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Health Literacy in HIV Treatment: Accurate Understanding of Key Biological Treatment Principles is Not Required for Good ART Adherence

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Abstract

Findings on the relationship between health literacy and outcomes in HIV have been inconsistent. Health literacy has previously been operationalized as general functional literacy, but has not included content knowledge about HIV disease and treatment. Semi-structured interviews with people living with HIV in 2 U.S. cities, including questions about the etiology, pathophysiology and treatment of HIV. We compared responses to biomedical conceptions. The 32 respondents were demographically diverse. Although most understood that HIV degrades the immune system, none could explain the nature of a virus, or the mechanism of antiretroviral (ARV) drug action. Fewer than half accurately reported that it is desirable to have a high CD4+ cell count and low viral load. A minority understood the concept of drug resistance. While most believed that strict adherence to ARV regimens was important to maintain health, three believed that periodic treatment interruption was beneficial, and three believed they should not take ARVs when they used alcohol or illicit drugs. Respondents generally had very limited, and often inaccurate biomedical understanding of HIV disease. Most reported good regimen adherence but did not have any mechanistic rationale for it. The failure to find a consistent relationship between health literacy and ARV adherence may be largely because most people simply follow their doctors' instructions, without the need for deep understanding.

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Keywords

Health literacy; Health beliefs; HIV; Decision making; Adherence

Introduction

Despite the benefits offered by modern antiretroviral treatment for HIV [1–4], the most recent estimate from CDC finds that due to the so-called “treatment cascade”—people not being diagnosed, not being engaged in care, and not adhering to therapy—only about 39 % of people with HIV in the U.S. had suppressed viral loads in 2010. CDC also estimates that that of people living with HIV in the U.S. who are in treatment, about 72 % have suppressed viral loads [5]. The effectiveness of ART depends on a high level of adherence to dosing regimens [6–8]. However, many studies find substantial rates of sub-optimal adherence to ART in North America. A recent pooled analysis of data from 16 studies found that only 20 % of study participants had 93 % or more “covered time”—doses taken within 3 h of the scheduled time—in the previous 28 days [9]. The consequences of erratic adherence include not only the possibility of treatment failure for the individual, but the development of drug resistant virus [10, 11] and increased probability of transmitting HIV to others [12].

Accordingly, there has been enormous interest in the causes and correlates of non-adherence, and interventions to promote improved ART adherence. One area of interest is in the relationship between health literacy and medication adherence. A rich body of literature addresses connections between health literacy and health status; much of this involves medication adherence. One standard definition of health literacy is “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions” [13]. In diseases other than HIV, a number of studies and reviews have suggested an association between low health literacy and poorer adherence to medication regimens [14, 15], poor self-management [16, 17], and worse understanding of chronic disease [18, 19].

However, findings in the case of HIV have been inconsistent and difficult to interpret. Some studies using the REALM [20], that tests ability to pronounce medical terms (e.g., “fat” and “impetigo”), found that higher literacy was associated with poorer health outcomes [21, 22], while other studies found a positive association between REALM scores and ARV adherence [23, 24]. A study that used the TOFHLA, which is a test of reading comprehension [25], found low literacy to be positively associated with two-day non-adherence to ART [26]. A later study found that lower TOFHLA scores were associated with poor adherence as measured by unannounced pill counts [27]. However, a 2004 study failed to find a link between literacy and adherence [28].

A limitation of this research has been that it treats health literacy as essentially equivalent to functional literacy in general—the REALM and TOFHLA measure basic literacy and numerical skills. A proposed expanded concept of health literacy incorporates patient knowledge and beliefs as important factors in the provider-patient interaction, involvement in decision making, and self-care [29].

In medical sociology and anthropology, it is conventional to distinguish between “disease” and “illness” [30, 31]. Disease is a biomedical category, referring to abnormal functioning of the body. Diseases are abstract entities which are similar regardless of the psychosocial setting or the afflicted individual. Illness refers to the patient's experience, which is particular to the individual and patterned by psychological, social and cultural factors. It brings disease into the social world via communication and interpersonal interaction. According to Kleinman, it “is the shaping of disease into behavior and experience,” having been “created by personal, social, and cultural reactions to disease.” (p. 72) Both disease and illness incorporate explanatory models for processes and experiences [32]. Kleinman's classic framework for explanatory models includes etiology, time and mode of symptom onset, pathophysiology, sickness course, and treatment. It can generally be expected that medical practitioners couch their explanatory models in terms of biomedicine and disease, while illness forms the basis of patient explanatory models.

We undertook an exploratory study to develop an understanding of common patterns of cognition and personal meaning about HIV and HIV treatment among people living with HIV. Responses ranged over wide categories of meaning and explanation. Illness representations with little or no reference to biomedical models were most salient. However, we have little information about the concordance of the knowledge, beliefs and explanatory models of people living with HIV with the biomedical knowledge and models of their health care providers, and how concordant understanding may be related to treatment decision making and adherence. For this report, therefore, we focus on presenting what we found about our respondents’ knowledge and interpretation of biomedical understanding of HIV and HIV treatment, how these are related to their decision making about seeking medical treatment, acceptance of ART and adherence to therapy, and other self-care behaviors. This constitutes an expanded definition of health literacy which includes content knowledge as well as basic skills.

