Clinical Epidemiology and Global Health 19 (2023) 101206

Contents lists available at ScienceDirect

Clinical Epidemiology and Global Health

journal homepage: www.elsevier.com/locate/cegh

Original article

Evaluation of health literacy and medication regimen complexity index among patients with human immunodeficiency virus infection: A single-Centre, prospective, cross-sectional study

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ARTICLE INFO

Keywords:
Health literacy
Medication regimen complexity index
People living with HIV
Antiretroviral therapy

ABSTRACT

Background: A limited number of studies have explored the association between health literacy (HL) and health outcomes. Effectively managing HIV infection expects from the patients the ability to seek medical help, understand the instructions provided by the healthcare professionals, and adhere to the treatment plans. This study aimed to evaluate the HL and medication regimen complexity index (MRCI) among people living with HIV and determine the associated factors.

Methods: This was a prospective, cross-sectional study. Each study participant was assessed using the HIV literacy test (HIV-LT). The complexity of the prescribed drug regimen was measured using MRCI. Changes in HL and MRCI with age, gender, and educational status of the individual were assessed. The presence of any correlation between HL and MRCI scores was assessed using Spearman's correlation coefficient test.

Results: Of the 285 patients with HIV infection studied, 51.6% were males and 48.4% were females. The median HIV-LT score was 3 (out of 10) (interquartile range [IQR], 0–6), and the median MRCI score was 8 (6–12). A statistically significant increase in the HL scores based on the educational status of the participants was seen ($x^2 = 87.324$, $p < 0.001$).

Conclusion: Our study reveals that the majority of the HIV-infected patients studied had inadequate HL as measured using the HIV-LT tool. Those with poor HL did not receive more number of drugs as compared with those with higher HL. Strengthening the counselling and supportive care in patients with HIV, particularly among those with poor HL, is necessary.

Clinical trial registration: CTRI/2019/06/019609.

1. Introduction

The role of health literacy in influencing the health-related behaviours, such as physical activity, seeking health care, adherence to treatment, among people living with human immunodeficiency virus infection (PLHIV) has not been adequately studied in the Asian population. Health literacy (HL), a subdivision of the overall education talents, which relatively corresponds with it, is the ability of individuals to obtain, understand and apply basic health information in making appropriate decisions regarding their health as well as utilizing services to achieve the same[2] Inadequate health literacy is not unusual even in industrialized nations, including the USA, where 90 million population is estimated to have low or insufficient health literacy.[1]

A limited number of studies have explored the association between health literacy and health outcomes.[3,4] Effectively managing HIV infection requires from the patients the ability to seek medical help, understand the instructions provided by the healthcare professionals, and adhere to the treatment plans.[1] Earlier studies have shown that people living with HIV who have marginal health knowledge have lower knowledge of the disease,[5,6] lower capacity to correctly manage the drugs,[7] and lesser chances of attaining the target viral load levels compared with those with acceptable HL levels.[5]

In India, the incidence of HIV in 2017 among those aged 15–49 years was 0.2%[8]; the state of Maharashtra had the highest number of new HIV infections in 2019 (8.54 thousand), and Delhi had the lowest number (2.99 thousand). The 2011 national census data shows that 88.57% of

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https://doi.org/10.1016/j.cegh.2022.101206
Received 6 June 2022; Received in revised form 26 November 2022; Accepted 26 December 2022
Available online 31 December 2022

the population of Dakshina Kannada, a southern district of Karnataka, were educated in comparison with the national adult literacy rate of 74.04%.[9] There is evidence that poor HL influences the ability of adults to self-monitoring disease conditions like HIV; however, data on the potential consequences of limited health knowledge on patient behavior, and thereby, the treatment outcomes in Indian population is limited. In particular, HL is one of the factors that influences adherence to pharmacotherapy, with high degree of adherence being essential for treating HIV and preventing development of resistance.[10]

The success of pharmacotherapy depends significantly on the ability of the patients to execute the recommended treatment plan in terms of following the instructions for drug intake. Depending on the complexity of such prescribed regimens, in terms of drug quantity and the relevant instructions to be followed, patients' ability to follow the planned treatment strategy may vary. Hence, tools have been devised to determine the complexity of prescribed drug regimens. One such tool is the Medication Regimen Complexity Index (MRCI), which scores prescriptions based on the drug formulation(s) used, the dosing frequency, and the instructions for drug intake.[11]

Observational studies have shown that an increase in dosing frequency or complexity of the medication regimen leads to a decrease in adherence to treatment.[12]

