

ORIGINAL ARTICLE

Factors associated with knowledge about ‘Undetectable HIV viral load is Untransmittable’ among Zambian adults on antiretroviral therapy: a mixed method approach

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Abstract

Background: Knowledge of ‘Undetectable HIV viral load (VL) is Untransmittable’ (U=U) motivates optimal adherence to antiretroviral therapy (ART).

Objective: This study assessed factors associated with knowledge about U=U among Zambian people living with HIV on ART.

Design: The study used questionnaires and in-depth interviews (IDIs) concurrently between December 2018 and January 2019. Three high volume health facilities, Chilenje, Chipata, and Kalingalinga, were selected. A single proportion of 63.4% of HIV VL suppression (VLS) in Lusaka Province was used to calculate a sample size of 362 respondents. Probability proportional to size procedure was used to apportion the sample to the study sites while a simple random technique was employed in selecting respondents aged 18–59 years and on ART for over 9 months. Stata 14 was used to run descriptive and chi-square statistical analyses. Fifty-five respondents were drawn from 362 respondents for IDIs. The selection was based on varied VL levels. Interviews were audio-recorded, transcribed and analysed thematically, and the findings merged in the discussion.

Results: Approximately, 34.5% of the 362 respondents ($n = 125$) had knowledge about U=U. The VLS status was significantly associated with U=U knowledge ($P = 0.01$).

Discussion: Diverse information sources, symbiotic understanding of VL, and treatment-as-prevention benefits were enablers of acquiring more knowledge about U=U, while inadequate health discussion about VL and congestion and waiting time were barriers.

Conclusions: The findings suggest that increased information sharing on the implication of suppressed VL being able to prevent HIV transmission could motivate people living with HIV to adhere to ART, thus sustaining VLS.

Keywords: *human immunodeficiency virus; knowledge; antiretroviral therapy; viral load; sustained virologic response; transmission; Zambia*

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Globally, individual countries are striving to attain the 90% viral load suppression (VLS) goal by 2020 (1). According to the Joint United Nations Programme on HIV/AIDS (UNAIDS), attaining population level VLS would halt new human immunodeficiency virus (HIV) transmissions, thereby ending acquired immunodeficiency syndrome (AIDS) by 2030 (2). A number of countries have not yet attained this goal (3). Factors that affect optimal adherence to antiretroviral therapy (ART) include beliefs and knowledge held by people living with HIV (PLHIV), pill burden, client and provider interface, and health facility related factors. To attain optimal adherence, the World Health

Organization (WHO) recommends that adults living with HIV (ALHIV) must be made aware that when they attain VLS, they cannot transmit HIV to HIV uninfected sexual partners (1, 4, 5). This forms the basis of the campaign termed ‘Undetectable equals Untransmittable’, commonly denoted as “U=U” or ‘Treatment as Prevention’ (TasP) (6). The WHO envisions that when adults have knowledge about U=U they will be motivated to adhere to ART optimally for VLS (7). This study thus sought to assess knowledge on U=U among ALHIV on ART, including enablers and barriers affecting acquisition of knowledge of U=U in Lusaka, Zambia.

Background

In 2017, Zambia had 89.2 and 63.4% PLHIV aged 15–59 years who attained VLS at national level and in Lusaka Province, respectively (8, 9). At the same time, Lusaka District recorded 89,489 cases of PLHIV who were inactive on ART, with 64,154 being lost to follow up and 58 having stopped ART, as previously identified (10). These cases contribute to sub-optimal ART adherence (11), with subsequent viral load (VL) rebound and further HIV transmission (12), thereby stalling achievement of the third 90% goal to control HIV infections and end deaths due to AIDS by 2030 (13, 14). It has been well investigated that sustained adherence to ART halts sexual transmission of HIV (5, 15) and that this can be achieved by PLHIV being motivated to take ART (7, 16–18). Schaefer et al. (13) state that knowledge is a motivation for effective HIV prevention intervention (13, 15). Lack of knowledge about U=U could thus pose a great hurdle to optimal adherence and VLS especially among asymptomatic PLHIV.