Methods

This study is based on semi-structured interviews with people living with HIV in two cities in New England. The interview guide was based in part on a guide used in an earlier study [33], which had principally focused on patients’ experience of taking ART, and their rationale for their decisions. The guide was initially modified to cover broader domains based on the components of explanatory models described above, incorporating insights gained from four focus groups conducted in connection with a different study with overlapping aims [34]. Dr. Laws then piloted the draft guide with four respondents to insure good conversational flow, that the items were readily interpreted and effectively elicited responses that addressed the intended questions, and to identify any important issues or themes we had failed to include. These initial interviews are not included in the analysis.

Respondents were recruited through flyers placed in a hospital-based HIV specialty care clinic, and an AIDS Service Organization, in each city. Interested individuals called a research assistant, who then scheduled an interview with an RA in one of the cities, or with one of the investigators (Laws or Rana) in the other, either at the clinic or at a nearby office,

depending on the participant's preference. Interviews were audio-taped and transcribed for analysis.

The only eligibility requirements were that respondents be 18 years of age or older, diagnosed with HIV, and able to converse comfortably in English. The goal was to have a sample that would be diverse in terms of education, race/ethnicity, gender, and history of injection drug use. Because this diversity emerged naturally, we did not have to screen for these characteristics. We planned to continue recruiting until 50 interviews were conducted or saturation was reached; we found that little new information of interest was emerging after completing 32 interviews. However, we did not succeed in recruiting people who were not currently receiving medical care, although many respondents recalled times when they were not in care. This study was approved by the Institutional Review Boards of Brown University, and both hospitals where the clinics were housed.

An initial structured portion of the interview guide included basic demographic and background information such as race/ethnicity, formal education, and living situation. (Health insurance status turned out not to be an issue as these states provide near universal access to medical care and antiretroviral treatment for people living with HIV.) The semi-structured portion then covered domains including the experience of receiving the diagnosis, and living with HIV, and how feelings about it may have changed over time; treatment history and relationships with physicians and other health care providers; comorbidities; current and past medication regimens; living situation, employment and natural supports; and disclosure to others. Items intended explicitly to elicit patients' explanatory models included such questions as "If you were going to explain to a friend what HIV is, what would you say?" and "How would you explain what T cell, or CD4 count, means?" Similar items covered the various elements of the domains of explanatory models as identified by Kleinman, including etiology, time and mode of symptom onset, pathophysiology, sickness course, and treatment. Specific items of note include the explanation of drug resistance and consequences of non-adherence.

Analysis of the transcribed interviews was conducted by two authors (MBL and MD) using Atlas.ti software (©Scientific Software Development GmbH). Initially, we applied broad topic codes to highlight patient explanatory models, decision making processes, and indicators of the illness experience. (Information about explanatory models emerged at various places in the interviews, not only in response to items intended to elicit them.) Codes indicated such concrete topics as "What is a virus?" and "What is viral load? "What is CD4 count?"

Transcripts were initially open coding by one of us (MD), and the coding was reviewed by the first author and consensus was achieved after discussion. At this state, we found that most of the time, respondents' initial responses were not framed in biomedical terms, but referred to other categories of meaning. These included such issues as stigma, shame, responsibility, moral evaluation, responsibility to others, and the evolution of illness identity and acceptance of the diagnosis. The interviewer would then probe to determine respondents' biomedical understanding and beliefs.

For purposes of this analysis, we restrict our presentation to the biomedical realm. We will present other dimensions of explanation and meaning elsewhere. This distinction is not always straightforward, however, because our lay respondents seldom presented ideas which correspond to accepted biological constructs. The problem is how to classify explanations or attempted responses as pertaining to this realm, however cursory or discordant with scientific beliefs. One widely cited concept is what Mishler has called the “voice of medicine” and the “voice of the lifeworld,” [35] drawing on Habermas's theory of communicative action [36]. Habermas's construct of the “lifeworld” is complex, but a central component of his thought is the distinction among three kinds of “criticizable validity claims,” or three “worlds.”

The first is the world of intersubjective reality. Within this realm we can further distinguish between immediate apprehension and credible direct reports on the one hand; and expertise or complexly derived conclusions on the other. The latter is the domain of science, including biomedicine. The second world is the social and moral order. Assertions in this realm are about what ought to be, the appropriateness of social relations, the categories of social status. Finally, the third world is our inner experience, our likes and dislikes, feelings and esthetic experience. Habermas summarizes these as analogous to the Platonic ideals of The True, The Good, and The Beautiful.

Here we present and categorize explanations that pertain to the first world, claims which are in principle verifiable by empirical investigation. We also include respondents’ assertions that they lack relevant knowledge or understanding. We take the scientific theories about the nature of HIV, its pathophysiology, prognosis, and treatment, as our a priori or etic organizing principle. Exploration of respondents’ second and third worlds might call for a grounded theory approach in which their responses generate their own interpretive framework. Here, however, we are concerned in a straightforward way with the degree of correspondence between the knowledge and beliefs of people living with HIV, and those of physicians; and their explanatory depth. For each topic, we will present a summary of currently accepted scientific understanding, followed by a presentation of responses by our participants. We do not provide specific references for our summaries of scientific understanding. Interested readers may consult a standard textbook [37].

