



Qualitative Thematic Analysis of Social Media Data to Assess Perceptions of Route of Administration for Antiretroviral Treatment among People Living with HIV

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Abstract

Background HIV is a condition that requires lifelong treatment. Treatment options currently consist of oral antiretroviral therapies (ART) taken once or twice daily. Long-acting injectable HIV treatments are currently in development to be administered monthly or every other month. Preferences for route of administration could influence treatment adherence, which could affect treatment outcomes. The purpose of this study was to examine patient perceptions of oral and injectable routes of administration for ART.

Methods Qualitative thematic analysis was conducted to examine 5122 online discussion threads by people living with HIV (PLHIV) in the POZ Community Forums from January 2013 to June 2018. Analysis focused on identifying perceptions of oral or injectable routes of administration for ART. Relevant threads were extracted and imported into the qualitative data analysis software package ATLAS.ti.8 so that text could be reviewed and coded.

Results Analyses identified 684 relevant discussion threads including 2626 coded quotations from online posts by 568 PLHIV. The oral route of administration was discussed more frequently than injectable (2516 quotations for oral; 110 injectable). Positive statements on the oral route of administration commonly mentioned the small number of pills (276 quotations), dose frequency (245), ease of scheduling (153), and ease of use (146). PLHIV also noted disadvantages of the oral route of administration including negative emotional impact (166), difficulty with medication access (106), scheduling (131), and treatment adherence (121). Among the smaller number of PLHIV discussing injectable ART, common positive comments focused on dose frequency (34), emotional benefits of not taking a daily pill (7), potential benefits for adherence (6), overall convenience (6), and benefits for traveling (6). Some comments from PLHIV perceived the frequency of injections negatively (10), and others had negative perceptions of needles (8) or appointments required to receive injections (7).

Conclusions Qualitative analysis revealed that route of administration was frequently discussed among PLHIV on this online forum. While many expressed positive views about their daily oral medication regimen, others perceived inconveniences and challenges. Among PLHIV who were aware of a possible monthly injectable treatment, many viewed this new route of administration as a convenient alternative with potential to improve adherence.

1 Introduction

Human immunodeficiency virus (HIV), the virus that causes acquired immunodeficiency syndrome (AIDS), affects 36.9 million people and is a major health concern worldwide [1].

Management of the disease requires lifelong treatment with antiretroviral therapies (ART), which have been shown to decrease the replication of the virus, improve survival, and minimize the risk of transmitting the virus to others [2–4]. Despite the known benefits of ART, its effectiveness could be affected by challenges associated with the treatment regimens.

Currently available ART is primarily administered as oral treatment. When these treatments were first introduced, they consisted of complex regimens of multiple medications administered several times per day [5]. Current treatment regimens are typically more convenient, often requiring only one tablet per day [1, 5]. Despite the reduced dose frequency and pill burden, some challenges may persist. For example,

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Key Points for Decision Makers

This qualitative analysis of social media data shows that people living with HIV (PLHIV) have a wide range of concerns and preferences related to route of administration for antiretroviral therapy.

While some PLHIV were satisfied with their oral regimen, others focused on challenges of oral treatment and said they would welcome injectable medication as a convenient alternative, primarily because of its less frequent dosing.

This analysis adds to a growing body of research suggesting that social media data can provide useful insight into patients' experience of disease and treatment.

as with any oral medication, patients need to take it according to the prescribed dosing schedule. When patients are not adherent to dosing recommendations, treatment effectiveness is compromised [6, 7]. In addition, HIV is associated with stigma and discrimination that is particularly detrimental in some cultures and geographic locations [8–10]. It can be difficult for some patients to be discreet when taking an oral treatment that requires daily dosing.

Long-acting injectable ART, such as the regimen of cabotegravir and rilpivirine, are currently being investigated for administration every 1 or 2 months [11–14]. While some patients may prefer the oral route of administration, recent data suggest that a long-acting treatment may be preferred by patients who want to avoid the daily inconvenience and treatment adherence challenges associated with oral medications [15–17]. Because preferences for route of administration could influence treatment adherence [18–20], which could have an impact on treatment outcomes, it is important to understand and consider the patient perspective when selecting treatment options. Therefore, the purpose of this study was to examine perceptions of oral and injectable routes of administration for ART through a qualitative thematic analysis of online discussions among people living with HIV (PLHIV). These public online discussions provide a unique view into patient perceptions and experiences because they occur without researcher intervention [21]. Furthermore, because people do not often disclose their real-world identity in online forums, patients may be willing to share sensitive information with fewer inhibitions related to embarrassment and social desirability [21–23].