Symptomatic PLHIV are motivated to initiate and adhere to ART because they aim to restore their health (19), while the motivation for asymptomatic PLHIV is having undetectable VL (3, 15, 20). Ultimately, whether the reason to initiate ART is to restore health or suppress VL, optimal adherence to ART is the means to both (21).

A literature review found limited publications reporting discordant couples opting for U=U as a measure to prevent the uninfected sexual partner from HIV infection (15). In Australia, activists embarked on a community-level campaign on U=U and TasP to increase optimal adherence to ART among homosexual and heterosexual couples (16). A study across 25 countries showed 66.5% PLHIV reported ever discussing U=U with their healthcare providers (22). A study conducted in South Africa, however, found that sexual partners (23%) in discordant or HIV unknown status relationships were motivated to take ART to protect their partners from HIV infections (23). A recent study in Eswatini found that asymptomatic PLHIV felt motivated to adhere to ART when their VL declined (3). A study conducted in 2015 found limited understanding of U=U and TasP in Zambia (19).

A decision to adopt an HIV prevention intervention is determined by a number of factors, of which knowledge about a prevention method and its risks and benefits are key (13). When PLHIV have knowledge of U=U, it could influence their adherence to ART, VLS, and thus curb new HIV infections. Reduced risks of HIV sexual transmission could be successful when there is more support and education to encourage discordant couples to use the U=U strategy (16). Increased availability of routine VL testing and effective communication of suppressed VL test results would also motivate optimal adherence, which

would halt upstream new HIV infections at population level (3, 17, 24).

Suggestions from the few published studies on minority populations indicate that disbelief, misinformation and lack of awareness are barriers to acquiring knowledge and acceptability of U=U (25, 26). Sustained adherence and routine VL testing increased knowledge about U=U (25), whereas in general population discussions on U=U between healthcare provider and client showed better health outcomes (22). In Zambia and South Africa, a study of community-based TasP strategy observed reduced HIV incidence in sites that were initiating PLHIV on ART following standard guidelines, in comparison to sites that were immediately initiating PLHIV on ART and control sites (27, 28). The reduced HIV incidence was not associated with knowledge of U=U. This study aimed to highlight knowledge of U=U, including enablers and barriers affecting acquisition of knowledge of U=U, in Lusaka, Zambia.

Methods

Study site

The study was conducted between December 2018 and January 2019 in three high volume public health facilities: Chipata and Chilenje hospitals and Kalingalinga clinic, with a total catchment population of 25,982 PLHIV on ART. Site selection was based on the short turnaround time (approximately less than 2 weeks) of VL test results (29).

Study design

Quantitative and qualitative methods were used concurrently, consisting of survey questionnaires and in-depth interviews (IDIs). A mixed method approach was applied to get deep understanding of factors affecting acquisition of knowledge of U=U.

Quantitative methods

Sampling techniques. We used the single proportion formula (30) with 63.4% prevalence of suppressed VL in Lusaka Province to calculate the sample size ($n = 362$) of respondents. The respondents included those who started ART before and after August 2016 when scaling up of the 'Test and Treat' (TT) policy (early initiation of ART after HIV diagnosis) started (31).

$$S = \frac{(z^2) \times p \times (1 - p)}{(e^2)}$$

The z -value is found in a Z table.

' S ' is the sample size to be determined

' e ' is the margin of error for the desired level of precision at 0.05 (5%)

' p ' is the estimated proportion of the population at 0.634

' q ' is the difference between estimated proportion of the population and 1, which is 0.366

' Z ' is value or score at 1.96 obtained from the Z Table

We apportioned the sample using probability proportional to size with the following distribution [Kalingalinga 27.6% (100/362), Chipata 47% (170/362), and Chilenje 25.4% (92/362)]. Respondents were aged 18–59 years of age and selected using a simple random technique; each day at a respective health facility, 40 potential respondents were assigned numbers from 1 to 40, where a raffle of 20–25 numbers was drawn from a box to select respondents. This took 5–10 days at each facility until the apportioned number was attained. The respondents also needed to satisfy the criterion of having been on ART for over 9 months. A person on ART for 9 or more months is likely to attain VLS. Duration on ART was verified with the respective health facility's electronic health records called SmartCare (32, 33) using respondent SmartCare cards.