We wish to emphasize again that these were not usually the most salient categories for respondents, nor do we make any normative claims about what they “should” know or what information should be relevant for them. Rather, our purpose here is to explore how relevant this knowledge is for people living with HIV, and what relationship, if any, it has to treatment decision making and adherence. This is by no means exhaustive of our data, it is simply the focus we have chosen for this report.

Results

Respondent Characteristics

Of the 32 interviewees, 22 were male. Eight self-identified as African American, four as Hispanic, 17 as White, two as Native American, and one identified as African. The latter was a recently arrived refugee from Namibia. Respondent age ranged from 22 to 63 years,

but only one was under 30. Reported year of diagnosis with HIV ranged from 1981 (which seems improbable and is likely an erroneous memory) to 2010. As interviews were conducted in 2012–2013, this means that no-one was newly diagnosed. The typical respondent had a high school education; only three had completed college. All but one (the refugee) currently had prescriptions for ARTs, and most reported recent good adherence.

Most respondents reported at least a moderate level of satisfaction with their current knowledge of HIV and ARV therapy. A few noted that they were “80” or “90 %” confident that they understood the virus and its mechanisms. Others indicated that their knowledge was limited but they felt what they did understand was adequate for their needs. One respondent stated that he knew the “bare minimum” about HIV and that more information did not interest him. A small number of patients expressed frustration with their limited knowledge.

What is a Virus?

The scientific meaning of “virus” is a fragment of genetic material which is an obligate intracellular parasite that replicates using host cell machinery. Viral genomes may consist of DNA or RNA. Extracelluarly, they are packaged in a protein shell, an assemblage called a virion, that can attach to cells for replication, or be transmitted to a different host organism. Some viruses are pathogenic in humans. Viruses are nonliving but often considered to be on the “border” between living and non-living.

One respondent, who has a college degree in biology, said that HIV “infects your immune cells so that your ability to fight infections is not as good and you could get sick,” but despite some probing, did not provide any more detailed information about its nature. Most respondents offered little scientific content, for example:

> Interviewer: Okay. And what—if somebody asks you, well, what is a virus anyway?
>
> Interviewee: If somebody asks me what is the virus?
>
> Interviewer: Yeah, what would you say?
>
> Interviewee: We all know what a virus is.
>
> Interviewer: Uh-huh.
>
> Interviewee: A regular virus. Everybody get em and you take medication for it.

One essentially denied the relevance of the question.

> Interviewer: And if you were gonna explain what a virus is?
>
> Interviewee: Well, they usually don't ask you what the virus is, they just ask you how are you gonna get HIV, you know what I mean, you know, normally people you see—and what is the virus. You don't have people come and ask me those kind of questions, you know what I mean.

Another simply admitted to having no idea what a virus is. Some said it is similar to bacteria. One simply said, “But they—the only thing about it maybe is just that it doesn't die.”

What is HIV?

HIV, specifically, is a retrovirus, meaning that its genetic material is RNA, which is “reversed transcribed” into the nuclear DNA of the host cell. In this form, it is called a provirus, and it can remain inactive until the cell divides. HIV is principally transmitted through unprotected sexual contact, blood-to-bloodstream contact as through sharing of injection needles, and from mother to newborn.

The respondent with a biology degree used the term “retrovirus,” but did not define it. Otherwise, none used the term or referred to the properties of a retrovirus. Respondents generally knew that HIV is transmitted through unprotected sex and needle sharing, and when asked what HIV is specifically, 5 responded in these terms, e.g. “I'd tell them HIV is a virus. You can get infected when you have a relationship with no condom.” Fifteen respondents defined HIV as a virus or a weakness/disease in/of the immune system, although their explanations of this generally incorporated little scientific content.

> Interviewee: I'd say “My immune system is not as strong as someone else's, so I'm more susceptible to any kind of germs, viruses, whatever's out there than you are because your immune system is right and mine's not.”
>
> Interviewer: And that's because?
>
> Interviewee: Because I have the virus, and that's pretty much—I mean, what does HIV mean?
>
> Interviewer: It stands for Human Immuno-deficiency Virus.
>
> Interviewee: Yeah, it's the immune part—that's my immune system, which is not working up to par like it's supposed to.

Eight respondents included references to other chronic diseases in their definitions. HIV was compared to or described as “cancer” (and even “seven kinds of cancer”) and compared to conditions such as hepatitis and diabetes. In this regard, it could seem to be “just another disease,” another chronic illness.

How Does HIV Cause Disease?

The scientific model of HIV disease is that the virus preferentially infects important cells of the immune system, specifically T cells expressing the CD4 receptor. These cells interact with antigen-presenting cells and produce signals which activate other components of the immune response. Over time, typically several years in untreated persons, HIV infection depletes CD4+ cells resulting in declining immunocompetence and eventually, susceptibility to opportunistic infections. In the latter stage of the disease, called Acquired Immunodeficiency Syndrome (AIDS), the patient experiences wasting, and chronic infections, including disease caused by organisms which are not normally pathogenic in humans, and ultimately death.

Over half of the respondents reported that HIV attacks the immune system, kills T cells, or lowers their “counts.” For example:

> Interviewer: How would you describe the way that it creates the disease, that HIV causes the disease?
>
> Interviewee: It attacks your immune system. It shuts everything down eventually.
>
> Interviewer: So you'd say how it attacks your immune system? Can you get into more detail? Would you describe how it does that?
>
> Interviewee: I can talk about the viral loads and the CD4 counts and what does what, what white cells do and this and that if I had to, and if I had to I would do my research first so I wouldn't get nothing wrong.

