.9)		
Heterosexual male	23(10.7)	13 (12.1)	10 (11.2)		
Bisexual male	29 (14.8)	16 (15.0)	13 (14.6)		
Female	11 (5.6)	1 (0.9)	10 (11.2)		
Age				1.565	0.667
18–24	57 (29.1)	33 (30.8)	24 (27.0)		
25–34	85 (43.4)	47 (43.9)	38 (42.7)		
35–44	39 (19.9)	21 (19.6)	18 (20.2)		
≥ 45	15 (7.7)	6 (5.6)	9 (10.1)		
Current place of residence				2.554	0.110
Guangzhou	108 (55.1)	65 (60.7)	43 (48.3)		
Non-Guangzhou	88 (44.9)	42 (39.3)	46 (51.7)		
Educational level				4.087	0.252
Junior school or below	33 (16.8)	13 (12.1)	20 (22.5)		
Senior school	44 (22.4)	24 (22.4)	20 (22.5)		
Post-secondary school	63 (32.1)	36 (33.6)	27 (30.3)		
Undergraduate college or above	56 (28.6)	34 (31.8)	22 (24.7)		
Employment status				2.412	0.120
Full-time	84 (42.9)	40 (37.4)	44 (49.4)		
Part-time/unemployed/student	112 (57.1)	67 (62.6)	45 (50.6)		
Monthly personal income (RMB)				1.998	0.573
No fixed income	48 (24.5)	24 (22.4)	24 (27.0)		
1,000–2,999	19 (9.7)	11 (10.3)	8 (9.0)		
3,000–9,999	110 (56.1)	59 (55.1)	51 (57.3)		
≥ 10,000	19 (9.7)	13 (12.1)	6 (6.7)		
Marital status				3.476	0.324
Currently single	118 (60.2)	62 (57.9)	56 (62.9)		
Have boyfriend/girlfriend	46 (23.5)	30 (28.0)	16 (18.0)		
Married	27 (13.8)	12 (11.2)	15 (16.9)		
Divorced	5 (2.6)	3 (2.8)	2 (2.2)		
Movement restrictions				5.921	0.052
Yes, completely restricted	59 (30.1)	26 (24.3)	33 (37.1)		
Yes, partially restricted	109 (55.6)	61 (57.0)	48 (53.9)		
No/unknown	28 (14.3)	20 (18.7)	8 (9.0)		
HIV/AIDS-related status					
Route of HIV transmission				4.790	0.310
Homosexual sexual behavior	155 (79.1)	87 (81.3)	68 (76.4)		
Heterosexual sexual behavior	19 (9.7)	8 (7.5)	11 (12.4)		
Bisexual sexual behavior	10 (5.1)	5 (4.7)	5 (5.6)		
Other ^a	2 (1.0)	0 (0.0)	2 (2.2)		
Unknown	10 (5.1)	7 (6.5)	3 (3.4)		
Duration of ART in months (mean [SD])	16.8 (23.0)	15.3 (19.1)	18.5 (27.0)	0.912	0.363
ART regimen ^b				0.432	0.806
First line	157 (80.1)	87 (81.3)	70(78.7)		
Second line	17 (8.7)	8 (7.5)	9 (10.1)		
Other	22 (11.2)	12 (11.2)	10 (11.2)		

Table 2 (continued)

Characteristic	Needed ARVs	Failed to access ARVs	Successfully accessed ARVs	χ^2/t	
	(N = 196) N (%)	(N = 107) N (%)	(N = 89) N (%)		<i>P</i>
CD4 cell count (mean [SD])	456 (188)	481 (186)	427 (186)	1.983	0.049
Viral load suppression (N = 80)	68 (85.0)	38 (86.4)	30 (83.3)	0.004	0.950
7-day ARV adherence	177 (90.3)	95 (88.8)	82 (92.1)	0.299	0.585

^a: Other refers to blood transfusion, occupational exposure or mother-to-child transmission

^b: First-line: TDF (Tenofovir)/AZT (Zidovudine)+3TC (Lamivudine)+EFV (Efavirenz)/NVP (Nevirapine); second-line: TDF/AZT + 3TC + LPV/r (Lopinavir/Ritonavir), AZT + TDF + 3TC + LPV/r

Table 3 Awareness of ARVs-related services amongst participants who needed ARVs and the association between awareness and ARV accessibility