Data collection method. Primary data were collected using hard copy questionnaires administered by a research assistant, which comprised social demographic, knowledge of U=U (did you know that 'Undetectable HIV viral load is Untransmittable?'), and the year they started taking ART. The VL data were obtained from respective ART health facility SmartCare databases. The latest VL within the 9-month period was recorded. The data were retrieved with assistance of a data clerk from respective health facilities.

Data management and analysis. Data were categorised, coded, cleaned and entered using Stata 14 (StataCorp, College Station, TX, USA). The VL threshold of <1,000 copies/mL was used to categorise VL status (7). We ran descriptive analyses on socio-demographics and knowledge about U=U and reported frequencies and percentages. The chi-square test was performed to assess the association between socio-demographic factors and knowledge of U=U. These were reported using frequencies, percentage, and P -value for statistical significance.

Qualitative methods

Sampling technique. Fifty-five respondents were purposively selected from the survey, based on whether they had suppressed or unsuppressed VL. Respondents were selected during each interview by retrieving and assessing the responses to the VL survey while the interview was being conducted.

Data collection method. Unstructured interview schedules were used. The selected respondents took part in the IDIs immediately after the survey interview. Questions included which factors contributed to having knowledge or not having knowledge of U=U and VL. Interviews were audio recorded and follow up notes were written in notebooks. Spontaneous unstructured observations were

conducted and recorded in notebooks during group adherence counselling sessions in the ART clinics and at the ART dispensaries in the respective health facilities.

Data management and analysis. Microsoft Office Word (Microsoft, Redmond, WA, USA) was used to write up field notes, unstructured observation notes, and to transcribe and translate audio-recorded interviews from local languages to English. Notes and transcripts were combined. Thematic analysis was used by identifying codes, which were summarised to form themes. The themes were aligned with quotations from respondents. The quantitative and qualitative findings were merged in the discussion to enhance understanding.

Ethics approval and consent to participate

Ethics approval was sought from the Bioethics Committee of the University of Zambia Reference No. 038-09-18, authorised by the National Health Research Authority Zambia and the Zambian Ministry of Health. Informed consent was obtained from all respondents and confidentiality was assured and upheld.

Results

The results include both the quantitative and qualitative, presented separately. The quantitative results are presented first.

Quantitative results

The quantitative results are presented under themes. These consist of social demographic information and knowledge on U=U and factors associated with knowledge of U=U.

Socio-demographic information and knowledge of 'Undetectable equals Untransmittable'

Respondents ($n = 362$) were aged 18–59 years old (mean age of 38.5 years, standard deviation of 9.6 years), with 144 (39.8%) aged 34–44. Approximately 56.6% of respondents were women ($n = 205$) while 157 (43.4%) were men. Those who had attained primary educational level were 127 (35.2%), while those who initiated ART before scaling up of the TT policy in August 2016 were 213 (58.7%). A total of 125 (34%) respondents had knowledge of U=U and 237 (65.5%) had no knowledge of U=U. Across all socio-demographic information, only those in the unsuppressed VL category had over 50% knowledge on U=U as shown in Table 1.

Those who had attained primary educational level were 127 (35.2%), while those who initiated ART before scaling up of test and treat policy in August 2016 were 213 (58.7%). A proportion of 125 (34%) respondents had knowledge on U=U and 237 (65.5%) of them had no knowledge on U=U. Across all the social demographic information, only those in the unsuppressed VL category had over 50% knowledge on U=U (Table 1).