“It makes the immune cells not function as well and destroys some of them,” said another interviewee.

These explanations are generally concordant with the biomedical theory. Only two respondents, however, provided explanations that suggested a deeper understanding of biological mechanisms. The biology graduate stated that HIV infects particular immune system cells and causes disease by depleting them. He wasn't sure whether they were the helper cells (an informal term for CD4+ cells) or killer cells (referring to cytotoxic cells which are activated by CD4+ cell signaling), but he didn't think that distinction was important. Another respondent, who had only a high school education, gave a rich, if slightly confusing explanation in purely lay terms:

> ‘Cause HIV likes your T-cells, your CD4 cells. Your CD4 cells are the ones that go, and they be like, oh, that's a cup [referring to the interviewer's untidy desk]. It's not supposed on this desk and they eat it to clean the desk off. And they eat it and then they'll be like, okay, and then they send these little people out so they can be like, hey, man, you're not supposed to be here. I told you last time. .... And then they be like, I told you last time you're not supposed to be here. So they beat him up, beat up the cup. And they clean the desk off. But then when HIV comes through, it's like they eat their self. They go into a cell that remembers what's going on and you already have immunity to certain things. And it eats those cells. And then it's like your cells are sending out soldiers but then it's not enough because now the HIV is shooting them down real fast. Faster than they can produce by themselves. So then if you don't have any medicine, the HIV is just working by itself. The body's working by itself with the HIV in it. The HIV's going to eventually win ‘cause it's really strong.

She stated that she had learned that from the facilitator of a support group.

Not all respondents said that HIV attacks the immune system, however. Two said that it attacks other organs, especially the liver. One said it causes the immune system to attack the patient's own body.

How Does Antiretroviral Medication Work?

Antiretroviral drugs inhibit replication of HIV by interfering with one or another step in the replication cycle. Reverse transcriptase inhibitors (RTIs), the first class to be approved, interfere with the integration of the HIV genome into the nuclear DNA of infected cells, by one of two basic mechanisms. The early RTIs alone, however, did not prove to have long-term effectiveness. Protease inhibitors (PIs), the second class of drugs to emerge, interfere with an enzyme that cleaves long polypeptides transcribed from the viral genome into functional fragments. The introduction of PIs resulted in effective long-term treatment, called Highly Active Antiretroviral Therapy, through the use of multiple medications with differing modes of action. Even newer medications inhibit the entry of HIV into the cells.

Although formulations are available today that contain multiple medications in a single dose, most respondents were taking two or more different pills. Most could name their medications, and were aware that one or more of them was a combination of different chemicals. The most commonly prescribed combination pill contains three active ingredients; one respondent confidently proclaimed that it contained five, the initials of which provided the letters in its name. One respondent had yet to begin treatment, and three could not name their medications.

Although all the respondents essentially believed that medications would help keep them healthy, they were largely unable to explain their mechanisms of action, e.g.:

> Interviewer: Can you tell me what each of them does?
>
> Interviewee: Hopefully what they're supposed to. These are medications that help me keep my—whatever, T-cell—it's supposed to, you know, when I was taking them regularly, I was undetected, so obviously they were helping because as soon as I stopped my T-cell count went low.

One was aware that ritonavir, which he called by its brand name, was prescribed to boost the action of other medications. (Respondents exclusively used brand names. Ritonavir impedes the action of the liver enzyme that degrades other PIs.) In one case, the patient essentially reversed the mechanism of the drug action, saying that they “[fight] the immune system”.

CD4+ Count and Viral Load

The CD4+ count and the viral load are two important surrogate markers of HIV progression. The CD4+ count refers to the number of CD4+ cells per milliliter of blood. The viral load is the count of provirus particles per milli-liter of blood. The CD4+ count is a marker of the patient's level of immunosuppression and susceptibility to opportunistic infections. A CD4+ above 600 is considered normal, though typically it is even higher in uninfected people. For many years this count was used as an indication for initiation of therapy, with the consensus trending over time toward earlier and earlier initiation of treatment. Many clinicians now do not wait for declining CD4+ counts to initiate treatment, but recommend treatment for all people diagnosed as HIV infected. A CD4+ count below 200 is definitive for a diagnosis of AIDS.

The viral load is a marker of the effectiveness of ARV treatment. Ideally, a viral load result for a patient on antiretroviral therapy will be “undetectable,” that is, below between 20 and 75 copies of virus per milliliter of blood, depending on the sensitivity of the assay. A rising viral load is an indicator of treatment failure, either because the patient is non-adherent to the medication, or the viral strain has become resistant. (See below.)

Many respondents could not accurately describe the meaning of CD4+ count and viral load. In total, 19 examples of difficulties explaining viral load and CD4 count were present in the interviews. Some respondents were unable to explain their counts at all:

> Interviewer: And if somebody were to ask you what...we talked about viral load earlier, how you were undetectable and now it's down, if somebody were to ask you, “What does that mean, viral load?” what would you tell them?
>
> Interviewee: I don't know. That's why it would be good if I had meetings so you learn more about it. So if somebody asks you what's going on between something and another thing, you've got the right answer.

And:

> Interviewer: And I know we touched on this a little bit, but do you understand what it means for a T-cell count or CD4 count? What does that mean?
>
> Interviewee: I don't know nothing about that.