2 Methods

2.1 Data Source

To examine the patient perceptions of ART route of administration, the source of qualitative data was the group of publicly accessible online discussion forums sponsored by POZ Magazine in New York. The discussion forums were introduced in 2006, and members include PLHIV, friends/family of PLHIV, medical professionals, and anyone else seeking information about HIV.

The following terms are used to refer to elements of this data source: A 'forum' is a collection of discussions on related subjects. An 'author' is anyone who posts on a forum. A 'thread' consists of an initial post from an author, plus all replies that follow (which may include additional posts from the original author). On the POZ website, threads are called 'topics'. A 'post' is an individual message posted to any of the threads.

The forums had over 33,049 members in June 2018 when the data were accessed for this study [24]. Each year, the POZ forum discussions are viewed by millions of people who do not post on the forums (e.g., 32,955,772 views in 2017). All messages posted to the forums are publicly visible to anyone with access to the Internet. A warning is posted prominently on the front page of the site, alerting participants to the public nature of the forums and encouraging them to avoid providing self-identifying information if privacy is a concern. Although the POZ forums may not be used to recruit patients for research studies, there are no prohibitions against analyzing forum threads and posts for research purposes. POZ forum discussions have been used as a data source in previously published research [25].

There are 19 forums organized by topic including HIV transmission and testing; living with HIV; AIDS activism; questions about treatment and side effects; nutrition and HIV; and forums for casual conversation. As of June 27, 2018, these 19 forums had 732,453 posts in 60,229 discussion threads (i.e., conversational threads usually consisting of multiple posts from a range of authors).

The three forums selected for the current analysis were "Living with HIV" (the largest forum with 207,106 posts in exactly 14,000 threads as of June 27, 2018); "Questions about treatment and side effects" (fourth largest forum with 38,856 posts in 4570 threads); and "Research news & studies" (eighth largest forum with 17,406 posts in 2284 threads). These forums were selected because they were most relevant to the current research goals focusing on the mode of administration of HIV/AIDS medications. The rules of the POZ forums indicate that participation in these three forums is limited to PLHIV, and people are asked to introduce themselves to the group when they post for the

first time. Therefore, all statements analyzed in the current study were from people who self-reported living with HIV. Although it is not possible to be certain that all participants are truly diagnosed with HIV, the moderators make an effort to enforce these rules. For example, in response to a concern regarding whether a participant was truly HIV positive, a moderator asked, “Please answer the question, have you been diagnosed with HIV and confirmed with a western blot?”.