Table 1. Socio-demographic information and factors associated with knowledge of ‘Undetectable equals Untransmittable’

| Socio-demographic factors | Total N = 362 (%) | Knowledge N = 125 (%) | No knowledge N = 237 (%) | X ² | P |
|---------------------------------|-------------------------|-----------------------------|--------------------------------|----------------|------|
| Age | | | | | |
| 18–24 | 35 (9.7) | 17 (48.6) | 18 (51.4) | 6.9 | 0.13 |
| 25–34 | 85 (23.5) | 33 (38.8) | 52 (61.2) | | |
| 35–44 | 144 (39.8) | 47 (32.6) | 97 (67.4) | | |
| 45–54 | 84 (23.2) | 22 (26.2) | 62 (73.8) | | |
| 55–59 | 14 (3.9) | 6 (42.9) | 8 (57.1) | | |
| Sex | | | | | |
| Men | 157 (43.4) | 56 (35.7) | 101 (64.3) | 0.2 | 0.69 |
| Women | 205 (56.6) | 69 (33.7) | 136 (66.3) | | |
| Education | | | | | |
| Primary school | 127 (35.2) | 44 (34.7) | 83 (65.3) | 2.2 | 0.33 |
| Junior secondary | 79 (21.8) | 20 (25.3) | 59 (74.7) | | |
| Senior secondary | 97 (26.7) | 36 (37.1) | 61 (62.9) | | |
| Tertiary | 59 (16.3) | 25 (42.4) | 34 (57.6) | | |
| Residence | | | | | |
| Live within facility catchment | 129 (35.5) | 53 (41.1) | 76 (58.9) | 3.8 | 0.05 |
| Live outside facility catchment | 233 (64.5) | 72 (30.9) | 161 (69.1) | | |
| Viral load status | | | | | |
| Suppressed | 328 (90.6) | 106 (32.3) | 222 (67.7) | 7.6 | 0.01 |
| Unsuppressed | 34 (9.4) | 19 (55.9) | 15 (44.1) | | |
| Period initiated on ART | | | | | |
| Before 08/2016 ‘TT’ Policy | 213 (58.7) | 80 (37.6) | 133 (62.4) | 2.1 | 0.15 |
| After 08/2016 ‘TT’ Policy | 149 (41.3) | 45 (30.2) | 104 (69.8) | | |

Factors associated with knowledge of ‘Undetectable equals Untransmittable’

Table 1 also shows that only VL status had a statistically significant association with knowledge of U=U ($P = 0.01$). There was a statistically insignificant association between those who started ART before or after the scaling up of TT and knowledge of U=U ($P = 0.15$).

Qualitative results

The presentation of qualitative results is structured as factors enabling and barring acquisition of knowledge of U=U. Table 2 shows the structure of the results in a thematic framework.

Enablers of knowledge about ‘Undetectable equals Untransmittable’

Diverse information sources. There were various sources of knowledge on U=U that were mentioned by those with knowledge of U=U. Apart from the ART clinic in health facilities, alternative sources of information about

Table 2. Thematic framework for qualitative results

| Themes | Sub-themes | Codes |
|-----------------|-----------------------------------|--|
| Enablers | –Diverse information sources | – Friends LHIV |
| | –Symbiotic understanding of VL | – Discordant relationship |
| | | – Internet |
| | | – Radio programme |
| | | – Health worker |
| | | – Adherence counselling |
| | | – Adolescent health clubs |
| | | – HPTN 071 study* |
| | –Treatment-as-prevention benefits | – Address stigma/discrimination |
| | | – Health sexual relationship |
| Barriers | –Inadequate health talk on VL | – Emphasis on CD4 count: |
| | | – Limited interaction with health discussion |
| | | – Perceived risks of U=U |
| | | – Presumption of VL suppression |
| | – Congestion and waiting time | – Access to VL results |
| | | – Limited interaction with health services |
| | | – Extended fast truck visits |

*HPTN 071 Study, Population Effects of Antiretroviral Therapy to Reduce HIV Transmission (PopART): A cluster-randomised trial of the impact of a combination prevention package on population-level HIV incidence in Zambia and South Africa (19, 34).

