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Research Article

Identifying Effective Factors in the Management of Medication Errors in HIV/AIDS Patients in Iran's Health System Using Structural Equation Modeling

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Abstract

Background: One center that provides health services and treatment for immunodeficiency virus (HIV)/AIDS patients is a behavioral disease counseling center. Today, patient safety and treatment combined with compliance with ethical and legal standards are among the most important concerns of medical and health centers, including the most important criteria for the credibility of an institution. In the meantime, medication errors in HIV/AIDS patients can lead to treatment disruption, drug poisoning, or even death.

Objectives: Considering the importance of the subject, the present research was conducted to identify and explain the factors affecting the management of medication errors in HIV/AIDS patients in Iran's health system.

Methods: The present study is an applied study performed by descriptive method. First, by reviewing the research literature and interviewing 35 experts in the field of HIV/AIDS treatment, the variables and main components affecting the management of medication errors in HIV/AIDS patients were extracted, and a research questionnaire was designed using them. Data were collected from 400 experts and specialists in infectious diseases, etc. Then, the collected data were analyzed using structural equation modeling, SPSS23 software, and LISREL software.

Results: Four factors were identified as effective factors in medication error management in HIV/AIDS patients: Organizational, educational, individual, and communication factors. Organizational and communication factors loading 0.763 and 0.646 had the highest and lowest impact on drug error management in HIV/AIDS patients, respectively.

Conclusions: To efficiently and effectively manage medication errors in HIV/AIDS patients, while considering all four factors, organizational and educational factors should be given more attention and emphasis by managers.

Keywords: HIV/AIDS; Medication Error Management; Patient Safety; Structural Equation Modeling; Exploratory Factor Analysis

1. Background

Access to appropriate and high-quality medical services is considered a basic right for the patient. However, the worsening of patient probl ems and the complexity of medical services continue to threaten patient safety, and for this reason, improving patient safety and quality of care has become an important public health issue (1-3). Medical errors are one of the most important challenges that threaten patient safety. One of the most common known medical errors is medication errors. Medication errors are unintentional failures in the treatment process that lead to patient harm (4, 5).

According to the World Health Organization (WHO) report, medication errors are one of the main causes of avoidable harm to the patient, which costs about 42 billion dollars to the patient and the health system per year worldwide, which is 0.7% of the total health costs. It is universal. The WHO announced the third global patient safety challenge as "medicine without harm" in the report of the global patient safety collaborative (GPSC) to strengthen and rapidly focus on activities that lead to drug safety improvement (6).

According to the WHO report, the number of people infected with human immunodeficiency virus (HIV) in the world in 2020 is 3,770,000 cases, global deaths are 680,000 cases, people who are newly infected with HIV in 2020 are 1,500,000 cases, and 73% of people with HIV are on antiretroviral therapy (ART). Like many developing countries, HIV is an important public health problem in

Iran. According to the UNAIDS report in Iran, the number of people infected with HIV until 2020 was 54,000, and 2,400 people were newly infected with the HIV/AIDS virus in 2020, and 15,000 people (29%) of those infected are under ART (7, 8). Advances in treating people with HIV/AIDS (PLWHA) have led to longer life spans. So that the transmission of HIV is now considered a chronic disease, but the current trend of HIV data shows that a large number of people are still living with HIV disease in the world (9).

According to various studies, the most common errors include omitting the drug in the patient's treatment regimen, not observing the correct time, correct dose and drug interactions, the mistake in prescribing the drug, not following the correct way of prescribing the drug, giving more than the prescribed amount of medication (9-12). People living with human immunodeficiency virus are at risk of medication errors due to the complexity of treatment, such as complex drug regimens, multiple co-morbidities due to a low immune system, and interactions with experienced hospital-based care providers with ART treatments. This is partially due to the complexity of ART and the doctor's lack of knowledge or familiarity with these treatments (13). Medication errors that occur during the care of HIV-infected patients may lead to treatment failure, drug toxicity, or even death. According to studies, thousands of people die yearly in America due to medication errors. Also, the financial costs of drug side effects in people infected with the virus are close to 77 billion dollars annually (14). Meanwhile, the probability of death due to accidents and death due to breast cancer is lower than death due to medication errors (15).