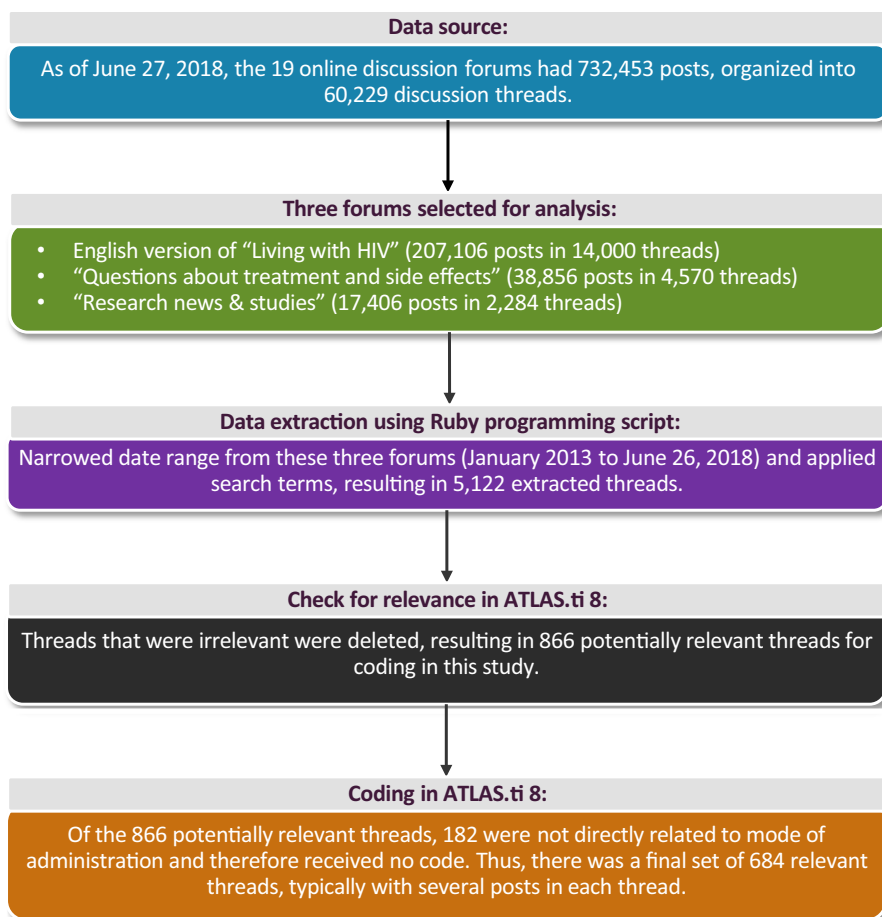
2.2 Data Extraction and Analysis

Data extraction and analysis focused on identifying and categorizing statements on oral and injectable modes of treatment administration for ART (see summary in Fig. 1). A Ruby programming script (an open-source computer programming language; <https://www.ruby-lang.org/en/>) was used to extract data for subsequent coding in ATLAS.ti 8. Data were extracted based on two criteria. First, threads were limited to the date range from January 2013 to June 26, 2018. Second, search terms in seven categories were applied to identify potentially relevant threads. The initial list of search terms was determined based on the study goals

(i.e., to examine perceptions of ART route of administration) by the study team during a series of meetings. This list was then revised and expanded based on initial review of quotations, and the searches were re-run with the final list of search terms that included (i) injection (e.g., injection, inject, injectable, shot, needle); (ii) long-acting or long-lasting; (iii) monthly (e.g., monthly, every month, once a month); (iv) dosage or dose; (v) oral medication (e.g., pill, tablet, oral); (vi) daily (e.g., daily, every day, once a day); and (vii) cabotegravir or rilpivirine (which were the only long-acting injectable ART in phase III clinical trials and close to a potential approval at the time the analysis was conducted). The data were also searched for the following potentially relevant abbreviations, but no posts with these abbreviations were found: Q1M, Q2M, CAB-LA, CAB-RPV, GSK744LAP, 744 LA, GSK-1265744, GSK1265744, GSK744, GSK744 LA, GSK744 LAP, LA, LAI, LA-ART, LL-ART.

With this approach, 5122 threads were extracted from the three forums, including 1911 from the “Living with HIV” forum, 1749 from “Research news & studies”, and 1462 from “Questions about treatment and side effects”. These 5122 threads were imported into the qualitative data analysis

Fig. 1 Selection of the analysis dataset from the POZ online discussion forums



software package ATLAS.ti 8 Windows [26]. These threads were reviewed for relevance with the keywords above, and irrelevant threads were deleted (i.e., threads that did not relate to mode of administration), resulting in 866 threads for subsequent coding.

The irrelevant threads were initially extracted because they included one of the search terms listed above. However, during the initial review for relevance and the subsequent coding, they were excluded because the content was not actually relevant to the current study. For example, some quotations included the word ‘shot’ in a way that was not referring to a long-acting ART injection (e.g., “What your labs show is a snapshot of your cd4 at the time your blood was drawn”; “I had syphilis three years ago... and I got treated with just a single shot of penicillin”). Similarly, the term ‘oral’ appeared in quotations that were not referring to ART mode of administration (e.g., “I was infected through oral sex”; “There is no moral compulsion to be unhappy with HIV”).

Codes were attached to portions of the posts using ATLAS.ti 8 to identify and categorize relevant quotations. Each quotation received four codes: (i) a route of administration code (oral or injectable), (ii) a sentiment code (indicating positive, negative, or neutral statements about the oral or injectable routes of administration), (iii) an author code (based on each unique author’s screen name), and (iv) a concept code. The list of concept codes was developed and revised based on review of the data. Concept codes were designed to capture statements related to either oral or injectable route of administration (see the final 27 concept codes in Table 1). Discussions of treatment efficacy and medication side effects were not coded because they were considered to be effects of the medication rather than statements directly related to route of administration. Quotations often received multiple concept codes when overlapping concepts were discussed.

The study team included a researcher who specializes in coding of social media data (TP), two health outcomes researchers (LM and KD), and three researchers whose work focuses on treatment of PLHIV (CG, NV, VC). Prior to coding the qualitative data, the full team met multiple times to draft and revise the list of search terms, develop the coding strategy, and discuss multiple iterations of the coding framework. Then, one researcher (TP) took primary responsibility for the qualitative coding in ATLAS.ti 8, with frequent input from the other authors. LM and CG reviewed coding results and met with TP to discuss quotations that were difficult to code. Final coding decisions were based on consensus among these three authors.