People living with HIV (PLWH) have a higher medication burden due to the presence of comorbid illnesses. Older age, female gender, obesity, and hepatitis B/C co-infection have been shown to receive more number of drugs and thereby, require more complex regimens for disease management over time.[13,14] The relationship between HL and MRCI in patients with HIV has not been explored. Available evidence suggests that patients with poor HL are likely to have poor outcomes; lack of understanding of treatment instructions or inadequate adherence to treatment may result in disease worsening/development of resistance and, thereby, require addition of more drugs, which adds to the prescription complexity.[15] However, this assumption needs to be formally studied. In this study, we used the Medication Regimen Complexity Index (MRCI), a 65-item tool that utilizes data from a patient's treatment record, to measure the medication regimen complexity.[16] The aim was to evaluate the HL and medication regimen complexity index among people living with HIV and determine the associated factors.

2. Methods

This was a prospective, cross-sectional study conducted at the government-funded antiretroviral treatment (ART) center of Kasturba Medical College Hospital (KMCH), Attavar, Mangaluru. The center caters to the population of the Dakshina Kannada district situated in the southern part of the state of Karnataka. In addition, the clinical services are availed by patients from adjoining districts, including those from the neighboring state of Kerala.

The study was initiated after receiving approval from the institutional ethics committee of Kasturba Medical College, Mangaluru, Karnataka, India (IEC KMC MLR 05–19/227, Clinical Trial Registration: CTRI/2019/06/019609). Potential subjects were approached at the waiting area of the ART clinic on the day of their visit and were explained the objectives of the study in a language that they understood; anonymity was assured and maintained.

The consenting participants were included in the study if they were PLHIV aged 18 years or more, stable patients on antiretroviral therapy for a minimum period of six months, and had ART adherence >95% based on the patient records. Participants with a severe neurocognitive disorder or HIV malignancy were excluded from the study.

3. Health literacy assessment

Each study participant was assessed using the HIV Literacy Test (HIV-LT),[17] a novel 10-item scale developed to assess general and numerical literacy associated tasks. Briefly, these tasks include questions assessing the management of oneself, the ability to take oral medicine, understanding the follow-up date for the next clinic visit, understanding the date and time of appointments, etc. The score of a participant is computed as the number of objects answered accurately, and ranged from 0 to 10; higher scores indicate greater literacy.

The HIV-LT questionnaire was adapted for use in the study population by translating, following the recommendations for cross-cultural translation guidelines,[18] from English to Kannada and Malayalam, by two professional translators, separately. The forward translation-back-translation method was used for language validity.[19] The content validity was done by obtaining the opinions of five health professionals regarding the translated questionnaire. A pilot study using the translated questionnaire was carried out with 10% of the estimated sample size (n = 29) to determine the face validity of the questionnaire. The translated questionnaire was found to have good reliability (Cronbach's alpha 0.847).

4. MRCI assessment

The MRCI is a validated instrument for measuring the complexity of a prescription.[16] The MRCI tool comprises three parts, A, B, and C; part A scores the pharmaceutical formulation used to deliver the drug; part B, the frequency of drug administration; and part C, the direction(s) given for medication administration. Each section is scored separately, and the sum of the three sections constitutes the MRCI score. The MRCI scores were calculated using an MRCI scoring manual.[16] The score is calculated for a participant's prescription of ART and concomitant medicines.

5. Statistical analysis

The sample size was calculated based on the assumption that a moderate negative correlation (0.3) would be present between the HL and MRCI scores. For the study to have 90% power to detect a correlation coefficient of 0.3 or above, with a p-value of 0.001, the sample size required is 221. Assuming a 30% non-response error, based on a two-tailed test, the sample size required for the study was 285.

Data were twice entered using EpiData Entry software version 3.1 (EpiData Association, Odense, Denmark) and analyzed using IBM® SPSS®, version 11.0 (Chicago, IL, USA). The demographic and clinical characteristics of the study participants, the MRCI, and health literacy scores have been presented as frequency/percentage or median and interquartile range, as appropriate. The normality of data distribution was assessed using the Shapiro-Wilk test; the study parameters were not normally distributed ($p < 0.05$). Study groups were compared using the Mann Whitney *U* test or Kruskal Wallis test, as appropriate; the correlation between HL and MRCI scores was assessed using Spearman's correlation coefficient test. A p-value <0.05 was considered statistically significant.