Awareness of ARV-related services during the COVID-19 pandemic	Needed ARVs (N = 196) N (%)	Failed to access ARVs (N = 107) N (%)	Successfully accessed ARVs (N = 89) N (%)	OR _u (95% CI)	OR _a (95% CI) ^a
Drug-borrowing service	175 (89.3)	91 (85.0)	84 (94.4)	2.95 (1.10, 9.35) [*]	3.86 (1.31, 13.58) [*]
Drug-delivery service	177 (90.3)	93 (86.9)	84 (94.4)	2.53 (0.92, 8.10)	2.47 (0.85, 8.34)
Information-assistance service	169 (86.2)	88 (82.2)	81 (91.0)	2.19 (0.94, 5.55)	3.62 (1.32, 11.82) [*]
Knew about at least one of the above services	181 (92.3)	97 (90.7)	84 (94.4)	1.73 (0.59, 5.75)	1.62 (0.51, 5.76)
Knew about at least two of the above services	176 (89.8)	92 (86.0)	84 (94.4)	2.74 (1.01, 8.72)	3.24 (1.10, 11.31) [*]
Knew about all of the above services	164 (83.7)	83 (77.6)	81 (91.0)	2.93 (1.29, 7.31) [*]	5.25 (1.95, 16.97) ^{**}

P* < 0.05; *P* < 0.01

^a: Factors for which *P* < 0.1 in Table 2 were adjusted, including gender, movement restrictions in the city/county during the COVID-19 pandemic and CD4 cell counts

Less than half of the patients undergoing ART during the COVID-19 pandemic opted for the drug-delivery or drug-borrowing services, with the drug-delivery service showing the highest utilization rate (39.3%). To increase confidentiality for PLWH, the Chinese AIDS NGO Red Ribbon has played a major role in assisting with the implementation of ARVs-related services. However, the drug-delivery service is also a major challenge for patients undergoing ART, due to the stigma caused by the potential for their HIV status to be leaked locally [22]. In China, PLWH may be stigmatized and subjected to discriminations from family members, health-care providers, and others if their HIV-positive status was disclosed unintentionally [27, 28]. Moreover, PLWH concerns that their family members may be stigmatized because of being related to them. Therefore, they may not disclose their HIV status to others to avoid anticipated stigma [29]. However, utilizing drug-delivery service may increase the risk for the disclosure of their HIV status, especially during the Chinese New Year when patients return to their hometowns to stay with their families. Therefore, the concerns regarding disclosure and stigma may be a reason for the low utilization rate of drug-delivery service. Utilization of the

drug-borrowing service was only 4.5%, which may also be related to potential stigmatization, in addition to COVID-19-related travel restrictions. It is, therefore, important to safeguard patient privacy and reduce the potential for stigmatization in the provision of ART-related services.

In addition, in the midst of a public health emergency, the complete restrictions of movement, leading to widespread courier shutdowns and travel restrictions, may disrupt drug-delivery and drug-borrow services. Enabling patients to access ARVs, while protecting their privacy, remains a challenge. New methods for the confidential supply of medicines are worth exploring. During the COVID-19 pandemic, a number of HIV-focused civil society organizations played a major role in contingency planning for HIV-positive patients [30]. They mobilized volunteers and partners quickly through regional networks to help people affected by COVID-19, ensured continuity of ART and delivered interventions online. For example, civil society networks in the Philippines worked with health institutions and local authorities to safeguard patient information, while successfully delivering drugs to the patients [31]. In our study, the financial burden may not be a main barrier for the utilization

of ARVs-related services as patients could use these services at a minimal cost. However, the cost of using ARVs-related services need to be concerned in other regions or countries. To prepare for future pandemics, service delivery to HIV-positive patients needs to be modernized, with increased dedicated funding [32] and strengthened collaborations with civil society organizations to scale up community responses and leverage the power of communities to provide the necessary services [33].

There are several limitations of this study that warrant mention. First, this study was conducted only in Guangzhou (moderate-level epidemic) and may not represent the national situation. Second, the cross-sectional design did not allow conclusions to be drawn about causality, and only association between the awareness of ARVs-related services and the accessibility of ARVs were determined. Thus, the results should not be overinterpreted. Additionally, the reasons for the difficulties in accessing ARVs during the COVID-19 pandemic remain unknown and thus require further investigation.

Conclusion

In summary, the effect of the COVID-19 pandemic on ART maintenance was found to be significant, with more than half of the surveyed patients not receiving their ARVs. The emergency measures taken by Guangzhou Eighth People's Hospital were effective, but the service awareness rate requires further improvement. In addition, we found that the awareness of ARVs-related services was positively correlated with the accessibility of ARVs, especially the awareness of the drug-delivery service, which facilitated access to ARVs. However, the drug-delivery service was still underutilized due to potential stigmatization. These results may help provide recommendations for ART maintenance during future pandemics in China and other countries. Further exploration of ART-related service modes to implement during major public health crises is warranted to ensure that patient privacy is protected and ART continuity is maintained.

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Data Availability Not applicable.

Code Availability Not applicable.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethics approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This study was approved by the Institutional Review Board (IRB) of the School of Public Health, Sun Yat-sen University, Guangzhou, China.

Consent to participate Not applicable.

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