3 Results

3.1 Frequencies of Threads and Quotations

Of the 866 threads reviewed during coding, 182 did not have statements directly relevant to route of administration and therefore did not receive a code (see examples of irrelevant threads above). This resulted in a final set of 684 relevant threads, typically with several posts in each thread. Most posts had only one coded quotation, although there were some posts with multiple quotations receiving more than one concept and/or sentiment code. There was a total of 2626 coded quotations from 568 unique authors who posted to the forums during the analysis time period. Of these 568 authors, only 47 had 10 or more posts. Relevant quotations were identified in every year included in the analysis: 545 quotations in 2013, 695 in 2014, 444 in 2015, 563 in 2016, 267 in 2017, and 115 in the first half of 2018.

3.2 Frequency of Quotations by Concept Code

The 27 concept codes are listed in Table 1, along with descriptions and/or examples to clarify each as necessary. The five most frequently mentioned concepts by PLHIV related to route of administration were schedule issues (719 quotations), number of pills/tablets (620 quotations), dose frequency (599 quotations), food requirements (560 quotations), and emotional impact tied to route of administration (320 quotations). Travel, adherence concerns, adherence reports including statements indicating a lack of adherence (e.g., mentioning missed medication doses), medication access, adherence strategies, and concerns about privacy/confidentiality (including the stigma related to taking medication for HIV) were also mentioned frequently, with over 200 quotations each (Table 1).

3.3 Quotations by Route of Administration

Frequencies of quotations for the oral and injectable routes of administration are presented in Table 2 (oral) and Table 3 (injectable). Examples of positive and negative quotations for every code are presented in Table 4 (oral) and Table 5 (injectable). The oral route of administration was discussed more frequently than the injectable route of administration (2516 quotations for oral vs 110 for injectable). Quotes about pills were more likely to be coded as neutral or negative, whereas a greater proportion of quotes about injections were coded as positive.

The most commonly mentioned positive statements for the oral route of administration (Table 2) focused on the small number of pills (276 quotations), dose frequency in comparison with the older oral ART (245 quotations), ease

Table 1 Concept codes

Concepts	Total number of quotations
1. Healthcare provider visits (impact of route of administration on provider visits)	13
2. Pain	12
3. Needles (statements about needles without discussion of pain)	16
4. Strength of dosage (e.g., concerns about whether a dose may be too strong or not strong enough)	46
5. Diversion (giving medication to other people or requesting medication from other people)	121
6. Medication access	263
7. Stockpiling (e.g., saving tablets for future situations when medication may not be available)	128
8. Travel (medication access while traveling, transporting medication, and time zone issues)	296
9. Food requirements (e.g., discussion of whether medication should be taken with food or with specific foods)	560
10. Number of pills/tablets for HIV	620
11. Number of pills/tablets in combination with treatment for other conditions (e.g., adding ART to pre-existing oral medication regimens)	28
12. Dose frequency	599
13. Schedule issues (discussion of time of day to take medication)	719
14. Control of dosing (e.g., ability to intentionally skip doses)	121
15. Adherence concerns (e.g., worried about missing a dose)	270
16. Adherence reports (e.g., reporting having missed a dose)	267
17. Adherence strategies (discussion of strategies for remembering to take doses)	252
18. Storage issues	105
19. Medication error potential	23
20. Ingestion issues (e.g., difficulty swallowing, taste of tablet, size of tablet)	87
21. Privacy and confidentiality, including stigma related to taking medication (e.g., fear of medication being discovered by friends, family, coworkers, or customs agents who may discover pills when patient is traveling)	211
22. Medication as a source of pride or control over HIV	63
23. Visible reminder of HIV status or treatment (can be negative [reminder of illness] or positive [reminder of effective treatment])	39
24. Emotional impact tied to mode of administration (specific emotion words, which may be double coded with any of the other concepts)	320
25. Ease of use	170
26. Convenience (e.g., statements that a route of administration is convenient or practical)	68
27. Unspecified reason (preference for a route of administration without explanation)	8

of scheduling (153 quotations), and ease of use (146 quotations). Commonly cited disadvantages of the oral route of administration included emotional impact (166 quotations), schedule issues (131 quotations), food requirements (126 quotations), reports of treatment adherence including lack of adherence (121 quotations), issues related to traveling (107 quotations), and difficulty with medication access (106 quotations).