6. Results

From August 2019 to November 2021, we recruited 285 adult patients with HIV who were receiving treatment at the ART center. Of the 285 participants, 48.4% were females. The median age of the study participants was 48.00 years (IQR, 39.50–54.00). Regarding educational status, 5.6% were unschooled, 23.9% had completed primary school, 50.5% secondary school, and 20.0% had completed college education. Kannada was the native language spoken by 85% of participants, the rest being Malayalam-speaking. The median duration of ART was 6 years (IQR, 4–9). The demographic profile of the study participants is shown in Table 1.

7. Assessment of health literacy

The median score on the HIV-LT was 3.00 (IQR: 0.00–6.00). Seventy-five (26.3%) scored zero in HIV-LT, and the median age of these

Table 1
Socio-demographic and clinical characteristics of PLHIV (n = 285).

Characteristics	Frequency	Percentage
Age in years		
<21	**8**	**2.8**
21-40	**70**	**24.6**
41-64	**194**	**68.1**
≥65	**13**	**4.6**
Gender		
Male	**147**	**51.6**
Female	**138**	**48.4**
Comorbidity		
Diabetes mellitus	**28**	**9.8**
Hypertension	**59**	**20.7**
Other comorbidity	**10**	**3.5**
Education		
Illiterate	**16**	**5.6**
Primary school	**68**	**23.9**
Secondary school	**144**	**50.5**
College & above	**57**	**20.0**
Years on antiretroviral therapy		
1-3	**50**	**17.5**
4-6	**94**	**33.0**
6-9	**132**	**46.3**
≥10	**9**	**3.2**

*PLHIV, People living with HIV.

participants was 49 years (IQR: 41–55); 39 were male and 36 were female; 14 were illiterate, 36 were primary school educated, 24 were secondary school educated, and one had completed college education. No significant age-related difference was seen in the HL scores (x^2 = 7.528, p = 0.057). Similarly, no gender-related differences were observed (Z = −1.841, p = 0.066). A statistically significant increase in the HL scores based on the educational status of the participants was seen (x^2 = 87.324, p < 0.001). Health literacy and medication regimen complexity index scores of PLHIV is shown in Table 2. Less than 20% of the study participants were able to mention the correct date of the next clinical visit, mention the number of tablets to be taken each morning, and interpret a generally used prescription card with directions for the proper time for medication intake (Table 3).

8. Assessment of medication regimen complexity

The 285 participants took a total of 639 drug formulations, and the median number of medications taken was 8.0 (IQR, 6–12) per person per day, with a minimum of one and a maximum of eight. The median number of drugs consumed daily was not significantly different between genders (males, 8 [8–14]; females, 8 [4–12]; p = 0.579). The overall median MRCI score 8 (6–12). The median score for each section of the MRCI was as follows: section A, 2 (1–3); section B, 2 (1–3); and section C, 4 (2–6). There was no significant difference in the MRCI score based on the duration of ART (X^2 = 5.147, p = 0.161). The median MRCI score was 9 (4–16) for patients on 1–3 years of ART, 8 (4–12) for 4–6 years treatment, 8 (7–12) for 6–9 years, and 12 (8–12) for those on 10 or more years of ART. The MRCI score of the study participants with comorbidities was as follows: 16 (13–22) in those with diabetes mellitus; 12 (9–16) in hypertensives, and 11 (8–15) in those with other comorbidities. The MRCI score among those without any comorbidities was 8 (4–12).

Table 2
Health literacy and medication regimen complexity index scores of PLHIV (n = 285).

Health literacy score categories	MRCI score	
	Median	Interquartile range (IQR)
0–2	8	8–12
3–4	8	8–15
5–6	8	7–12
7–8	10	4–16
9–10	8	4–8

*MRCI, medication Regimen Complexity Index, PLHIV, People living with HIV.

Table 3
HIV Literacy Test (HIV-LT) items and accurate responses among 285 adults with HIV on treatment.

SI·NO.	Questions	% of participants with correct response
1.	Report the date of the next clinical visit (presented in an consultation slip)	**17.1**
2.	Read a prescription card and, using the instructions, state the number of pills to take per day	**18.5**
3.	Calculate the number of pills to take each morning (using written instructions)	**46.5**
4.	Calculate how many pills would be needed for a 14-day trip (using written instructions)	**44.1**
5.	Report the proper time to take a medication using written instructions	**40.9**
6.	Interpret the value of CD4 count that would indicate the threshold for ART initiation	**42.3**
7.	Using a representation of a standardized dosing cup, indicate how to measure a dose of 7.5 mL	**36.4**
8.	Using a representation of a standardized dosing pill, indicate which one to take in children	**46.5**
9.	Using a representation of a standardized dosing syringe, indicate how to measure a dose of 3 mL	**45.5**
10.	Interpret a prescription card with instruction for the recommended time to take tablets	**12.2**

*HIV, human immunodeficiency virus, ART, antiretroviral therapy.