Research shows that people with HIV experience a high rate of medication errors during hospitalization (9-11, 16, 17). A study in major hospitals worldwide has shown that the error rate of HIV drugs is 22 to 86%. This study has been flawed in nearly every aspect of drug management, including ineffective antiviral regimens, inappropriate doses, failure to adjust doses in comorbid conditions, and numerous documented drug interactions with drugs for individual conditions and other antiretrovirals (18).

A systematic review reported a medication error rate of over 86% in hospitalized patients with HIV (9). Therefore, these medication errors in infected patients can lead to antiretroviral resistance, disease progression, and side effects (19, 20). In addition, almost every antiretroviral drug for the treatment of HIV requires some kind of dose adjustment in the presence of renal failure, liver failure, or concomitant use of drugs for co-morbidities. Medication errors can devastate patients, families, healthcare providers, healthcare facilities, and society. Although not all medication errors cause harm to some, they lead to prolonged hospital stays or death (21).

The solutions must also be multifactorial because the causes of medication errors in people with the virus are usually multifactorial (22-24). Most of the studies in Iran and the world are about adherence to medication (25-27). In Iran, no study has been conducted on the causes of medication errors in HIV/AIDS patients, but the results of studies conducted in other countries show that due to several challenges, such as deficiencies in communication factors (28) and patient education (29), the lack of reforms in hospitals and treatment centers and defects in organizational factors (30), inappropriate organizational structure (31), non-reporting of medication errors (32), increasing treatment costs (33, 34), individual factors affecting the behavior of patients and service providers (35) and modifying the structure and management method of these drug errors is the main solution to improve the safety of patients and improve their conditions. Due to the high importance of the topic and its role in improving safety and effectiveness in Iran's health system, however, a comprehensive investigation and study related to the classification of the causes of medication errors in HIV-positive patients in Iran and providing a suitable model for the management of medication errors in HIV infected patients has not been done.

2. Objectives

The present study was conducted to identify the effective factors for managing medication errors in HIV/AIDS patients in Iran.

3. Methods

This is an applied study that was performed using the descriptive method. First, we conducted a literature review. Then we interviewed the experts. The number of experts who participated in this stage was 35. The inclusion criteria were infectious disease specialists, nurses, experts, doctors, and faculty members at the Universities of medical sciences in Khuzestan province, Arvand International University, Tehran, Iran, and Shahid Beheshti Universities of Medical Sciences, and the Ministry of Health, and Medical Education of Iran, who are involved in the management of medication errors in patients with at least 5 years of experience in treatment and 10 years of management experience in HIV/AIDS patients. After collecting the participants' opinions, 188 components and variables affecting the management of medication errors in HIV patients were identified and extracted. In the next step, 95 variables were available to the supervisors of the country's HIV/AIDS committee working in behavioral disease counseling centers of the whole country, the infectious department of hospitals, university professors and faculty members, and the infectious focal points of the HIV/AIDS disease and the Ministry of Health. Finally, after reaching a consensus (the agreement of more than 75% of experts regarding each item was the basis of consensus), the initial conceptual model was introduced.

Then the obtained data were collected and classified. Using exploratory factor analysis, the factors affecting treatment adherence in HIV/AIDS patients were identified and extracted.

The findings of exploratory factor analysis using the

varimax rotation method showed that four factors identified by experts, including organizational, individual, educational, and communication factors, have an eigenvalue greater than one, which remained in the analysis. These 4 factors were effective in treating adherence in HIV/AIDS patients. In order to finally confirm the main components and factors, the consensus of experts was held in the presence of the same 35 experts participating in the interview, and subsequently, 81 variables with four factors of organizational factors (31 variables), individual factors (20 variables), educational factors (18 variables), and communication factors (12 variables) remained and formed the final framework of the questionnaire. The questionnaire was compiled with a five-point Likert scale (from very low = 1 to very high = 5). The Lawshe technique was used to evaluate questionnaire content validity by using experts' opinions on test content. To evaluate the reliability, the questionnaire was distributed and collected among 31 experts; Cronbach's alpha coefficient was calculated using SPSS version 23 software, which is equal to 0.92, indicating good reliability of the questionnaire. The reliability coefficient of the questionnaire is presented in Table 1.