U=U existed. These included self-education, internet, radio, spouses, friends, parents, adolescent health clubs, the household HIV testing and early ART initiation intervention study (HPTN 071). Learning by being in a discordant sexual relationship with a partner on ART was another stated source of U=U information. Despite taking the risk, partners who tested HIV negative on several occasions intuited that HIV cannot be transmitted when adherent to ART. A male respondent shared that:

‘I have journalism background, so, I came to know about undetectable viral load is not transmittable through self-education. That is how I came to know that with my 34 plus viral load I cannot be able to transmit HIV to a sexual partner, the chances are rather very slim. I learned about this through my own research on the internet using my mobile phone. It is important that people know about that, to have the information. As the Holy Scriptures says: “that due to lack of information my people perish”’. (Male, 55-year-old, VL 34 copies/mL)

Those in the age group 18–24 years learnt about U=U at adolescents’ ART clubs they attended. In respondents aged 55–59 years, some attributed knowing about U=U to being in a discordant sexual relationship. Respondents

who had attained tertiary education cited having learned about U=U through self-education on the internet and reading. Those respondents living within the facility catchment had the most interaction with health education sessions:

‘I knew about Treatment-as-Prevention at an adolescent group meeting. At the adolescent group we are urged to ask about our viral load, everyone should know about it’. (Female, 19-year-old, RNA 0 copies/mL)

Symbiotic understanding of viral load. Although the information on U=U was obtained from difference sources, it was coherent. The understanding of U=U was comprehensively demonstrated. Respondents explained how with an undetected VL, they could not transmit HIV to uninfected sexual partners. Understanding the implication of having a suppressed VL supported the fulfilment of conjugal rights without worry among discordant couples. The VLS non-transmission potential to avert new HIV infections was also clearly expressed. A female shared her insight:

‘My husband is HIV negative and he was told by his friend, a [medical] doctor that he cannot get infected if my viral load is undetectable. So sometimes we do not use condoms, and my viral load is undetectable though it is him who insists not to use condoms most of the time’. (Female, 44-year-old, VL 0 copies/mL)

Treatment as prevention benefits. The respondents with knowledge of U=U stated that they initiated ART because they were motivated by its TasP effect, which encouraged them to adhere well. They explained that the benefits of ART in a sexual relationship are similar to those of prevention of mother to child transmission. Because of that, asymptomatic adults and young PLHIV said they achieved VLS after years of defaulting. An adolescent shared:

‘I had stopped taking ART. I thought that I was the only one taking them. That is why I think my viral load was high. I continued disrupting treatment not until I joined a support group in 2017. That is where I learned about Treatment-as-Prevention. It encouraged me to stick to treatment’. (Female, 18-year-old, VL 40 copies/mL)

Knowledge of U=U also has the potential to reduce perceived stigma and to reduce discrimination among discordant couples. Asymptomatic respondents, who had disrupted ART for various reasons, resumed ART because of it. However, among those who did not know of the TasP benefit some felt that they missed out on the information, as explained here:

‘My husband does not give me peace; he complains all the time. He is HIV negative and I am HIV positive, he has even shifted from our home to that of his girlfriend. Maybe if we knew earlier on that being on ART prevents HIV infection, he would not have left’. (Female, 30-year-old, VL 59 copies/mL)

Barriers to knowledge about ‘Undetectable equals Untransmittable’

Inadequate health discussion on viral load

Emphasis on CD4 Count. There was a dearth of understanding on what VL is among the respondents, and they had more knowledge of CD4 count. Limited VL knowledge was attributed to inadequate health discussion on the implication of unsuppressed VL on HIV transmission. Among others, a respondent stated that:

‘The doctors tell us about CD4 cell count and do not tell us about viral load. That is why we do not know much about ART as prevention for HIV. They would say much about CD4 cell count and full blood count but not viral load, and how it works to prevent HIV infections’. (Male, 34-year-old, VL 0 copies/mL)