9. Health literacy and MRCI

There was no correlation between health literacy and MRCI scores (r = −0.002, p = 0.971). We further divided the study participants based on their HIV-LT scores into two groups, those with HIV-LT scores of 0–5 and 6–10; no significant difference in the MRCI scores was seen between the two groups (Z = −0.213, p = 0.755). There was no association between the educational status of the participants and the MRCI score (X^2 = 4.547, p = 0.208). Age-wise distribution, Educational Status and medication regimen complexity index and health literacy scores of PLHIV is shown in Table 4.

10. Discussion

Our study assessed the HL of 285 patients with HIV infection using

Table 4
Health literacy and medication regimen complexity index scores of people living with HIV categorized based on age and educational status (n = 285).

Age	MRCI score		HIV-LT score	
	Median	Interquartile range (IQR)	Median	Interquartile range (IQR)
Underage 21	8	6–8	5	4–7
Age 21-40	8	4–9	4	1–7
Age 41-64	8	7–13	3	0–6
Age 65 & above	12	8–16	5	0–6
Education				
Illiterate (n = 16)	8	6–8	0	0–0
Primary school (n = 68)	8	8–12	0	0–3
Secondary school (n = 144)	8	4–12	4	1–6
College & above (n = 57)	8	7–16	6	5–8

*MRCI, Medication Regimen Complexity Index, HIV-LT, HIV Literacy Test.

the HIV-LT tool and measured the complexity of the prescribed drug regimen using MRCI. There was no significant correlation between the HIV-LT and MRCI scores. There was no age- or gender-related differences in these scores, Although the HIV-LT scores increased with increasing education, the median HIV-LT scores in those who completed college education were 6, indicating that even in this group, there were individuals who were unable to understand and interpret the healthcare-related instructions provided during the HL assessment. Moreover, less than 20% of the study participants were able to accurately answer the items related to common tasks expected of patients; patients had difficulty in interpreting the generally used consultation slips, knowing the exact time and number of tablets to be taken daily, and comprehending disease-related information, like CD4 count and viral load. The study emphasizes various implicit difficulties associated with a patient's ability to understand the various HIV-relevant personal care activities. Colbert et al. describe the presence of sub-optimal medication adherence even among study participants considered to have adequate levels of health literacy. Kalichman et al. studied a community sample of 339 HIV-infected patients; those with low HL were less regular with their medication intake, experienced more hospitalizations, and had higher viral loads. A study assessing racial disparities in patients with HIV found that those with poor HL were likely to have difficulties with counting pills to determine missed doses and deciding on the need to refill medications.[20] These findings, along with those of the current study, highlight the importance of HL in disease management and outcome.

Assessment of HL in the context of various diseases, such as HIV and other infectious diseases, has been done by using tools such as the Test of Functional Health Literacy in Adults (TOFHLA) and the Rapid Estimate of Adult Literacy in Medicine (REALM).[21–26] These instruments necessitate the participants to carry out tasks that are not distinct to his/her disease or medical condition, to be able to interpret/understand numbers (such as clinic visit date) perform numerical tasks (count the number of pills), or to read out a set of medical terms. A study that assessed the psychometric properties of REALM in an African population found that the instrument was unsuitable to evaluate literacy in the multi-lingual population. Hence, HL tools may show a built-in cultural influence that restricts their application in other geographies.[3] The current study used HIV-LT which contains essential HIV-disease relevant and treatment-related terms that are employed regularly in care; it was used as a language and form used in day-to-day clinical care. This enhances the validity and applicability of the tool across populations.

The average quantity of drugs consumed was 8.0 (IQR 6–12) per person per day. This is comparable to data from other studies using MRCI. A study conducted by Libby et al. showed that the highest mean total medications per patient with HIV was 10.8 (range, 1–27), and the patient-level MRCI score was 21.76 [12.49].[27] The MRCI value was lower in those without comorbidities in comparison with those with a comorbid condition; for example, participants with diabetes mellitus received the highest number of pharmaceutical preparations, which emphasizes the unique difficulties in the care of those with poor HL.[28] This is similar to the findings of Rocío Jiménez Galán et al.[29]; PLHIV without comorbidity had MRCI ranging from 7.25 to 9.75 compared with coinfected subjects, whose values reached 13.25. The study by Contreras-Macías et al. showed that increased MRCI scores (mean 6.9 ± 5.5) in people living with HIV are associated with poor quality of life.[30]

The MRCI tool provides opportunities for clinical intervention to reduce drug regimen complexity and thereby nonadherence, such as by downscaling dosing frequency and simplifying the route of administration and directions for drug use.[31] The main attributing factor for an increased MRCI index score is concomitant medication,[32] as seen in the patients with comorbid diabetes mellitus in the current study.

