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10.4103/jehp.jehp\_42\_19

# Antiretroviral therapy adherence based on information, motivation, and behavioral skills model and its association with depression among HIV-positive patients: Health promotion strategy towards the 909090 target

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Received: 26-01-2019

Accepted: 07-04-2019

## Abstract:

**BACKGROUND:** HIV-infected patients with poor antiretroviral therapy (ART) adherence are prone to depression, and depression can exacerbate the disease condition. This study was conducted to determine ART Adherence based on Information, Motivation, and Behavioral Skills (IMB) Model and its association with depression among HIV-positive patients.

**MATERIALS AND METHODS:** This descriptive–correlational study was carried out on people over the age of 18 years with HIV/AIDS, who referred to the Behavioral Diseases Counseling Center in Kerman City, Iran, in 2017. In this regard, 119 patients were selected using the table of random numbers. To collect the data, we used the Beck’s depression inventory-II and the IMB researcher made questionnaire to evaluate the ART adherence.

**RESULTS:** The results of the study reveal that a significant association was observed between the total adherence and all constructs of the IMB model ( $P < 0.001$ ). Risk perception and self-efficacy had the highest mean scores regarding the ART adherence. The prevalence of depression was 71.5% among patients. Information, personal motivation, and total adherence had a significant association with depression.

**CONCLUSIONS:** IMB model was an appropriate and practical strategy with regard to the ART adherence among people living with HIV who are prone to depression and drug consumption is crucial for them to achieve the 90-90-90 target. This article created a questionnaire to assist policy-makers and health professionals designing interventions to improve adherence and health outcomes of ART.

## Keywords:

Antiretroviral therapy adherence, depression, HIV/AIDS, information, motivation, and behavioral skills model

## Introduction

HIV/AIDS is a major public health problem worldwide. The number of affected people was estimated as 36.7 million

in 2014.<sup>[1]</sup> In a recent study, it was shown that the estimated number of HIV-infected people were 89,000 in 2009 with a projected increase to 106,000 in 2014.<sup>[2]</sup> One of the

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**How to cite this article:** Morowatisharifabad MA, Movahed E, Farokhzadian J, Nikooie R, Askarishahi M, Bidaki R, *et al.* Antiretroviral therapy adherence based on information, motivation, and behavioral skills model and its association with depression among HIV-positive patients: Health promotion strategy towards the 909090 target. *J Edu Health Promot* 2019;8:192.

factors that help to control, treat, and suppress the HIV virus is consumption of and antiretroviral therapy (ART) adherence.<sup>[3]</sup> The rate of nonadherence to the ART in rural areas of Zambia was 40%<sup>[4]</sup> and North America was 45%.<sup>[5]</sup> The ART should be  $\geq 95\%$  in order to prevent drug resistance, transmit of HIV virus to noninfected sexual partners, progress of the disease to the AIDS stage, and achieve the 90-90-90 target.<sup>[6]</sup> The 90-90-90 target indicates that 90% of the patients should be diagnosed, 90% treated, and 90% should achieve the viral suppression, but in Iran, the ART adherence is 75.4%.<sup>[7]</sup>

Certainly, the antiretroviral (ARV) drugs should be used perpetually until the end of life; in the case that the medications discontinue, the number of HIV viruses in the patient's body increases rapidly.<sup>[8]</sup> The long-term use of medications and their complications lead to drug intolerance and depression among patients. On the other hand, poor adherence to the ART was associated with depression.<sup>[8]</sup> Studies conducted in countries with high and low income showed a strong association between AIDS and depression, so that depression was significantly associated with harmful effects of AIDS, low quality of life, low immune system, higher viral load, unemployment, and low labor productivity.<sup>[9]</sup> It is predicted that depression will be one of the three main causes of disease throughout the world along with AIDS and ischemic heart diseases by 2030.<sup>[10]</sup> Depression treatment can promote the patients' motivation and self-efficacy.<sup>[11]</sup> The prevalence of depression among HIV-positive patients was 50% in San Francisco.<sup>[12]</sup> The prevalence of moderate-to-severe depression among people living with HIV (PLHIV) was 68% in Iran.<sup>[13]</sup>

The Information, Motivation, and Behavioral Skills (IMB) model is one of the models widely considered in the area of ART adherence in health psychology.<sup>[14]</sup> In this model, information is considered as the prerequisite of personal and social motivation, while risk perception is a motivational prerequisite for learning skills.<sup>[15]</sup> The results of a study by Alexander *et al.* showed that behavioral skills were significantly affected by the mediating effects of information and motivation in treatment adherence.<sup>[14]</sup> Despite the studies conducted over the ART and use of IMB model in other countries,<sup>[16]</sup> no information is available on the ART adherence of the Iranian HIV-positive patients using the IMB model. Therefore, this study was conducted to answer two main research questions:

1. Is ART adherence based on the IMB model an appropriate strategy to achieve the 909,090 target?
2. Does ART adherence lead to depression?