Limited interaction with health discussion. Some respondents came from outside the ART health facility catchment areas. The distance to get to the health facilities limited their time to interact with health services. When health education sessions were held, they either missed them or had less time to attend. A male respondent stated:

‘Vital signs are taken whatever time you come here. But inadequate and restricted contact and time with psychosocial counsellors make some of us miss out on lots of information. I come from far and have to go for work to get permission before coming here. By the time I reach, some activities have been done. It is rare that I attend sensitisation meetings’. (Female, 28-year-old, VL 0 copies/mL)

Perceived risks of ‘Undetectable equals Untransmittable’. Respondents indicated that knowledge of U=U should be spread at population level, however, some stated otherwise. They perceived increasing community knowledge of U=U as a risk for continued spread of HIV as opposed to prevention. They also felt it could expose people to sexually transmitted infections as they could become irresponsible and stop using condoms. This is what one of the respondents observed:

‘People should not know about using ART as a form of HIV prevention because they could become

careless and immoral. They will be sleeping around... and get other infections'. (Female, 37-year-old, VL 19 copies/mL)

Presumption of viral load suppression: Additionally, as VL results were not routinely shared with clients, some of them assumed they had attained VL suppression. This was because they felt better after initiating ART, though they had a very high VL. A respondent stated his conviction that:

'I know that if you have suppressed your viral load, you cannot infect someone sexually and I think I have a suppressed viral load. Because I take ART very well. So, what I do is that if my CD4 count is high then I know that my viral load is low. I think it is easier to understand CD4 cell counts'. (Male, 22-year-old, VL 525,432 copies/mL)

Congestion and waiting time

Accessing viral load results. ART facilities had a huge flow of clients, which deterred some respondents from knowing their VL results. Congestion restricted time to share viral load results with clients as healthcare providers were busy with routine tasks, thus restricting follow up of results. Waiting made respondents tired and in a hurry to leave. A respondent attested that:

'They took blood before from me but never told me my viral load. Today they drew blood again, I hope they tell me the results next time I come. I do not have much time to wait on the queue. I stay far. It is better I join a fast-track group [differentiated service delivery]'. (Male, 36-year-old, VL 59 copies/mL)

Extended fast track visits. The health facilities implemented their own service delivery, using various models of transport. Fast tracking is one such model. It entails stable clients, during the 3 months before their next clinical review, visiting the facility to refill their ART drugs without having to wait in a queue, thereby reducing the huge flow of clients. They received assistance with adherence in order to preserve stability. Informal observations revealed that some clients missed VL test appointments. Missing routine VL tests limited them knowing their VL status. Some extended their fast-track visits beyond schedule by repeatedly sending buddies to collect drugs for them as elaborated in a chat here:

Healthcare worker: 'Where is the client? She is due for long visit'. (to see a clinician) [HCW asked a buddy while checking in the electronic database]

Buddy: 'She is at home busy with some chores'.

Healthcare worker: 'She is due to see the doctor and viral load testing. Tell her to come or next time we will not give you drugs. I have noticed an increasing number of short visits'. HCW telling a colleague]

Discussion

The HIV VL suppression in the study sites was found to be higher than that of Lusaka Province (90.6% vs. 63.4%) (9). Only a third of PLHIV with VL suppression had knowledge of U=U, which is a small proportion. This concurs with findings from a notable qualitative research, which reported a lack of understanding of U=U among community members with various HIV status in Zambia and South Africa (19). In the same vein, the unknown HIV VL load burden indicated in these findings could relate to an unexplained risk factor undermining the population level U=U intervention to curb new HIV incidents, despite progressive records of VL suppression (24, 35).

Prior to the evidence of U=U, in 2006, studies in Tanzania and Mozambique indicated similar proportions of knowledge of the perceived reason for taking ART, 35.3 and 22.8%, respectively (35). Moreover, 67.9 and 85.9% reported all PLHIV should be initiated on ART in Tanzania and Mozambique, respectively, an implication of TT. Withal, the study found below average (50%) knowledge levels of U=U across different socio-demographics, even among those with a higher education level. This indicates that the knowledge of U=U is scarcely spread, although currently, in 25 countries including one African country (South Africa), about 60.1% of adults prioritised TasP for their sexual partners (22), which is an indication of U=U knowledge. This means that there is an increase in knowledge of U=U, but again, the context is too wide to base the comparison on, and it comprised more than two-thirds of developed countries.