PLHIV also mentioned that oral medication adds to the challenges of maintaining confidentiality and dealing with the stigma associated with HIV (100 quotations). For example, one person wrote “Today I went and picked my meds up and was kind of feeling apprehensive about the people standing around as the pharmacy tech kindly waved my medication bag around”. Another said it is “inconvenient to take the medicine with meals, mainly due to the privacy issue. I normally take the medicine during dinner time. It would

Table 2 Number of quotations for each concept code: oral route of administration

	Quotations related to oral route of administration for antiretroviral therapies		
	Positive	Neutral	Negative
1. Healthcare provider visits	0	0	0
2. Pain	0	0	0
3. Needles	0	0	0
4. Strength of dosage	6	14	21
5. Diversion	25	91	5
6. Access	25	127	106
7. Stockpiling	25	101	0
8. Traveling	20	160	107
9. Food requirements	115	310	126
10. Number of pills/HIV	276	220	124
11. Number of pills/other conditions	4	11	13
12. Frequency of doses	245	199	107
13. Schedule issues	153	433	131
14. Control of dosing	10	55	53
15. Adherence concerns	20	143	97
16. Adherence reports	25	121	121
17. Adherence strategies	46	170	36
18. Storage issues	15	43	47
19. Medication error potential	0	6	17
20. Ingestion issues	32	18	37
21. Privacy/confidentiality (stigma)	9	101	100
22. Source of pride/control	59	4	0
23. Visible reminder of HIV status or treatment	12	1	23
24. Emotional impact	86	54	166
25. Ease of use	146	16	6
26. Convenience	35	11	11
27. Unspecified preference	0	1	0

not be convenient if I am going out with friends for dinner and have dinner with my family". Another person posted to ask for advice on how to maintain privacy: "I'd like to ask some ideas on how to hide the pills and keep my family from noticing that I am on treatment. My parents notice everything about me and sometimes look at my stuff. I am visiting them these days. Any ideas?"

Positive words and phrases used to describe emotions (concept code 24) related to the oral route of administration include "quite happy," "love," "life changer," "quite exciting," "I was petrified before I started and now I see how

foolish I was," and "I feel lucky and grateful." Negative emotional statements include "quite concerned," "not thrilled," "worry," "mental anguish," "scared," and "paranoid".

Among the smaller number of patients discussing long-acting injectable ART (Table 3), positive comments primarily focused on less frequent administration (34 quotations), emotional benefits of not taking a daily pill (seven quotations), benefits for traveling (six quotations), potential adherence benefits (six quotations), and convenience (six quotations). Some PLHIV perceived the frequency of injections negatively (10 quotations), and others had negative

Table 3 Number of quotations for each concept code: injectable route of administration

	Quotations related to injectable route of administration for antiretroviral therapies		
	Positive	Neutral	Negative
1. Healthcare provider visits	5	1	7
2. Pain	2	6	4
3. Needles	3	5	8
4. Strength of dosage	0	4	1
5. Diversion	0	0	0
6. Access	2	0	3
7. Stockpiling	0	0	2
8. Traveling	6	0	3
9. Food requirements	4	4	1
10. Number of pills/HIV	0	0	0
11. Number of pills/other conditions	0	0	0
12. Frequency of doses	34	4	10
13. Schedule issues	1	0	1
14. Control of dosing	1	0	2
15. Adherence concerns	6	0	2
16. Adherence reports	0	0	0
17. Adherence strategies	0	0	0
18. Storage issues	0	0	0
19. Medication error potential	0	0	0
20. Ingestion issues	0	0	0
21. Privacy/confidentiality (stigma)	1	0	0
22. Source of pride/control	0	0	0
23. Visible reminder of HIV status or treatment	3	0	0
24. Emotional impact	7	1	6
25. Ease of use	2	0	0
26. Convenience	6	0	5
27. Unspecified preference	7	0	0

perceptions of needles or appointments required to receive injections (eight and seven quotations, respectively).

Whereas very few of the statements coded for oral treatment mentioned injectable treatment, many of the statements coded for injectable treatment included a comparison to oral treatment. For example, many of the quotations expressing a positive reaction to the frequency of injections included a comparison to the more frequent administration of oral medication (e.g., “I’ll be happy to toss my current HIV meds out the window the day they finally develop that once-a-month drug even if it is an injectable”). Similar statements

were coded for scheduling of doses (e.g., “I honestly would prefer taking an injection every month instead of worrying about my next pill’s time.”).

Words and phrases used to describe positive emotions (concept code 24) associated with the injectable route of administration include “excited,” “happy dance,” “something psychologically better,” “love the idea,” and “over the moon happy.” Negative emotional language appearing in quotes about long-acting injectables includes “freaks me out,” “anxious,” “hope it’s not as bad as I’m anticipating,” and “could not cope”.

