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Pharmacists' awareness, knowledge, and attitudes regarding pharmacoeconomics in Al-Madinah Al-Munawara region, Saudi Arabia

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Abstract

Background: Due to the inflating prices of pharmaceutical products and services, medical burdens on patients and governments have increased. Pharmacoeconomics can assist decision-makers in allocating limited resources appropriately and utilizing cost-effective methods to improve patient care while reducing costs. However, pharmacoeconomics has still not been incorporated completely into practice.

Objective: The aim of this cross-sectional study was to assess pharmacists' awareness, knowledge, and attitudes regarding pharmacoeconomics in the Al-Madinah Al-Munawara region in Saudi Arabia and to find interventions to improve the application of pharmacoeconomics in clinical practice.

Methods: A validated questionnaire was used to collect demographic information and responses for the measures of awareness, knowledge, and attitudes about pharmacoeconomics. It was distributed among pharmacists of different nationalities, levels of education, degrees, and organizations in different cities in the Al-Madinah Al-Munawara region.

Results: After applying the inclusion and exclusion criteria, 182 pharmacists' responses were included in the final analysis. The results showed suboptimal awareness (mean score = 1.95 out of 4) and knowledge (mean score = 1.62 out of 7) about pharmacoeconomics. However, 93% of the participants thought that applying pharmacoeconomics would improve the healthcare system.

Conclusion: Pharmacists' awareness and knowledge of pharmacoeconomics are suboptimal. Policy implementation in healthcare organizations, addition of pharmacoeconomics courses in curricula, continuous medical education, encouraging self-involvement, and interest in the subject, will enhance their understanding. These would also expand the application of pharmacoeconomics in healthcare organizations and improve patient care and the utilization of healthcare resources, as well as reduce the total healthcare costs.

Introduction

The continuously increasing prices of pharmaceutical products and services have compounded economic burdens on patients and government healthcare systems. There is an urgent need for healthcare professionals and key decision-makers, such as pharmacists, to use the limited healthcare resources appropriately.[1–4] In an Indian study, for example, Abdulsalim et al.[5] showed that pharmacist intervention led to saving on direct medicine costs for patients with chronic obstructive pulmonary disease.

Pharmacoeconomics, which emerged in the literature in the mid-1980s, defines, measures, values, and compares costs of both input resources and consequences such as clinical, economic, and humanistic outcomes of pharmaceutical products and services. Such analyses can help determine whether the additional benefits of one treatment or service are worth the inherent additional costs.[3,6–8] Therefore, pharmacoeconomics can inform healthcare professionals' decision-making in terms of improving the allocation of limited healthcare resources by promoting the most appropriate and cost-effective pharmaceutical products and services. For example, a study by Mori and Robberstad[9] found significant evidence indicating that pharmacoeconomic studies impacted the selection and listing of drugs in the national medicine list in Tanzania. In addition, according to a survey of pharmacoeconomic assessment activity in 11 countries, some countries responded that pharmacoeconomic assessment met their goals for enhancing the cost-effectiveness of prescribing.[10] By avoiding unnecessary and cost-ineffective products and services, the economic burdens on patients and third-party payers, such as governments and healthcare insurance entities, will be reduced.[3,6,8] According to a survey conducted by Dickson et al.,[10] two countries stated that pharmacoeconomics reduced total drug expenditure. Thus, healthcare professionals and decision-makers should be able to measure the total costs and benefits of interventions, which would assist them in managing drug formularies and clinical practice guidelines, and continually accessing new healthcare interventions and technologies.[3,6,8,11,12] Furthermore, pharmacoeconomics would assist pharmaceutical companies in evaluating the marketability and revenue generation of new products that meet patients' and third-party payers' needs. The above-mentioned survey by Dickson et al.[10] showed that some countries indicated that pharmacoeconomic assessment met their goals by sensitizing drug manufacturers to the need for effective drugs.

However, pharmacoeconomics is a new field and has not been incorporated completely into practice in many countries, including Saudi Arabia.[1,13–17] Fewer than 50% of the countries

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that participated in the abovementioned survey by Dickson et al.[10] reported using pharmacoeconomic assessment to establish the value-for-money of new pharmaceuticals, and some stated that they used it mainly for cost-containment. In addition, a study showed that most drug therapy decisions in Saudi Arabia are based on clinical outcomes, such as safety and efficacy associated with a treatment alternative without regard for their cost effectiveness[18]. However, in Saudi Arabia, a huge healthcare transformation is currently occurring to meet the Saudi National "Vision 2030." Through its evidence-based health technology assessment entity, Saudi Arabia is looking to maximize health gains through the efficient use of resources.[19]

Among different healthcare organizations, pharmacists are considered key decision-makers in developing drug formularies and clinical practice guidelines as well as selecting appropriate treatments for patients. Given the relevance of pharmacoeconomics for healthcare resource allocation, pharmacists would benefit from learning about and adapting this subject into practice. Therefore, this study was conducted with the following aims:

(a)   Assess pharmacists' awareness and knowledge of and attitudes toward pharmacoeconomics in the Al-Madinah Al-Munawara region of Saudi Arabia and

(b)   Explore appropriate interventions that could improve pharmacists' knowledge of pharmacoeconomics, enhance their attitudes, and increase the application of pharmacoeconomics in different healthcare organizations.