## Materials and Methods

### Study design and setting

This descriptive–correlational study was conducted on PLHIV, who were 18 years and older and referred to

the Behavioral Disease Counseling Center in Kerman city in 2017.

### Participants and sampling

To collect the participants, the researchers referred to the Behavioral Disease Counseling Center and selected 119 patients randomly using the table of random numbers. The number of people receiving free ART was 188 at the time of data collection. The sample size was calculated as 119 people using the proportions formula with a significance level of 95%,  $d = 0.09$ , and the adherence level of 0.50. The inclusion criteria consisted of having 18 years of age and older, taking drugs for 6 months, and having the willingness to participate in the study.

### Measures

In this research, three questionnaires were applied to collect the data.

The first questionnaire was the demographic and clinical data of the patients including: age, sex, marital status, educational level, occupation, income level, number of children, housing, disease transmission forms, CD4 count, stage of disease, viral load, risk factors, history of disease, and body mass index.

### Questionnaire of antiretroviral therapy adherence based on Information, Motivation, and Behavioral skills model

The questionnaire of ART adherence based on IMB model was developed by the researcher after conducting a qualitative research and investigating the manuscripts and scientific papers on the ART adherence. This questionnaire dealt with six constructs of the IMB model using a five-point Likert scale as information, personal motivation, social motivation, risk perception, self-efficacy, and behavioral questions. That the options ranging from “totally agree” (five scores) to “totally disagree” (zero). In the part of self-efficacy and behavior, the options included always (5 scores) and never (1 score). Some items in the sections of information (questions 5 and 6), personal motivation (questions 6–9), social motivation (questions 3–7), and behavior (question 6) were scored reversely. The validity of the questionnaire was confirmed by ten experts which was calculated as 70%. The Cronbach's alpha test was also used to determine the scientific reliability of the data collection tool. The reliability of the questionnaire with regard to the construct of information was 82%, personal motivation 83%, social motivation 83%, risk perception 88%, self-efficacy 83%, and behavior was 83% [Appendix 1].

### Beck depression inventory II test

The Beck depression inventory-II (BDI-II) is widely used to diagnose depression and measure its severity.

Kanmogne *et al.* investigate the validity and reliability of the French version of this questionnaire in Cameroon.<sup>[17]</sup> The BDI-II consists of 21 items to evaluate the emotional factors of depression, such as hopelessness, irritability, guilty feelings, pessimism, worthlessness, self-efficacy, and suicidal thoughts, as well as the physical factors such as loss of appetite, fatigue, as well as sleep and concentration problems. The options were scored from zero to three and the total score was calculated to determine the severity of depression: normal (0–13), mild (14–19), moderate (20–28), and severe (29–63).<sup>[17]</sup>

### Ethical consideration

The Ethics Committee of Yazd University of Medical Sciences confirmed this study (IR.SSU.SPH.REC 1396.83). Subsequently, the participants were provided with comprehensive explanations about aim of the study, they were asked to sign the consent forms to participate in the research, and they were ensured about the confidentiality of information. In case that some people quit, we used the table of random numbers and selected participants to reach the determined sample size. To ensure the accuracy of participants in completing the questionnaires, the US \$3 was paid to each participant after completing the questionnaire.

### Statistical analysis

In this research, descriptive statistics was used to analyze the demographic characteristics, ART adherence, and depression of the study population. In addition, we used the Spearman's correlation test to analyze the association of the IMB model constructs with the total adherence, depression, and other demographic variables. The data were analyzed using SPSS 24. International Business Machines Corporation, New York, USA. The significance level was set at 0.05.

## Results

A total number of 119 PLHIV with an average age of  $41.59 \pm 9.57$  years participated in the study. The results showed that 54.6% of the participants were male [Table 1].

The rate of CD4 was higher than 350 in 58% of cases. In addition, 93.3% of the samples were infected with HIV. The viral load was  $<100$  in 63.9% of cases and 42% of participants did not mention any risk factors such as using drugs [Table 2].

A significant association was observed between the total adherence and all constructs of the IMB model ( $P < 0.001$ ). Of the constructs of the model, the risk perception and self-efficacy had the highest mean scores in ART adherence [Table 3].