Table 4 Examples of quotations: oral route of administration

Examples of quotations about the oral route of administration ^a		
	Positive ^b	Negative ^b
4. Strength of dosage	Taking more pills wouldn't bother me, it doesn't mean it's more potent than the once a day regimens	I am getting concerned about the dosage of those drugs: (I know they are life saver, no doubt of that but if half of the pill is still doing "the job", why this dosage?
5. Diversion	Thank you so much to the folks that were so generous to give me their no longer needed meds. I am very confident that I now have plenty to carry me over until I figure things out in the sunshine state!	Sharing or dispensing prescription medications without a valid prescription for the patient is illegal here in America (and other countries)
6. Access	But I've still stayed with mail order. Just the convenience of them mailing it to me helps	My f'ing "specialty" pharmacy they would only give me 30 days supply not the 90 I use to get from the regular mail order
7. Stockpiling	I've considered changing, but have built up a nice 9+ month stockpile and that security, coupled with the relative lack of negative side effects, makes me very hesitant to change	None
8. Traveling	I travel all over the world, my medication is not a limitation and neither is yours	My son has a mandatory training in [state]. He needs an extra 14 days of pills but his insurance will not make a "vacation" allowance. His ID doctor has no samples. A clinic I called has no samples. The pharmacy he called in [state] was not very helpful
9. Food requirements	I take triumeq which is once a day and never worry about taking it with food or anything... So I would recommend it!	Complera isn't an option because of its solid food requirement. I have an unpredictable schedule... I can force a small snack but not a 400 cal meal
10. Number of pills for HIV	I got my prescriptions refilled yesterday and they give me the 800 mg pezista instead of the 2x400 mg/day. I think that is cool, so now I only have to take one	The downside to moving from Atripla to Prez/Nor/Tru is the amount of pills...I forget what my exact dosage was but I was taking a total of 5 pills a day...
11. Number of pills for other conditions	I've never understood the issue behind taking a pill everyday. Prior to my diagnosis in the morning I would get up and take a blood pressure pill, moxic, and osteo-biflex. Now, I've added a vitamin D pill in the morning and take Stribild with dinner	I'm not at all opposed to taking multiple pills a day but in addition to my multivitamins, vitamin d supplement, vitamin b12 supplements, and my anti anxiety meds, i'd rather not add 3 more pills into the mix if I can help it
12. Frequency of doses	When I was choosing my first combo, I...knew I wanted a once-a-day combo	I wouldn't want to do anything I'd have to take twice daily
13. Schedule issues	I'm very happy with it, and taking my pill in the morning with a nice breakfast suits me well	If I'm taking one pill a day, how much deviation can I have with when I take it? Is a four-hour window too much of a window? ... I'm new to all this, am I worrying for nothing? Or have I been committing egregious errors the last few weeks without even realizing it?
14. Control of dosing	I'm the same. I'd prefer to regulate my own dosage via tablets	Suffice it to say, playing with doses outside a properly monitored research/trial setting is really playing with the fire that is a virus. One that can burn out your life
15. Adherence concerns	The efavirenz also has a very long half life, over 48 h which makes atripla somewhat forgiving if you miss a dose	My problem is that I am not sure whether or not I had two or three pills... I am worried that the potential overdose may be an issue
16. Adherence reports	I feel fine, life is good. Tomorrow, I go pick up another 30 day supply. (Zero missed doses for first month)	Just don't drink to the point of forgetting your meds. To this day, my only skipped doses have been a result of a glass of wine
17. Adherence strategies	A simple fix for an evening dose is a pill fob. Since most people carry keys, it's a convenient way to always have them	One thing I've found useful is to have a pill holder on my keys, but I worry about the pills perhaps being sensitive and degrading

Table 4 (continued)