Some respondents reversed the significance of these measures, stating that they wanted a high viral load or a low CD4+ count. One explained that she wanted her CD4+ count to remain high, which she equated with her CD4+ count being “undetectable.” For some, the explanations were partly correct: viral load might be described in biomedically plausible terms but not CD4+ count, or vice versa. One described CD4+ cells as the oxygen-carrying cells of the body.

In 14 cases—fewer than half—descriptions of viral load and CD4 counts were largely accurate, at least to the extent that respondents could distinguish between the two and recognize which number should be high and which should be low. Although the following respondent initially deprecated her own knowledge, she did accurately explain viral load and T-cell count:

> Interviewee: Some people can go on and on about the science and everything, but I can't. I'm not ashamed to say because I don't really - I know it all, I've read it all. I can't—with me, it has to be sunk in over and over and over and over. Even after 25 years, it's still like I have to read all the basic information over, and I just can't spout it out. And I know it doesn't look good on my part, but that's just the way it is.
>
> Interviewer: No, no. You're like a lot of people, I'll say that right now. How would you explain what viral load means?
>
> Interviewee: It's the amount of virus that's in a percentage of your blood. I think they take something to do with a thousand or so many parts of—they take the blood

in so much—they measure the virus in the amount of the blood and so much of the -.

Interviewer: That's it. That's basically it.

Interviewee: The viral load is a percentage of the virus in that certain amount of blood, right.

Interviewer: There you go. No problem. And how do you explain what a T cell count is?

Interviewee: I think it's the same way. The T cells are a certain—or you take a certain amount of the blood and then there's a certain amount of T cells in that part and then they gotta—however they can measure them to see what the percentage is, total for that amount of blood from what the normal—what it should—what the normal should be.

One respondent said the following: “Basically, I just think of it like this: ‘I don't necessarily need to know what CD4+ count is, but all I know is the lower the worse, the higher the better. So, there it is.”’.

Drug Resistance

Drug resistance refers to genetic mutations in the HIV virus that compromise the ability of antiretroviral drugs to inhibit viral replication. Resistance results from inconsistent adherence to the antiretroviral regimen, such that viral replication is not fully suppressed but some medication is present in the blood, and resistant variants are selected.

Respondents had many explanations for the nature of HIV drug resistance. Eleven had no idea what “drug resistance” meant at all. One could say nothing more than it meant that the pills stopped working. Eleven believed that resistance resulted from a change in the body of the person living with the virus, as illustrated here:

Interviewer: And then you said your body became resistant to it?

Interviewee: Right.

Interviewer: Is that how you explained it to me?

Interviewee: Right.

Interviewee: That means that instead of—in other words instead of the pill helping you take care of the virus, it was affecting, it was opening other areas of the virus. So it will like spread a little more.

Another respondent in this category said:

Medication resistant would be that your body is not accepting the medication, so it's gonna resist it, or vice versa....Medication could resist your body...there could be some kind of medication that could alter what it's supposed to do for the disease....Your body could be allergic to—it could be just a coating and not the medication, and your body would be resisting the medication.

Five respondents attributed drug resistance to a change in the virus, but did not have an accurate understanding of how this occurred. Some described the virus as a "learning" to subvert the effects of the drugs, as below:

> So being as HIV is a learning virus and adaptable, which means wherever I caught it from could've been someone who was on that specific drug and had stopped taking it. So they're resistant—they had a resistance to it.

Two respondents—the biology graduate, and the woman who gave a rich explanation of the function of CD4+ cells and the mechanism of HIV disease—had a basic understanding of Darwinian evolution as the mechanism. The biology graduate said "once you go below [a] level [of medication in the blood], you start to get the ability for these [aberrant] virus populations to wreak havoc if they return." The other respondent gave an even richer explanation:

> I think it's when the virus—if you have a certain amount of medicine in your body, it keeps the virus from mutating. And then if you don't have that certain level, certain populations of the virus comes up and will be resistant to the treatment. The treatment won't—'cause if the population changes and new forms of the virus—not a new virus but new forms of it, new subtype of what have you, which is not—the medication won't work well.

How Can One Avoid Resistance?

Strict adherence to the antiretroviral regimen results in a low probability of resistance. The highest probability of resistance results from erratic adherence, with repeated treatment interruptions of 2 or 3 days. Longer term treatment interruption, while not optimal, produces a lower probability of resistance than frequent, brief interruptions.

Nine respondents said they had no idea how to prevent resistance, including some who had never heard of it, and one who said "give it to higher power." However, most did connect drug resistance with poor adherence to ARV therapy.

Ten reported accurately that erratic adherence could be responsible for drug resistance. "If you're on the right meds, stay on them," encouraged one of the patients. "Take them how you're supposed to. It's what makes it work. If you take it consistently like it's supposed to be done." However, eight people attributed drug resistance to longer-term "breaks" or "holidays" from the medications, without referring to brief treatment interruptions.

Some respondents offered more idiosyncratic explanations for drug resistance. Three of the respondents believed that staying on the same medications, or taking too much medication, would cause drug resistance. One framed resistance in terms of a genetic flaw in the individual with the virus that makes the medications ineffective. Another attributed resistance to drug abuse, and another to "your physical makeup."