**Table 1: Demographic characteristics of the study participants**

Sociodemographics	n (%)
Gender	
Female	54 (45.4)
Male	65 (54.6)
Marital status	
Single	29 (24.4)
Married	56 (47.1)
Divorced	9 (7.6)
Widow	25 (21)
Education	
<Elementary	44 (37)
Middle school	31 (26.1)
Diploma and more	44 (36.9)
Job	
Homemaker	36 (30.4)
Free	11 (9.2)
Employed	40 (33.6)
Unemployed	32 (26.8)
Children	
0	41 (34.5)
1	28 (23.5)
2	24 (20.2)
3 and more	26 (21.9)
Housing	
Owned	47 (39.5)
Hired	55 (46.2)
Others	17 (14.3)
Income	
US \$ <60	69 (58)
US \$ 60<	50 (42)

The prevalence of depression was 71.5% among patients; 29.4% of these participants had severe depression and the others had moderate-to-low depression. Furthermore, 28.6% of participants had no depression [Table 4].

According to Spearman's correlation coefficient, except for the constructs of information ( $P = 0.000$ ), personal motivation ( $P = 0.04$ ), and total adherence ( $P = 0.006$ ), no significant relationship was observed between depression and ART adherence in other constructs. The results showed that gender had a significant correlation with information ( $P = 0.001$ ) and total adherence ( $P = 0.008$ ). In addition, marital status had a significant association with information ( $P = 0.01$ ), personal motivation ( $P = 0.03$ ), and total adherence ( $P = 0.02$ ). Spearman's correlation showed a significant association between income and behavior ( $P = 0.03$ ) [Table 5].

## Discussion

Considering the strong association of the IMB model constructs with total adherence and the significant effect of ART adherence on the reduction of depression, application of IMB model was appropriate for ART

**Table 2: Clinical information of the participants**

Variable	n (%)
Disease transmission from	
Sexual intercourse	48 (40.4)
Injection	41 (34.1)
I do not know	30 (25.2)
Others	
CD4 count	
<100	11 (9.2)
101-200	16 (13.4)
201-350	23 (19.3)
Higher than 350	69 (58)
Disease stage	
HIV*	111 (93.3)
AIDS	8 (6.7)
Viral load	
<100	76 (63.9)
100 and higher	43 (36.1)
Risk factor	
No	50 (42)
Yes	69 (58)
Disease history	
<5 years	37 (31.1)
5-10	35 (29.4)
10-15	20 (16.8)
15 and higher	27 (22.7)

\*Human immunodeficiency viruses

**Table 3: Mean and standard deviation of Information, Motivation, and Behavioral skills model constructs and their relationship with antiretroviral therapy adherence**

Constructs	Range	Mean±SD	Minimum	Maximum	P, r
Information	6-30	3.41±0.83	1.67	5	0.000, 0.76
Personal motivation	9-45	3.73±0.73	2	5	0.000, 0.60
Social motivation	7-35	3.52±0.62	1.86	5	0.000, 0.68
Risk perception	5-25	4.1±0.80	1	5	0.000, 0.70
Self-efficacy	7-35	4.05±0.98	1	5	0.000, 0.68
Behavior	6-30	4.01±0.72	1.67	5	0.000, 0.69
Total adherence		22.84±3.26	13.12	28.36	0.000, 0.68

SD=Standard deviation

**Table 4: Severity of depression in PWHIV**

Variable	Severity	n (%)
Depression	Mild	35 (29.4)
	Moderate	31 (26)
	Severe	19 (16)
	Normal (no)	34 (28.6)
Total		119 (100)

PWHIV=People with HIV

adherence. Risk perception and self-efficacy had the highest mean scores with regard to ART adherence

among the constructs of the model. In confirmation of the second hypothesis, it should be noted that depression decreased with ART adherence, so that information and personal motivation were the predictors of depression reduction among PLHIV. The married and female patients had better medication adherence in comparison with other groups.

The results of the current study showed that risk perception was a strong predictor of ART adherence among PLHIV. In the same line with our research, the results of the study by Zhang showed that risk perception was one of the most important elements of the target behavior.<sup>[18]</sup> However, in other studies, the risk perception was low with regard to the medications.<sup>[8]</sup> However, the patients of the present study had a high-risk perception, which was due to the follow-ups and care services rendered by nurses and physicians as well as the beneficial effects of medications.