Examples of quotations about the oral route of administration ^a		
	Positive ^b	Negative ^b
18. Storage issues	I like that it is one small pill instead of two big capsules (easier to store/swallow)	Sometimes I wonder how stable these actives are if keeping them above room temperature (i.e., in a hot car)
19. Medication error potential	None	Keep an eye on the generic meds you are taking. If the pills are a different color, shape, call your pharmacy
20. Ingestion issues	It's no more difficult to swallow them all at once than it is a single pill. I pop them all in my mouth, take a big swig of water, throw my head back and swallow. Simple	My husband is getting ready to start his meds, Stribild, and he has a very hard time swallowing big pills
21. Privacy and confidentiality (stigma)	Do I care if people see me taking my pills? Heck no. It seems everybody I know takes a pill for something. In the big scheme of things, an antiretroviral is just another pill	I'd like to ask some ideas on how to hide the pills and keep my family from noticing that I am on treatment. My parents notice everything about me and sometimes look at my stuff
22. Source of pride and control over HIV	A pill a day is a sense of control, I am in control of my illness, and I choose each day to be in control of my health and HIV	None
23. Visible reminder of HIV status or treatment	when you see your med. don't see it as a reminder of having HIV, see it as a blessing you have a second chance...you will adjust to your new life	Just as quickly as I open the medicine cabinet, I see the glowing purple letters piercing my soul with utter judgement. TRIUMEQ! It hit me. I'm HIV Positive. I am living with an incurable disease that, for all intents and purposes, is my fault
24. Emotional impact	I have been on Triumeq for about a year already and I love it! 1 pill a day compared to 4 pills twice a day for the first 2 years after being diagnosed	It's something that I run to my bag and grab. There is no privacy when you work in retail. I was just venting my frustrations. ...Just frustrates me that they would be so involved in my medicine
25. Ease of use	meds are easy to take now, compared when I started treatment almost 21 years ago	Its a huge pain to me. Someone who liked to live life so untethered and free. The HIV never really bothered me but when the time came to get on pills i avoided it until i could no longer avoid it
26. Convenience	It's quite exciting to have a new medication on the market, especially another one pill once a day, can't beat that for convenience	Probably the most difficult med (in terms of convenience) was which-ever one it was that had to be refrigerated. What a total pain in the ass if you wanted to stay away from home for more than a few hours

^aConcept codes 1, 2, 3, and 27 are omitted from this table because there were no statements on the oral route of administration that received these codes

^bThe sentiment of each quotation (i.e., positive, negative, or neutral) was coded from the patient's point of view, which may diverge from the clinical, regulatory, or payer perspective in some situations

Table 5 (continued)

Examples of quotations about the injectable route of administration ^a	
Positive ^b	Negative ^b
25. Ease of use	None
26. Convenience	Personally the Long lasting injections (or the idea of them) is not interesting for me or at least I simply don't consider it practical
27. Unspecified preference	None

^aConcept codes 5, 10, 11, 16, 17, 18, 19, 20, and 22 are omitted from this table because there were no statements on the injectable route of administration that received these codes

^bThe sentiment of each quotation (i.e., positive, negative, or neutral) was coded from the patient's point of view, which may diverge from the clinical, regulatory, or payer perspective in some situations

3.4 Association Between Concept Codes

When quotations received more than one concept code, there were some pairs of codes that tended to be mentioned together. For example, schedule issues were often mentioned along with food requirements (292 quotations receiving both codes), frequency of doses (116), adherence strategies (110), adherence reports (92), adherence concerns (83), number of pills for HIV (81), and emotional impact (81). Frequency of doses was often associated with number of pills (366 quotations receiving both codes), schedule issues (116), ease of use (84), food requirements (83), and emotional impact (73). Traveling was often mentioned along with privacy/confidentiality (137 quotations receiving both codes) and schedule issues (67). Food requirements tended to be associated with schedule issues (292), frequency of doses (83), and number of pills (69). Emotional impact most frequently occurred with schedule issues (81 quotations receiving both codes), frequency of doses (73), adherence reports (69), number of pills (63), and food requirements (57).

4 Discussion

Route of administration was frequently discussed among PLHIV on the POZ discussion forums. Oral administration was discussed more frequently than long-acting injectable administration, which was expected given that commonly used ART is administered orally while injectable ART is still investigational and in clinical trials. PLHIV expressed both positive and negative views of their oral medication regimens. Positive statements commonly referred to ease of use, the small number of pills in their regimen, and the convenient dose frequency, which was often only once daily.

Challenges associated with the oral route of administration included food requirements (e.g., taking medication with meals) and difficulty accessing the medication, particularly when traveling. Negative emotional statements (e.g., frustration, anxiety, fear, anguish) appeared in 166 of the quotations, sometimes because oral medication can be an unwanted daily reminder of HIV status. For some PLHIV, daily oral treatment raised issues of confidentiality because they try to keep their medication hidden to avoid stigma that may be associated with HIV. This finding is consistent with previous literature linking HIV stigma with difficulties adhering to oral treatment regimens [10]. A substantial number of PLHIV reported concerns about treatment adherence with daily oral medication, as well as examples of times when they had not been adherent to their oral treatment regimen. From a clinical perspective, the extent to which route of administration can have an impact on adherence is particularly important because suboptimal adherence with

oral ART has been shown to reduce treatment effectiveness [6, 7].