Table 1. The Reliability Coefficient of the Questionnaire on the Management of Medication Errors in Human Immunodeficiency Virus/AIDS Patients

Variables	Cronbach's Alpha
Organizational factor	0.84
Individual factors	0.93
Educational factors	0.91
Communication factors	0.79
Overall	0.92

The recommended sample size for confirmatory factor analysis and the use of Lisrel software is about 200 samples for the ten recommended areas, and the questionnaire was distributed among 435 people. In order to minimize the drop in the questionnaires due to the dispersion of the sample size throughout the country, the cooperation of one to two officials and experts related to research in each of the provinces was used, and finally, out of 435 questionnaires distributed, 400 questionnaires (response rate = 91.9%) were collected and analyzed. The Kaiser-Meyer-Olkin (KMO) index was used to measure the sufficiency of the sample size for factor analysis. The amount of KMO is variable between zero and one, and the values close to one of these tests indicate the usefulness of factor analysis of the data (36). In the present study, the adequacy of the sample size was measured using this index, which was obtained as 0.96. The collected data were analyzed using structural equation modeling and SPSS version 23 and Liserl software.

4. Results

The highest frequency among the participants was related to men (66%), ages 31 to 40 years (48%), and professional doctorate level of education (59%). Table two shows the frequency distribution of the demographic characteristics of the participants in the study.

Table 2. Demographic Information

Variables	Frequency (%)
Gender	
Male	264 (66)
Female	136 (34)
Age	
21 - 30	52 (13)
31 - 40	192 (48)
41 - 50	80 (20)
50 <	56 (14)
Missing data	20 (5)
Level of education	
Bachelor	16 (4)
Master	96 (24)
Ph. D.	40 (10)

GP	236 (59)
Specialist	12 (3)
Field	
Management	3 (0.75)
Medical	160 (40)
Allied health	79 (19.75)
Health	130 (32.5)
Others	28 (7)
Setting	
Behavioral Diseases Counseling Center	281 (70.25)
Hospital	63 (15.75)
Faculty	29 (7.25)
Ministry of Health and Medical Education	7 (1.75)
Rehabilitation center	13 (3.25)
Other	7 (1.75)
Position	
Academic	76 (19)
Managerial	161 (40)
Personnel	101 (25)
Others	62 (16)

The findings of exploratory factor analysis using the varimax rotation method showed that the factors affecting the management of medication errors in HIV/AIDS patients include four categories of organizational factors, individual factors, educational factors, and communication factors. The eigenvalue of the first factor (organizational factors) was equal to 12.56, and of the fourth factor (communication factors) was equal to 5.88. Also, these four extracted factors were able to explain a total of 69.004% of the variability of the variance of the variables. The specific values of factors affecting the management of medication errors in HIV/AIDS patients and the percentage of variance explained by each factor are shown in Table 3.

Table 3. Eigenvalues of Factors Affecting the Management of Medication Errors in Human Immunodeficiency Virus/AIDS patients

Factor	Specific Value		
	Eigenvalues	Variance Percentage	Cumulative Percentage
Organizational	12.56	12.93	12.932
Individual	9.23	9.92	26.300
Educational	6.45	6.31	53.136
Communication	5.88	4.70	69.004

Then, to confirm the factors obtained from exploratory factor analysis, confirmatory factor analysis was performed using Liserl software, and the relationships of variables were extracted using the structural equation method. Also, the findings showed that all factors and their components' loadings are more than 0.7 and are confirmed. The main factors included organizational factors with 31 components, individual factors with 20 components, educational factors with 18 components, and communication factors with 12 components. These dimensions, in order of influence on the whole pattern, were: Organizational factors (0.763), educational factors (0.732), individual factors (0.651), and communication factors (0.646). Organizational and communication factors had the highest and lowest standard coefficients, with factor loadings of 0.763 and 0.646, respectively. The factor loadings of factors affecting the management of medication errors in HIV/AIDS patients are given in Table 4.