Our study has limitations. First, the study was conducted at a single urban center; so, the quality of care may not be generalizable to other health care settings and patient populations. Second, there was no time limitation for answering the HIV-LT questions; the scores may vary in a clinical setting based on the available assessment time. The study participants were on ART for >6 months with an adherence rate of >95%. The MRCI scores might vary during the initial 6-month period, particularly due to the occurrence of adverse effects.

11. Conclusion

HL skills are important for day-to-day self-care in patients living with HIV. Our study showed that the level of HL, as assessed using the HIV-LT tool, was inadequate in the majority of the studied patients with HIV infection. Poor HL was not associated with an increased medication regimen complexity. However, the presence of comorbidities increased the drug regimen complexity, particularly in patients with diabetes mellitus. Doctors and care givers should attempt to strengthen the counselling and supportive care in patients with HIV, particularly among those with poor HL. Also, attempts should be made to determine the possible simplification of the prescribed drug regimen in those with comorbidities.

Ethical considerations

The study was initiated after receiving approval from the institutional ethics committee of Kasturba Medical College, Mangaluru, Karnataka, India (IEC KMC MLR 05–19/227).

Funding

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Declaration of Interest'/Competing interest of statement

None.

Acknowledgements

We thank Dr Sudha Kumari K, Assistant Professor, Department of Kannada, St Aloysius College, Mangaluru for translating HIV-Literacy Test Questionnaire for this study.

References

1 Nielsen-Bohlman L, Panzer AM, Kindig DA. *Committee on Health Literacy. Health Literacy: A Prescription to End Confusion*. 2004.
2 Parker RM, Ratzan SC, Lurie N. Health literacy: a policy challenge for advancing high-quality health care. *Health Aff*. 2003;22(4):147–153.
3 Howard LM, Tique JA, Gaveta S, et al. Health literacy predicts pediatric dosing accuracy for liquid zidovudine. *Aids*. 2014;28(7):1041–1048.
4 Ciampa PJ, Vaz LM, Blevins M, et al. The association among literacy, numeracy, HIV knowledge and health-seeking behaviour: a population-based survey of women in rural Mozambique. *PLoS One*. 22 Jun 2012;7(6), e39391.
5 Kalichman SC, Benotsch E, Suarez T, Catz S, Miller J, Rompa D. Health literacy and health-related knowledge among persons living with HIV/AIDS. *Am J Prev Med*. 2000;18(4):325–331.
6 Banagi Yathiraj A, Unnikrishnan B, Ramapuram JT, et al. HIV-related knowledge among PLWHA attending a tertiary care hospital at Coastal South India—a facility-based study. *Journal of the International Association of Providers of AIDS Care (JIAPAC). Nov*. 2017;16(6):615–619.
7 Waldrop-Valverde D, Jones DL, Gould F, Kumar M, Ownby RL. Neurocognition, health-related reading literacy, and numeracy in medication management for HIV infection. *AIDS Patient Care & Stds*. 2010;24(8):477–484.
8 HIV and AIDS in India | Avert [Internet]. [cited 8 Feb 2022]. Available from: https://www.avert.org/professionals/hiv-around-world/asia-pacific/india.
9 Dakshina Kannada District Population Census 2011-2022, Karnataka literacy sex ratio and density [Internet]. [cited 8 Feb 2022]. Available from: https://www.census2011.co.in/census/district/252-dakshina-kannada.html.
10 Ingersoll KS, Cohen J. The impact of medication regimen factors on adherence to chronic treatment: a review of literature. *J Behav Med*. 2008;31(3):213–224.
11 Berry SD, Quach L, Procter-Gray E, et al. Poor adherence to medications may be associated with falls. *Journals Gerontol - Ser A Biol Sci Med Sci*. 2010;65(5):553–558.
12 Ma A, Chen DM, Chau FM, Saberi P. Improving adherence and clinical outcomes through an HIV pharmacist's interventions. *AIDS Care - Psychol Socio-Medical Asp AIDS/HIV*. 2010;22(10):1189–1194.