There is limited explicit health education on U=U provided at the health facilities. Those who accessed U=U knowledge through other means did so using their own initiative. Most respondents attained primary school level of education, which spells illiteracy to comprehend concepts of U=U unless aided by health providers. It was unanticipated that those with tertiary education level had low knowledge of U=U, which echoes similar findings in a recent study across 25 countries (22). This is contrary to findings that higher education is a determinant of good knowledge on ART (36). Another surprise is the low knowledge of U=U among women, because women interact with the ART services including at antenatal clinics more than men. Perhaps this could imply the general low health literacy on the prevention of sexual transmission of HIV through U=U.

Although quantitative findings indicated low knowledge on U=U, there were various sources of knowledge on U=U that PLHIV had access to. This indicates that people are not waiting on the mainstream ART health facilities to provide information on U=U. However, these sources are thinly distributed at population level. This makes a case for intensifying and widening health education using the already existing channels that PLHIV are using to access information. This would empower them with knowledge on U=U. These findings further speak to already existing evidence that there are many sources of information on ART (35). The Australian health literacy study demonstrated the feasibility of conducting community level sensitisation to increase knowledge on U=U (16).

Thus, the 'Ending AIDS Zambia' initiative ought to devise ways (37) to comprehensively increase knowledge of U=U to counter potentially inaccurate information as there are many sources of knowledge of U=U. Notably from the findings, and as agreed by other analysts, HIV VL results are a basis for knowledge on U=U. Hence, access to and coherent understanding of viral load should be inevitable (17, 24, 38, 39).

The prerequisite for knowledge of U=U is the information about one's VL test results, for which access to results is a challenge in Zambia (8). These findings confirm the gap of knowing VL results among PLHIV. However, the huge menace is among those with unknown and unsuppressed HIV VL, which poses a possible source for new HIV infections. Access to HIV VL results for all PLHIV on ART is fundamental for effective utilisation of the results regardless of the amount of VL, and for attaining VL suppression (38), with the gap existing more in VL utilisation at client level.

Besides that, health facilities grapple with space, time and human resources to meet the demand for health education (4), thus other means of providing health education on U=U ought to be devised (37). The findings explicitly agree with the Bavinton et al. (14) study in Australia where a community level campaign increased knowledge of U=U, and the lesson could be learned from such a proactive intervention (16).

According to Schaefer et al. (13), knowledge is one of the factors required to decide which HIV prevention measure one practises and that is dependent on the motivation and benefits. In a recent literature review, findings on TasP in advanced countries by Hollingdrake et al. (15) and by Kim et al. (23) indicated that some people were motivated to opt for TasP to prevent their partners from acquiring HIV infections. It is obvious that the choice to use TasP as an HIV prevention measure was based on an informed decision, although the studies did not assess the knowledge of U=U. However, our findings indicate high proportions of PLHIV on ART lacking knowledge of U=U. Choosing a conventional HIV prevention mode should be

based on available information or knowledge (13). Thus, low numbers of PLHIV opting for U=U implies that less knowledge of U=U is shared with PLHIV on ART. The findings also indicate that attaining VL suppression cushions tensions among discordant couples.

However, those with suppressed VL had less than 50% knowledge of U=U compared with those with unsuppressed VL, which means those with unsuppressed VL were targeted for health talks on adherence (40). Mukumbang et al. (41) stated that differentiated service delivery is designed to promote adherence through health literacy and counselling (41), and Schwartz et al. (42) reiterate similar remarks but emphasise that proper interpretation of VL results must be provided to all PLHIV (42). Tsondai et al. (43) also observed that differentiated service delivery gives hope of offering long-term ART to stable patients and relieve health facilities of burden (43), while also noting that young people were likely to be lost to follow up and have a viral rebound, the same as patients from health facilities with huge cohorts implementing differentiated service delivery. This implies that vital health literacy such as U=U, which motivates adherence should be intensively provided to all PLHIV regardless of VL status.