Table 4. Factor Loadings Obtained from Confirmatory Factor Analysis of Factors Affecting the Management of Medication Errors in Human Immunodeficiency Virus/AIDS Patients

Factors	Factor Load of the Main Factor	Component	Factor Load of a Component
Organizational (31 components)	0.763	Application and development of a comprehensive HIV management system	0.79
		Scheduling of patient appointments (patient-to-workload ratio)	0.789
		Admitting and correct detection of those infected with the virus	0.789
		Feedback from officials on errors in patients' medication documents	0.788
		Planning for providing resources and manpower management	0.78
		Errors and punishment of employees	0.78
		Monitoring the drug supply system and process (improper inventory management and inefficient distribution system)	0.777
		Monitoring of drugs used by patients by non-governmental organizations and welfare centers	0.771
		The existence of a unit for handling patients' medication documents	0.77
		Protocols and guidelines in the treatment of patients	0.759
		Management of stress and burnout of employees	0.757
		Allocation of organizational posts for pharmaceutical experts	0.757
		Supervising the way of writing patients' drug reports (complete and legible writing) by doctors	0.757
		Management of physical space, medicine, equipment, and environmental safety (crowding and disorder control, physical protection)	0.751
		The complexity of care and working environment conditions	0.743
		Systemic barriers	0.737
		Increasing the capacity of manpower	0.736
		Management barriers	0.735
		Using a multi-layered communication platform and contributing medical and therapeutic information	0.732
		Forming a quality care committee to monitor the work of experts and doctors	0.731
		Continuous analysis and evaluation of the current situation	0.727
		Provision of welfare facilities for employees	0.717
		Implementation of the error reporting process	0.717
		Determining the limits of responsibilities and the limits of authority of employees	0.714
		Monitoring the delivery and prescription of medicine by experts and doctors	0.714
		Modification of pharmaceutical processes of counseling centers	0.706
		Existence of long-term planning	0.661
		Confidentiality of all patient information	0.659
		Adaptation of the field to the occupation	0.659
		Non-implementation of regulations in cases of patients' unofficial prescriptions	0.651
		Monitoring the expiration date of drugs	0.613

Educational (18 components)	0.732	Education about the importance of error reporting culture	0.814
		Empowering human resources	0.801
		Training employees regarding the identification of different forms of medicine	0.791
		Using up-to-date guidelines and instructions	0.785
		Training of hospital staff and nurses regarding the cold chain and how to store medicines in the refrigerator	0.784
		Determining job descriptions for staff	0.759
		Monitoring human power capability, participation, and welfare training	0.744
		Empowerment of human resources (expert working in pharmaceutical unit)	0.736
		Training employees about different trade names of drugs and the similarity of names of drugs	0.729
		Training of doctors regarding the correct prescribing and correct dosage of medicines	0.724
		Training of doctors regarding the principles of correct prescription and the structure of drug prescriptions	0.719
		Involvement of managers in training employees about the latest guidelines	0.676
		Educating patients about the type of disease and the consequences of not taking or stopping the medicine	0.662
		Training based on pre-prepared programs	0.63
		Monitoring how the type of medicine is used by patients, experts, and doctors	0.548
		Educating patients about stopping alcohol and drugs and their consequences on drug use	0.545
		Supervising educational sessions for patients' families	0.475
		Supervising educational sessions for patients	0.414
Individual (20 components)	0.651	Obstacles related to the employee, fear of the consequences of reporting, and the reaction of others (managers, colleagues, patients)	0.838
		Management of stress and burnout of employees	0.833
		Not coping with the condition of the disease and fear of disclosing it.	0.827
		Performing side activities with doctors and experts	0.82
		Over-prescription of drugs by doctors	0.814
		Patients' depression and other psychiatric problems	0.814
		Documenting the activities performed in the pharmaceutical unit	0.803
		Lack of drug information	0.802
		Non-cost of medicines	0.799
		Provision of welfare facilities for employees	0.772
		Existence of a payment and compensation system for employees	0.772
		Worried about the impact of mistakes in the evaluation score	0.769
		Determining the job descriptions	0.765
		The high number of drugs	0.759
		Patients' insufficient understanding of the effect and effectiveness of drugs	0.747
		Needs assessment of the current situation	0.733
		The existence of a system of punishment and encouragement of employees	0.717
		Providing comfort facilities for patients and improving difficult living conditions	0.715
		Placing patients under medical insurance coverage	0.632
		Side effects of drugs	0.626