Non-Adherence and Treatment Interruptions or "Holidays"

Although so-called structured treatment interruptions—of several months or more—were considered to be a therapeutic option in the past, more recent research has found them to be

associated with poorer long term outcomes. Additionally, although physicians obviously discourage alcohol and other drug abuse, ARV medications are effective when patients abuse alcohol and other drugs and physicians recommend that patients still take them. We asked why it is important to stay on the medications, and, as a follow-up, what respondents would tell a friend considering taking a "drug holiday," or taking time off from their medications.

Most respondents did consider treatment interruptions to be a bad idea. They typically framed their answer in terms of living longer and/or feeling better: "[I]f you've got HIV, it's better to do the medicine before the symptoms become more hard on your body" or "You can live longer, you'll be happier, you'll feel better". Some of the interviewees also brought up the concept of resistance in this context. Others noted that not taking the drugs has negative results on the CD4 count and the viral load.

However, a few respondents did endorse drug holidays, as in this case:

> I think you take a holiday when your body's too stressed out. When you have so many symptoms and you just can't take them, so it's best to probably build your body up.... But I wouldn't take a holiday because you can develop resistance.

Here, the interviewee notes that a drug holiday may help alleviate the "overload" of "too many" HIV medications in the body at one time, but also brings up the potential for resistance. One respondent said that "your body gets saturated" with the medications and it's good to give your body a break sometimes. He explained that drug holidays have worked for him in the past, and that too much of the medication has made him sick:

> It goes in—I will get sick. I will throw the medicine up just because my body is trying to tell me enough's enough. I can't do this anymore. I have to stop. And I listen to my body.

Another said that "there have been times in my life where I just feel like I cannot take another dose," and a drug holiday was an appropriate response to the feeling of saturation.

Finally, three respondents said that you should not take ARV medications when you drink or use illicit drugs, as illustrated here:

> Interviewee:...No, it wasn't a thought. It was just I know if I'm gonna use, I just wouldn't take them. I was scared. I was scared that I would hurt myself more - because I figured, well, I got drugs in my system, and I'm putting these other drugs, you know, and could there be a bad reaction?

One of these respondents said his doctor had given him this instruction. According to his explanation, one must choose between alcohol and ARV therapy, since the alcohol "blocks" the medication.

Discussion

In general, respondents had very limited understanding of the biomedical explanatory models of HIV disease and antiretroviral treatment. In many cases, their beliefs were wildly inaccurate. Most reported being adherent to their medications and believed that it was

important to be diligent about taking doses on schedule. However, most did not have a mechanistic rationale for this belief. Essentially, they trusted their providers' instructions. It is particularly noteworthy that most did not connect viral drug resistance to non-adherence, or if they did, they attributed it more to long-term treatment interruption than to erratic medication taking.

These observations may help to explain the inconsistent results of studies of the relationship between health literacy and ARV adherence. Essentially, most people who are told by their providers, and perhaps others, that strict adherence is essential to prevent disease progression, simply believe it, without needing further explanation. It doesn't even seem to matter whether people believe that they should strive to have a high viral load and a low T-cell count. Indeed, in our sample there are examples of people who may be non-adherent because they apply inaccurate mechanistic explanations, e.g. they interrupt treatment when they use alcohol (a phenomenon which has been observed previously [38–40]), or take longer-term holidays because they believe it is better for their health.

Also of interest, one of the two respondents who offered a deeper, and generally accurate understanding of why strict adherence is important and understood resistance to be a result of Darwinian evolution (albeit using lay vocabulary) reported poor recent adherence. Medication taking behavior in this sample is not consistently associated with mechanistic explanations or any degree of explanatory depth.

These findings raise the question of what kinds of information people living with HIV, or other chronic conditions, require to participate in treatment decision making and undertake effective self-care. In terms of Paasche-Orlow and Wolf's expanded concept of health literacy [29], it seems that for most respondents, biomedical knowledge is less important than health beliefs for effective provider-patient interaction and self-care. While it may seem to be an a priori ethical imperative to try to provide patients with chronic diseases as much understanding of the biology of their condition as possible, it may have little bearing on outcomes. In fact, our respondents' motivations for the decisions they have made about medication taking and other health-related behaviors are framed in very different terms, which we will discuss elsewhere.

However, it is important to note that inaccurate understanding of the mechanism of viral drug resistance, and specific beliefs about ARV toxicity and the interaction of ARV with alcohol are associated with non-adherence for some respondents. That so many respondents confuse the targets for CD4+ count and viral load also suggests that clinicians should assure that patients understand these if laboratory counts are to be an effective motivator for ARV adherence.

This study has some limitations. This is a convenience sample, taken from a limited geographic region. It includes few people who are recently diagnosed and none who are not currently in treatment. The generalizability is unclear. Nevertheless, it indicates that we need a better understanding of what information people living with HIV—or other chronic diseases—really need, or want, in order to participate effectively in self-care and treatment decision making; and how to more effectively communicate biomedical concepts to patients.

Our respondents received their HIV care from specialists, at relatively well-resourced clinics, with ancillary services available such as support groups and case managers. We do not know what efforts their providers and other staff made to educate these patients about the nature of HIV, mechanisms of disease, and treatment. The patients may have been told a great deal that they did not understand, or remember. While it does not appear that a sophisticated understanding of the science of HIV is generally necessary to motivate treatment adherence, more research to find effective ways of providing relatively in-depth information that is understandable for more patients may be indicated.