13 Gimeno-Gracia M, Crusells-Canales MJ, Armesto-Gomez FJ, Rabanaque-Hernandez MJ. Prevalence of concomitant medications in older HIV+ patients and comparison with general population. *HIV Clin Trials*. 2015;16(3):117–124.
14 Marzolini C, Elzi L, Gibbons S, et al. Prevalence of comedications and effect of potential drug-drug interactions in the Swiss HIV cohort study. *Antivir Ther*. 2010;15 (3):413–423.
15 Kalichman SC, Rompa D. Functional health literacy is associated with health status and health-related knowledge in people living with HIV-AIDS. *J Acquir Immune Defic Syndr*. 1999;25(4):337–344, 2000 Dec 1.
16 George J, Phun YT, Bailey MJ, Kong DCM, Stewart K. Development validation of the medication regimen complexity index. *Ann Pharmacother*. 2004;38(9):1369–1376.
17 Tique JA, Howard LM, Gaveta S, et al. Measuring health literacy among adults with HIV infection in Mozambique: development and validation of the HIV literacy test. *AIDS Behav*. 2017;21(3):822–832.
18 Su CT, Parham LD. Generating a valid questionnaire translation for cross-cultural use. *Am J Occup Ther*. 2002;56(5):581–585.
19 Sartorius N, Kuyken W. Translation of health status instruments. In: *Quality of Life Assessment: International Perspectives*. Berlin, Heidelberg: Springer; 1994:3–18.
20 Waldrop-Valverde D, Murden RJ, Guo Y, Holstad M, Ownby RL. Racial disparities in HIV antiretroviral medication management are mediated by health literacy. *HLRP: Health Literacy Research and Practice*. 2018 Nov 1;2(4):e205–e213.
21 Wolf MS, Davis TC, Arozullah A, et al. Relation between literacy and HIV treatment knowledge among patients on HAART regimens. *AIDS Care*. 2005;17(7), 863 73.
22 Colbert AM, Sereika SM, Erlen JA. Functional health literacy, medication-taking self-efficacy and adherence to antiretroviral therapy. *J Adv Nurs*. 2013;69(2):295–304.
23 Drainoni ML, Rajabiun S, Rumptz M, et al. Health literacy of HIV-positive individuals enrolled in an outreach intervention: results of a cross-site analysis. *J Health Commun*. 2008;13(3):287–302.
24 Kalichman SC, Cherry J, Cain D. Nurse-delivered antiretroviral treatment adherence intervention for people with low literacy skills and living with HIV/AIDS. *J Assoc Nurses AIDS Care*. 2005;16(5):3–15.
25 Wolf MS, Davis TC, Arozullah A, et al. Relation between literacy and HIV treatment knowledge among patients on HAART regimens. *AIDS Care - Psychol Socio-Medical Asp AIDS/HIV*. 2005;17(7):863–873.
26 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):374–378.
27 Libby AM, Fish DN, Hosokawa PW, et al. Patient-level medication regimen complexity across populations with chronic disease. *Clin Therapeut*. 2013;35(4).
28 Singh S, Acharya SD, Kamath A, Ullal SD, Urval RP. Health literacy status and understanding of the prescription instructions in diabetic patients. *J Diabetes Res*. 2018;2018.
29 Galán RJ, Cidoncha EC, Martin MF, Rodriguez CC, Almeida CV, Verdugo RM. Antiviral regimen complexity index as an independent predictor of sustained virologic response in patients with chronic hepatitis C. *J. Manag. Care Pharm.* 2013 Jul;19(6):448–453.
30 Contreras-Macías E, Gutiérrez-Pizarraya A, RobustilloCortés MA, Morillo-Verdugo R. High level of medication regimen complexity index correlate with worse quality of life in people living with HIV. *Rev Española Quimioter*. 2021;34(2):93–99.
31 Metz KR, Fish DN, Hosokawa PW, Hirsch JD, Libby AM. Patient-level medication regimen complexity in patients with HIV. *Ann Pharmacother*. 2014;48(9):1129–1137.
32 Morillo-Verdugo R, Robustillo-Cortés MDLA, Martín LAK, De Sotomayor Paz MÁ, De León Naranjo FL, Almeida-González CV. Determination of a cutoff value for medication regimen complexity index to predict polypharmacy in HIV+ older patient. *Rev Española Quimioter*. 2019;32(5):458–464.