Communication (12 components)	0.646	Social support of the patient by those around him to adhere to the treatment	0.807
		Efficient information systems and error reporting	0.805
		Intra-organizational communication with the infectious focal point regarding the type of medicine used by patients	0.804
		Facilitating group relations between hospitals and behavioral disease counseling centers	0.801
		Referral to a consultant to improve the patient's mental and emotional state and convince them to take medicine	0.801
		Effective communication with the patient to adhere to the treatment	0.757
		Changes in the system of providing services and improving communication between the patient and the patient's companions and the expert (detailed history of the patient))	0.745
		Improving communication processes	0.722
		Treating patients directly (in the presence of experts)	0.713
		Supervise communication between treating physicians and drug delivery experts.	0.677
		Changes in the service delivery system and improvement of communication between therapists and experts	0.632
		Involvement of senior managers	0.514

Abbreviation: HIV, human immunodeficiency virus.

5. Discussion

In the present study, the factors affecting medication error management in HIV/AIDS patients and their impact were determined. The obtained results showed that the main factors affecting the management of medication errors in HIV/AIDS patients in Iran's health system include organizational, educational, individual, and communication factors, respectively. The results of this study showed that among the organizational factors, one of the reforms that have the highest impact factor and can lead to reducing and improving the management of medication errors in HIV patients is the use and development of a comprehensive HIV management system.

Hardmeier et al. emphasized the role of organizational factors such as path components, technique, time, and drug removal as the main factors affecting medication error management. Also, the results of their study indicate that the successful reduction of medication errors in hospitals has been associated with implementing the barcode medication management system (37). Furukawa et al. also emphasized the effect of adopting appropriate information technology (for example, implementing a medication order system) on reducing medication errors (38). Yürür and Ramirez Valdez emphasized the implementation of electronic systems for reporting medication errors and the creation of the necessary infrastructure for developing a comprehensive medication error management system (39). Vrbnjak et al. also stated in their study that one of the ways to reduce medication errors is to develop electronic and efficient reporting systems (40). Al-Ahmadi et al. in a study pointed out the components of individual factors, organization and management, task, work, and group as effective factors in the management of medication errors in hospitals, drug safety, and employee well-being. This study has proposed promoting a comprehensive management information system to reduce medication errors (41). DeLorenze et al. have mentioned the role of organizational factors, the development of a comprehensive HIV management system, and the use of electronic medication records to determine the accuracy of medication errors (42). The results of all the studies mentioned above were consistent with the results of our study.

The results of the present study showed that organizational factors are the most important factors affecting the management of medication errors in HIV/AIDS patients. One of the reforms that can improve the management of medication errors in HIV patients is developing and implementing a comprehensive HIV management system. Also, existing protocols and guidelines should be the basis of patient treatment to reduce medication errors in patients. Officials can regularly measure the knowledge of experts and doctors in this regard. These guidelines should be taught and reminded monthly or quarterly in behavioral disease counseling centers so that they remain in the minds of human resources working in behavioral disease counseling centers. Also, encouraging supervision and control over all existing processes, reviewing or complying with regulations and guidelines, error reporting processes, and planning to provide resources and correct patient appointments can be other factors that reduce medication errors (43). Jang et al. stated that no significant relationship exists between the perception of patient safety culture and medication error reporting among nurses. However, they suggested promoting the culture of patient safety and medication error reporting and its role in reducing medication errors (44).

Dyab et al. also suggested an educational program highlighting the benefits of reporting culture in the hospital to promote the reporting of medication errors (32).

Samsiah et al. highlighted the importance of error, the medication error reporting system, organizational factors, and the benefits of medication error reporting (45). Furukawa et al. stated that learning from previous errors is the best way to prevent errors. For this purpose, they mentioned the impact of the error reporting program and patient safety management training (38). Baloochi Beydokhti et al. also reported in their study the factors related to medication errors: Doctors' distorted orders, high workload, and lack of manpower. They considered the lack of specific guidelines for error reporting, obstacles related to employees, and managerial obstacles as other factors related to the non-reporting of medication errors, and considering the importance of patient safety, they recommended that the executive managers think of measures to reduce the incidence of errors in medical staff and if it occurs, provide measures to report it based on a system of registration and error reporting without fear of its consequences (46). Therefore, it is suggested that behavioral disease counseling centers always have access to a group of trained employees to play a role and provide constructive and effective training when necessary, and in order to quickly access the training group, their list, along with their phone numbers should be kept and updated in provincial centers and medical sites.