The results of our study indicated that the patients' self-efficacy was high in ART adherence, which was in the same line with other study.<sup>[8]</sup> However, the results of the study carried out by Barclay and Alexander *et al.* showed that self-efficacy was low among HIV-positive adults. Furthermore, they observed no significant association between self-efficacy and treatment adherence among the participants.<sup>[14,19]</sup> This discrepancy in the findings can be attributed to the variety in participants' age and geographic region, so that the elderlies did not have enough trust in ART adherence.

In our study, all constructs of the IMB model were associated with the total ART adherence. Similar results were observed in other study.<sup>[20]</sup> However, the results of the study carried out by Chang were different with the results of the current study.<sup>[21]</sup> In the previous studies, the participants were selected from wide varieties of geographic region, and the sample size was large, which caused the difference in the results. Information and personal motivation, among other constructs of model, had the highest mean scores in ART adherence. In confirmation of our results, Norton *et al.* showed that high motivation affected the ART adherence.<sup>[22]</sup> Meanwhile, the results of the study by Starks *et al.* contradicted our results regarding three groups of PLHIV, which was due to the difference in mental health.<sup>[16]</sup> However, in the current study, the support from nurses and physicians of the Behavioral Disease Counseling Center increased the ART adherence among patients.

Furthermore, in the current study, information and personal motivation were considered as two important predictors of depression reduction, which was similar to a previous study.<sup>[23]</sup> However, Egede reported that only "social motivation" was the most important

**Table 5: The correlation matrix between depression and demographic data regarding the Information, Motivation, and Behavioral skills model (Spearman's correlation test)**

Construct	Depression ( <i>r</i> , <i>P</i> )	Information ( <i>r</i> , <i>P</i> )	Personal motivation ( <i>r</i> , <i>P</i> )	Social motivation ( <i>r</i> , <i>P</i> )	Risk perception ( <i>r</i> , <i>P</i> )	Self-efficacy ( <i>r</i> , <i>P</i> )	Behavior ( <i>r</i> , <i>P</i> )	Total adherence ( <i>r</i> , <i>P</i> )
Depression	-	-0.319**, 0.003	-0.183, 0.043	-0.12, 0.26	-0.14, 0.12	-0.08, 0.33	-0.12, 0.16	
Age	-0.15, 0.08	0.03, 0.6	0.000, 0.9	0.04, 0.6	0.05, 0.5	0.12, 0.1	0.01, 0.8	0.07, 0.4
Gender	0.009, 0.9	0.2**, 0.001	0.05, 0.5	0.1, 0.1	0.1, 0.051	0.1, 0.2	0.1, 0.1	0.2, 0.008
Education	0.02, 0.7	0.001, 0.9	0.1, 0.1	-0.03, 0.7	-0.03, 0.7	-0.04, 0.6	0.02, 0.8	0.005, 0.9
Marital status	-0.1, 0.1	0.2*, 0.01	0.1*, 0.03	0.1, 0.07	0.1, 0.1	0.07, 0.4	0.08, 0.3	0.2, 0.02
Job	0.07, 0.4	-0.1, 0.1	-0.03, 0.7	-0.06, 0.4	-0.04, 0.6	-0.05, 0.5	-0.04, 0.6	-0.1, 0.2
Income	-0.1, 0.06	-0.002, 0.9	0.1, 0.1	0.05, 0.5	-0.09, 0.3	0.1, 0.2	0.1*, 0.03	0.1, 0.1
CD4	-0.007, 0.9	0.1, 0.2	-0.05, 0.5	-0.01, 0.8	-0.01, 0.8	0.03, 0.6	0.04, 0.6	0.05, 0.6

\*0.05 level (two-tailed), \*\*0.01 level (two-tailed)

construct in reducing depression.<sup>[24]</sup> This discrepancy can be related to the difference in the applied data collection tools and the studied group, who were the people with diabetes in Egede research. Similar to the findings of Coleman, we found that the prevalence of moderate-to-severe depression was more than the average.<sup>[25]</sup> However, the results of other studies were not in the same line with our results.<sup>[17,26]</sup> In our study as well as the study by Georgette,<sup>[16]</sup> participants included both genders and the BDI-II was applied as the research tool. Hence, the difference in the findings can be related to the large sample size in Georgette study, which was two times more than the sample size in our study. In the current study, females had a greater ART adherence than males, which was similar to other study.<sup>[27]</sup> However, Kim *et al.* (2018). did not confirm this finding.<sup>[28]</sup> This difference can be because many female participants were widowed and lived with their parents or other family members, so they were supported to a higher degree.<sup>[29]</sup> The results of this study showed that ART adherence was higher among the married individuals who were in the same line with the study by Oskouie *et al.*<sup>[30]</sup> However, this finding was different from the results reported by Mukui *et al.*<sup>[31]</sup> The study by Oskouie *et al.* showed that married females with HIV who were supported by their spouses had higher ART adherence.<sup>[30]</sup>

The strength of the study was to extract the questionnaire from the qualitative design that was done by face-to-face interviews. However, this study is limited by being conducted at one site, and the data were collected in a self-reporting mode.