This would be an ethical imperative to meet the needs of people who express a wish to have deeper understanding. It is also important to prevent people from developing misleading ideas, such as the body becoming “saturated” with the drugs and treatment interruption being beneficial. It is also possible that other misconceptions could affect adherence, even though we did not observe it in this sample. For example, people who believe drug resistance is a change in their bodies, rather than the virus, could be less motivated to long-term consistent adherence, even though most of our respondents who believe this reported good current adherence.

In sum, it appears that few lay people have sufficient grounding in biology to assimilate basic biomedical ideas. Health care providers need to assess not only what people do understand, but what it is important for them to understand in order to participate effectively in treatment decision making and self-care according to their own inclinations and decision heuristics. While full and deep comprehension of biomedical concepts does not appear to be essential for good clinical outcomes for most people, we do need a better understanding of how to diagnose the informational and explanatory needs of individuals; what informational and instructional points are important to emphasize for typical patients; and how to convey biomedical concepts in terms that are accessible to lay people.

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References

1. Horowitz HW, Telzak EE, Sepkowitz KA, Wormser GP. Human immunodeficiency virus infection, Part I. Dis Mon. 1998; 44(10):545–606. [PubMed: 9814367]
2. Hogg RS, Heath KV, Yip B, Craib KJ, O'Shaughnessy MV, Schechter MT, et al. Improved survival among HIV-infected individuals following initiation of antiretroviral therapy. JAMA. 1998; 279(6): 450–4. [PubMed: 9466638]
3. Piacenti FJ. An update and review of antiretroviral therapy. Pharmacotherapy. 2006; 26(8):1111–33. [PubMed: 16863488]
4. Kitahata MM, Gange SJ, Abraham AG, Merriman B, Saag MS, Justice AC, et al. Effect of early versus deferred antiretroviral therapy for HIV on survival. N Engl J Med. 2009; 360(18):1815–26. [PubMed: 19339714]
5. Centers for Disease Control and Prevention. National HIV Prevention Progress Report. 2013 2014.
6. Bangsberg DR, Perry S, Charlebois ED, Clark RA, Roberston M, Zolopa AR, et al. Non-adherence to highly active antiretroviral therapy predicts progression to AIDS. AIDS. 2001; 15(9):1181–3. [PubMed: 11416722]

7. Bangsberg DR, Kroetz DL, Deeks SG. Adherence-resistance relationships to combination HIV antiretroviral therapy. Curr-HIV/AIDS Rep. 2007; 4(2):65–72. [PubMed: 17547827]
8. Paterson DL, Swindells S, Mohr J, Brester M, Vergis EN, Squier C, et al. Adherence to protease inhibitor therapy and outcomes in patients with HIV infection. Ann Intern Med. 2000; 133(1):21–30. [PubMed: 10877736]
9. Genberg BL, Wilson IB, Bangsberg DR, Arnsten J, Goggin K, Remien RH, et al. Patterns of antiretroviral therapy adherence and impact on HIV RNA among patients in North America. AIDS. 2012; 26(11):1415–23. [PubMed: 22767342]
10. Ledergerber B, Egger M, Opravil M, Telenti A, Hirschel B, Battegay M, et al. Clinical progression and virological failure on highly active antiretroviral therapy in HIV-1 patients: a prospective cohort study. Swiss HIV Cohort Study. Lancet. 1999; 353(9156):863–8. [PubMed: 10093977]
11. Sterne JA, Hernan MA, Ledergerber B, Tilling K, Weber R, Sendi P, et al. Long-term effectiveness of potent antiretroviral therapy in preventing AIDS and death: a prospective cohort study. Lancet. 2005; 366(9483):378–84. [PubMed: 16054937]
12. Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N, et al. Prevention of HIV-1 infection with early antiretroviral therapy. N Engl J Med. 2011; 365(6):493–505. [PubMed: 21767103]
13. National Research Council. Health Literacy: A Prescription to End Confusion. Nielsen-Bohlman, L.; Panzer, AM.; Kindig, DA., editors. The National Academies Press; Washington: 2004.
14. Gazmararian JA, Kripalani S, Miller MJ, Echt KV, Ren J, Rask K. Factors associated with medication refill adherence in cardiovascular-related diseases: a focus on health literacy. J Gen Intern Med. 2006; 21(12):1215–21. [PubMed: 17105519]
15. Muir KW, Santiago-Turla C, Stinnett SS, Herndon LW, Allingham RR, Challa P, et al. Health literacy and adherence to glaucoma therapy. Am J Ophthalmol. 2006; 142(2):223–6. [PubMed: 16876500]
16. Schillinger D, Grumbach K, Piette J, Wang F, Osmond D, Daher C, et al. Association of health literacy with diabetes outcomes. JAMA. 2002; 288(4):475–82. [PubMed: 12132978]
17. Bohanny W, Wu SF, Liu CY, Yeh SH, Tsay SL, Wang TJ. Health literacy, self-efficacy, and self-care behaviors in patients with type 2 diabetes mellitus. J Am Assoc Nurse Pract. 2013; 25(9): 495–502. [PubMed: 24170654]
18. Williams MV, Baker DW, Parker RM, Nurss JR. Relationship of functional health literacy to patients' knowledge of their chronic disease. A study of patients with hypertension and diabetes. Arch Intern Med. 1998; 158(2):166–72. [PubMed: 9448555]
19. Dewalt DA, Berkman ND, Sheridan S, Lohr KN, Pignone MP. Literacy and health outcomes: a systematic review of the literature. J Gen Intern Med. 2004; 19(12):1228–39. [PubMed: 15610334]
20. Davis TC, Long SW, Jackson RH, Mayeaux EJ, George RB, Murphy PW, et al. Rapid estimate of adult literacy in medicine: a shortened screening instrument. Fam Med. 1993; 25(6):391–5. [PubMed: 8349060]
21. Nokes KM, Coleman CL, Cashen M, Dole P, Sefcik E, Hamilton MJ, et al. Health literacy and health outcomes in HIV seropositive persons. Res Nurs Health. 2007; 30(6):620–7. [PubMed: 18022832]
22. Paasche-Orlow MK, Cheng DM, Palepu A, Meli S, Faber V, Samet JH. Health literacy, antiretroviral adherence, and HIVRNA suppression: a longitudinal perspective. J Gen Intern Med. 2006; 21(8):835–40. [PubMed: 16881943]
23. Wolf MS, Davis TC, Osborn CY, Skripkauskas S, Bennett CL, Makoul G. Literacy, self-efficacy, and HIV medication adherence. Patient Educ Couns. 2007; 65(2):253–60. [PubMed: 17118617]
24. Osborn CY, Paasche-Orlow MK, Davis TC, Wolf MS. Health literacy: an overlooked factor in understanding HIV health disparities. Am J Prev Med. 2007; 33(5):374–8. [PubMed: 17950402]
25. Parker RM, Baker DW, Williams MV, Nurss JR. The test of functional health literacy in adults: a new instrument for measuring patients' literacy skills. J Gen Intern Med. 1995; 10(10):537–41. [PubMed: 8576769]
26. Kalichman SC, Ramachandran B, Catz S. Adherence to combination antiretroviral therapies in HIV patients of low health literacy. J Gen Intern Med. 1999; 14:267–73. [PubMed: 10337035]