The qualitative findings further indicate that some PLHIV who knew their HIV VL results and the implication in terms of transmission were motivated to adhere to ART. This reflects the assertion by Horter et al. (3) that when PLHIV receive effective communication regarding their progression of HIV VLS they get motivated to adhere to ART. It is of particular note among asymptomatic clients because the tangible and immediate benefit they obtain from taking ART is VLS, and not restoration of health since they initiated ART while healthy (3). These findings emphasise client-centred communication to include a symbiotic explanation of HIV VL results with regard to HIV prevention, which is vital to increase ART uptake (7).

It has been noticed by other studies that distance, space and time limit interactions between patients and health education (43, 44). The qualitative findings show that low sensitisation and misconceptions on U=U contributed to inadequate knowledge on U=U despite two-thirds attaining HIV VLS. This confirms observations in a study by Renju et al. (45), which concluded that healthcare workers prioritised HIV VLS for their clients regardless of whether had knowledge about ART medication. However, challenges affecting efficient delivery of health services in the advent of HIV/AIDS have been well documented, and congestion and waiting time is one of them (46, 47). The qualitative findings attest that those who resided outside the catchment area of the ART facilities had less interaction with health services. This implies limited exposure to interact with health education on U=U, although it was infrequently offered.

Tsondai et al. (43) insights resonate with the qualitative findings and health facility context in our research. Observations revealed that some clients were missing VL testing and clinical appointments and would instead ask their buddies to collect ART drugs on their behalf. Others assert that even though the differentiated service delivery models capably facilitate decongestion of facilities (47, 48), there lies a potential challenge in tracking clients for routine VL, monitoring and retention failure. Our findings are in tandem with recent observations in Zambia, recommending improvement on differentiated service delivery due to gaps in follow up and delays in VL testing (49). Another study recorded adverse clinical outcomes among PLHIV in the long-term supply of the ART model (6). Therefore, proactive surveillance could be devised to trace occurrences of HIV VL burden caused by clients missing scheduled VL tests and clinical appointments.

Knowing VL test results for PLHIV not only assists the clinician to monitor treatment outcomes for clients but also motivates adherence to ART, which is the ultimate goal. If PLHIV are motivated to adhere to ART then better treatment outcomes are obvious (3). As noticed earlier, access to health services such as health education was limited by congestion and waiting time. Therefore, intensified health literacy on HIV VL knowledge by allocating ample time to effectively share individual VL results would increase optimal adherence among ART clients (3).

The findings also agree with Horter et al. (3) and Schwartz et al. (42), in that participants with comprehensive knowledge of TasP reported that they were motivated to adhere to ART, while those who did not know about their VL did not appreciate TasP. However, echoing observations by Tsondai et al. (43), the longer a patient is on ART more likely they are to disrupt ART. Efforts are therefore required to increase knowledge of U=U to motivate PLHIV on ART to sustain and adhere to treatment and to encourage asymptomatic PLHIV to link to care.

It was anticipated that initiation of ART after 2016 post the TT policy would have a statistically significant association with knowledge of U=U. This is because after the 2016 TT policy, there was an increase of health facility level interventions to initiate PLHIV on ART aimed at population level VL suppression. This reflects global level findings by Okoli et al. (22), where there was no significant difference in healthcare provider and client discussions on U=U knowledge between those who initiated ART before and after 2017.

Our findings echo the Horter et al.'s (3) study, except that our findings show that PLHIV testing for HIV VL without knowing the results and the implication for HIV transmission is counterproductive to acquiring knowledge on U=U. By and large, to motivate PLHIV to sustain optimal adherence to ART and VLS, knowledge on

U=U must be scaled up through the identified enablers and other innovative approaches by addressing barriers affecting acquisition of the information at health facility level.

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