### Recommendations for practice and research

We suggest other researchers and health-care providers to use the IMB model in their interventional studies. Policy-makers are also recommended to consider the patients' mental health, social support, and financial support along with their ART adherence. However, given the high prevalence of depression in HIV patients, it is better to choose a smaller sample size.

### Conclusions

The results of this study showed that IMB model was an appropriate, practical, and economic strategy with regard to the ART adherence among PLHIV, who are prone to depression and drug consumption. Furthermore, depression decreased by continuous ART adherence. So with the IMB model, we can reach the 90-90-90 target earlier.

### Acknowledgments

We would like to acknowledge authorities of the Jiroft University of Medical Sciences in the Southern Iran.

### Financial support and sponsorship

The author(s) received no financial support for the research, authorship, and/or publication of this article.

### Conflicts of interest

There are no conflicts of interest.

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**Appendix 1: Questionnaire of antiretroviral therapy adherence based on Information, Motivation, and Behavioral skills model**

IMB	Totally disagree	Disagree to some extent	No idea	Agree to some extent	Totally agree
<b>Information</b>					
I know about the functions and effects of medications on the HIV virus					
I know about the possible complications of each HIV medications					
I know what to do, in the case that HIV medications interact with alcohol, drugs, or other medicines					
I know that I have to take HIV medications until the end of my life					
I can ignore consumption of my medications in travel or unpleasant situations					
When my CD4 or immune system improved and I felt well, I do not need to take the HIV medications					
<b>Personal motivation</b>					
If I do not take my medications punctually, drug resistance will be developed					
Belief in God makes me to take HIV medications					
If I take my medications punctually, my CD4 will increase					
HIV medications control my disease					
If I take my medicines punctually forever, I can have a normal life similar to other people of the community					
HIV medications reduce the length of my life					
Punctually forever use of HIV medications makes me to feel hopeless					
The complications of medications make me reluctant to take them					
The high number of medications reduced my tendency to take them					
<b>Social motivation</b>					
The free counseling and medication services provided motivation for me to take the medicines					
If all health care centers provided services to patients with HIV, I would have more tendencies to take the medications					
I do not get enough support with regard to the perpetual provision and consumption of my medications					
I do not want to take HIV medications because if my friends see me in the counseling center, they will avoid me					
I feel unpleasant about the authorities of the counseling center because I need to answer them as if I am in a police station					
I do not take my medications for the costs of transportation					
The hidden feelings with regard to the HIV and nonfulfillment of confidential requirements made me frustrated with taking the medications					
<b>Risk perception</b>					
Nonpunctual consumption of medications will weaken my immune system					
If I do not take my medication punctually, the complications of the disease will exacerbate					
If I do not take HIV medications punctually, the length of my life will be reduced					
Tobacco and drug use reduces the effects of HIV medications					
If I do not take my medications punctually, my physical and psychological problems will increase					
<b>Behavioral skills</b>	<b>Always</b>	<b>Unusually</b>	<b>Sometimes</b>	<b>Rarely</b>	<b>Never</b>
<b>Self-efficacy</b>					
I can take HIV medications punctually during the travel					
I am able to remember taking my HIV medications even when I am very busy					
I can take my medications without the help of others					
I have enough skills to minimize the complications of medications					
I am able to take my medications, despite the temptation for ignoring them					

Contd...

**Appendix 1: Contd...**

<b>Behavioral skills</b>	<b>Always</b>	<b>Unusually</b>	<b>Sometimes</b>	<b>Rarely</b>	<b>Never</b>
Although the medications have unpleasant taste, I can always take them					
I am able to use my medications during the periods of depression, sadness, and anxiety					
<b>Behavior</b>					
I use HIV medications every day, despite the fact that they disturb my sleep and have unpleasant taste					
I keep medications at temperatures below 30°C					
I can avoid forgetting the medications by putting them in the medicine box					
I plan to take medications in any situation (travel, sickness, fatigue, being busy)					
2 days before my medications run out, I refer to the healthcare center to get them for the following month					
I do not take my medications at the presence of others, so that they do not know about my disease					

IMB=Information, Motivation, and Behavioral skills