The results of the present study showed that among the individual factors affecting the management of medication errors in HIV/AIDS patients, the components of error reporting and employee barriers (fear of the consequences of reporting and the reaction of others) constitute the highest coefficient of influence. Improvement in this area will improve the management of medication errors in these patients. It is worth mentioning that no study specifically investigates the reporting of medication errors in HIV/AIDS patients. However, in the study of Ghorbanpour Diz et al., the most common obstacles to not reporting these errors in nurses include the fear of the error's impact on the patient's serious injury, paying a ransom, and worrying about the bad track record in the evaluation of the employee after reporting (47). Vrbnjak et al. stated in their study that personal barriers such as fear, responsibility, and characteristics of nurses are barriers to reporting medication errors. Also, these researchers emphasized in their study that creating a safe culture of learning is necessary without blame, punishment, and fear (40).

The results of the present study showed that among the communication factors, one of the reforms that have the highest impact factor and can lead to the reduction of medication errors in people infected with the virus is the use of components for medication adherence. Chory et al. conducted a pilot study in western Kenya to investigate a mobile phone intervention to support mental health and medication adherence among adolescents with HIV. This study evaluated adherence to treatment, stigma, and mental and behavioral health prospectively. Participants reported positive experiences and indicated that the platform encouraged peer network development. They confirmed potential benefits for treatment adherence, reduced stigma, and psychological and behavioral health. All participants supported extending the intervention to mobile counseling and peer support (48). Glasner et al. noted the promising results of a cognitive behavioral therapy text message intervention targeting adherence to antiretroviral therapy and high-risk HIV behaviors among adults with HIV and substance use disorders, consistent with the present study's communication factors (49). Abdulai et al. conducted a study to qualitatively analyze the factors affecting antiretroviral adherence among people with HIV in Ghana. Their results mentioned communication factors such as coping skills, disclosure, self-regulation, healthcare-provider interaction, and family and life partner support (50). Okonji et al. also investigated psychosocial support interventions to improve adherence and retention in ART care for HIV-infected youth (10 - 24 years). This study identified four distinct treatment methods that focused on improving ART adherence and retention in care: Support groups, family-centered services, treatment advocates, and communication factors (51). Abdulrahman et al. emphasized the effect of communication factors (text messages and phone call reminders) and peer counseling on improving adherence and treatment outcomes of patients with HIV/AIDS (52). Also, Dowshen and colleagues emphasized the importance of communication factors (reminders with personal SMS to receive medicine and interaction with friends and peers) (53).

Considering the issue's importance, it is suggested to conduct more comprehensive studies on managing medication errors and the factors affecting them, especially in HIV/AIDS patients, so that effective strategies can be developed and implemented based on them. Considering the small number of studies conducted, it is suggested to conduct similar studies with a larger sample size in hospitals and counseling centers for behavioral diseases in Iran. Also, studies examining communication barriers between doctors and pharmaceutical experts of behavioral disease counseling centers, the effect of direct treatment of infected patients on reducing medication errors, and the effect of stigma on managing medication errors in HIV/AIDS patients are recommended. Also, it is suggested to examine things such as the effect of appointment systems on managing medication errors and the effect of psychosocial support sessions on reducing the exhaustion and stress of employees and patients at the level of Iran's health system. Due to the necessity of reforming the structure of pharmaceutical services in behavioral disease counseling centers, it is necessary to include organizational factors (work environment factors and team factors), individual factors, establishing a monitoring and evaluation mechanism, paying attention to

the needs of the patient and pharmaceutical experts providing the service, emphasizing compliance with instructions and meetings, and education for patients and their families should be considered. Also, it is recommended that the Ministry of Health and Medical Education use the research results to improve patient safety, adjust working environment conditions and organizational and human factors, reduce medication errors, and improve the quality of care for HIV/AIDS patients and patient satisfaction.

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