27. Kalichman SC, Pope H, White D, Cherry C, Amaral CM, Swetzes C, et al. Association between health literacy and HIV treatment adherence: further evidence from objectively measured medication adherence. J Int Assoc Physicians AIDS Care (Chic). 2008; 7(6):317–23. [PubMed: 19056866]

28. Golin CE, Liu H, Hays RD, Miller LG, Beck CK, Ickovics J, et al. A prospective study of predictors of adherence to combination antiretroviral medication. J Gen Intern Med. 2002; 17(10): 756–65. [PubMed: 12390551]

29. Paasche-Orlow MK, Wolf MS. The causal pathways linking health literacy to health outcomes. Am J Health Behav. 2007; 31(Suppl 1):S19–26. [PubMed: 17931132]

30. Caplan, AL.; McCartney, JJ.; Sisti, DA. Health, Disease and Illness: Concepts in Medicine. Georgetown University Press; Washington: 2004.

31. Kleinman A, Eisenberg L, Good B. Culture, illness, and care: clinical lessons from anthropologic and cross-cultural research. Ann Intern Med. 1978; 88(2):251–8. [PubMed: 626456]

32. Kleinman, A. Patients and healers in the context of culture. An explorationof the borderland between anthropology, medicine, and psychiatry. University of California Press; Berkeley: 1981.

33. Laws MB, Wilson IB, Bowser DM, Kerr SE. Taking antiretroviral therapy for HIV infection: learning from patients' stories. J Gen Intern Med. 2000; 15(12):848–58. [PubMed: 11119181]

34. Laws MB, Rose GS, Bezreh T, Beach MC, Taubin T, Kogelman L, et al. Treatment acceptance and adherence in HIV disease: patient identity and the perceived impact of physician-patient communication. Patient Prefer Adherence. 2012; 6:893–903. [PubMed: 23271898]

35. Mishler, EG. The Discourse of Medicine: Dialectics of Medical Interviews. Ablex; Norwood: 1984.

36. Habermas, J. Lifeworld and system: a critique of functionalist reason. Beacon Press; Boston: 1984. The theory of communicative action. V.1. Reason and the rationalization of society. V.2..

37. Mandell, GL.; Bennett, JE.; Dolin, R. Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. Vol. 7. Churchill Livingstone; Philadelphia: 2010.

38. Kalichman SC, Amaral CM, White D, Swetsze C, Kalichman MO, Cherry C, et al. Alcohol and adherence to antiretroviral medications: interactive toxicity beliefs among people living with HIV. J Assoc Nurses AIDS Care. 2012; 23(6):511–20. [PubMed: 22421097]

39. Kalichman SC, Amaral CM, White D, Swetsze C, Pope H, Kalichman MO, et al. Prevalence and clinical implications of interactive toxicity beliefs regarding mixing alcohol and antiretroviral therapies among people living with HIV/AIDS. AIDS Patient Care STDS. 2009; 23(6):449–54. [PubMed: 19413503]

40. Kalichman SC, Grebler T, Amaral CM, McNerey M, White D, Kalichman MO, et al. Intentional non-adherence to medications among HIV positive alcohol drinkers: prospective study of interactive toxicity beliefs. J Gen Intern Med. 2013; 28(3):399–405. [PubMed: 23065532]