Among the smaller number of PLHIV who discussed injectable treatment, many viewed this potential new route of administration as a convenient alternative to oral medication. Quotations indicated that PLHIV welcomed the less frequent dosing of the injectable treatments, and they believed that these injections had the potential to eliminate the daily reminder of HIV status, while reducing the treatment adherence problems that can occur with oral medication. These positive expectations of long-acting injections are consistent with reports of PLHIV who described the convenience and emotional benefits after receiving these treatments in a phase II trial [16]. However, it should also be noted that other PLHIV said they would prefer to keep their daily oral treatment regimen, rather than begin injectable ART, sometimes mentioning a fear of needles. In summary, while some PLHIV were satisfied with their current oral regimens, others have difficulty with aspects of oral treatment and hope to try the long-acting injectable medication when it is available.

This analysis adds to a growing body of research suggesting that social media data are a useful source of information on patients' experience of disease and treatment [25, 27–33]. These publicly available online discussion forums allow researchers to assess the patient perspective based on analysis of naturally occurring discussion without influence from research protocols or medical professionals. Because online forums can be fully anonymous or pseudonymous, patients may be more willing to express their views honestly with fewer inhibitions related to embarrassment or social desirability. They may also be comfortable discussing sensitive personal concerns that they may not report to clinicians or researchers. In addition, online forums can be used to gather data from a large number of patients more quickly and inexpensively than a study that requires patient recruitment [21, 22, 34].

The limitations of social media data should also be acknowledged [21, 22, 34]. In online forums, patients are identified by screen names (i.e., pseudonyms), and they do not typically provide personal identifying information. Therefore, it is not possible to know the demographic or clinical characteristics of the sample. Furthermore, patients who choose to post online could be different from other patients, and therefore, the extent to which quotes extracted from online forums represent the broader HIV patient population is not known. To understand the generalizability of the current findings, future research with a clinic-based sample could examine perceptions of route of administration among PLHIV with verified diagnoses and demographic diversity.

A limitation of the POZ forums as a data source is that the number of posts has been declining in recent years. Across the years in the current analysis, the number of new topics

(i.e., posts initiating new threads) declined from 5054 in 2013 to 3126 in 2017 and 1485 in the first 6 months of 2018, although it should be noted that the maximum number of page views occurred in 2016 (56,173,829). One possible reason for the decline in posting of new topics is that patients may have less need for online discussion because medications have become easier to manage and the availability of off-line support systems has grown. One post reflects this: "I remember logging online all the time to read this forum, but slowly I found my support outside and have stopped thinking about it like the end of the world. Now it is just two pills a day to keep the virus at bay." Although the POZ forums provided many relevant quotes from a large group of authors for the current analysis, the decline in forum usage could have an impact on representativeness of the sample.

Other limitations may stem from the qualitative coding strategy. Decisions about qualitative codes are inevitably subjective. For instance, the study team decided that the sentiment of each quotation (i.e., positive, negative, or neutral) would be coded from the patient's point of view, which may diverge from the clinical, regulatory, or payer perspective in some situations. One example is that some PLHIV perceived the ability to share medication (e.g., giving unused prescription medication to another patient) as an advantage of oral medication, whereas clinicians, pharmacists, and payers would likely view medication diversion as a negative attribute. As an alternative approach, sentiment codes could be based on clinical judgment rather than the patient perspective, which would lead to different results.

5 Conclusion

Overall, this qualitative analysis of social media data shows that PLHIV have a wide range of concerns and preferences related to route of administration. While some PLHIV were satisfied with their oral regimen, others focused on challenges of oral treatment and said they would welcome the less frequent dosing of injectable ART. Therefore, it appears that both treatment options could be useful, and the choice of route of administration may depend on the needs and preferences of each individual patient. By prescribing treatments that patients prefer, clinicians can help foster greater patient satisfaction and better treatment adherence, which could lead to improved health outcomes.

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Author Contributions LSM, TMP, and CPG co-directed this study and shared primary responsibility for study design decisions. All authors (LSM, TMP, CPG, NVV, VC, and KAD) made substantive contributions to the study design, analysis, and interpretation. For example, all authors worked together to determine the study goals, the search terms,

the list of codes, the presentation of findings in the Results section, the interpretations that would be included in the Discussion section, and the selection of key quotations for inclusion in the tables. LSM drafted this manuscript, KAD performed literature searches necessary to support the text, and all other authors provided input, comments, and approval. TMP performed the qualitative coding, while LSM and CPG performed detailed review and input on coding decisions.

Data Availability Data are available upon request.

Compliance with Ethical Standards

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Conflict of Interest LSM and KAD are employed by Evidera, a research company that received funding from ViiV Healthcare for time spent on this research. TMP is a consultant who was sub-contracted by Evidera to conduct the qualitative analysis. CPG, NVV, and VC are employees of ViiV Healthcare.

Ethical Approval This article does not report any data collection performed by the authors. The analysis used publicly available online discussions as the data source.

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