This is all to be consistent with the Saudi National Vision 2030 while maximizing health gains through the efficient use of resources.

Method

Data collection

In this cross-sectional study, a modified pre-validated self-administrated questionnaire, which has been used in several studies,[7,8,20,21] was prepared in Google Forms in both English and Arabic. The modifications in the original questionnaire include changing the specific questions that related to the country in which the original questionnaire were distributed to more general questions. Moreover, additional demographic questions were included in the modified questionnaire. The modified pre-validated self-administrated questionnaire was then reviewed by three faculty members, and their suggestions and comments were applied. Following that, as a pilot test, it was distributed to 27 PharmD interns, pharmacists in training, and professional pharmacists. The questionnaire was revised and finally distributed by the data collectors to participants.

Participants

Participants included pharmacists of varied ages, genders, levels of education, professional degrees, and nationalities, who were working at different government and private healthcare organizations in cities within the Al-Madinah Al-Munawarah region, Saudi Arabia. Pharmacy students and interns, faculty members, and pharmacists from outside the Madinah region were excluded.

Study Questionnaire

The questionnaire included information regarding participants' demographics, and awareness, knowledge, and attitude toward pharmacoeconomics.

The nine demographic questions included details about the workplace, its location, and type; nationality; gender; level of education; professional degrees; years of experience; and whether a participant ever had an administrative position. Second, the four questions for awareness inquired about participants' understanding of the term "pharmacoeconomics," its definition, four main types, and abbreviations used in the same. Third, the seven knowledge-based questions inquired about the basic concepts of pharmacoeconomics, including its four main types (cost-minimization, cost-effectiveness, cost-utility, and cost-benefit analyses) and application. Fourth, the five attitude-based questions inquired whether participants had attended any training or workshop on pharmacoeconomics; how they learned about the same; their opinions about how pharmacists should acquire knowledge of pharmacoeconomics; which departments or workplaces should learn the subject; and whether applying it in healthcare would improve the system's performance.

Response types include binary yes/no answers, multiple-choices, checkboxes, and long answers. The multiple-choice questions include the option "other" for demographic questions to filter out non-targeted responders, such as non-pharmacists or pharmacists from other regions. In addition, "I am not sure" was included as an option for the knowledge-related questions to avoid random answers, which may have affected the results. Checkbox answers, which also included the "other" option, were used for the attitude questions. Finally, a long-answer question was used to collect participants' additional comments.

Ethical approval

This study was approved by the ethics committee of the Ministry of Health in the Al-Madinah Al-Munawara region, Saudi Arabia, and the participants gave their consent to participate in the study.

Data analysis

Questions related to awareness and knowledge were assigned a value of 1 for correct answers and 0 for wrong answers. For each question, the percentage of correct answers was calculated. To calculate the overall score for the knowledge and attitude sections, the total number of correct answers was divided by the total number of questions and multiplied by 100. The results were expressed as a percentage response in these two sections, with the maximum total being 100%. In addition, total scores out of four for awareness and seven for knowledge were calculated for each participant. The mean scores for the awareness and knowledge sections were then calculated. Moreover, to investigate factors influencing awareness and knowledge, subgroup analyses were performed.

Results

One hundred and ninety-two participants were included after the pilot test, of which 10 participants were excluded due to not meeting the inclusion criteria (four PharmD interns, three from another Saudi region, two faculty members, and one pharmacy student). Thus, 182 responses were included in the final analysis.

Demographic characteristics

Approximately 86% of participants were from Al-Madinah city, and others were from the remaining cities in the region. Of the participants, 81% and 66% were Saudi and male, respectively. Fifty-seven percent had bachelor's degrees, 19% had diplomas, 18% had PharmD degrees, 4% had master's or PhD degrees, and 2% were clinical pharmacists with pharmacy residency. Approximately 72.5%, 20%, 7%, and .5% were pharmacists, pharmacy technicians, senior pharmacists, and consultant pharmacists, respectively. The majority (45%) worked at hospitals, while 34%, 8%, and 7% worked at community pharmacies, pharmaceutical companies, and primary healthcare centers, respectively.

The remaining worked in other healthcare centers, such as medical supply departments and pharmaceutical warehouses. Approximately 48%, 46%, and 5% worked in the government, private, and military sectors, respectively. Approximately 24% had worked for less than one year, 32% had been working for one to five years, and 44% had been working for more than five years. Furthermore, 76% of the participants never held administrative positions. Demographic details of the participants are presented in **Table 1.**

Table 1: Demographic details of the participants (n = 182)

Variable		No. of participants (%)	
City of Workplace	Al-Madinah	157	(86)
	Yanbu	9	(5)
	Al-Ula	8	(4)
	Al-Hinakiyah	3	(2)
	Wadi Al-Fora'a	2	(1)
	Al-Mahd	1	(1)
	Badr	1	(1)
	Al-Ais	1	(1)
Nationality	Saudi	147	(81)
	Egyptian	26	(14)
	Jordanian	3	(2)
	Sudanese	3	(2)
	Syrian	2	(1)
	Yemeni	1	(1)
Gender	Men	120	(66)
	Women	62	(34)
Level of Education	Diploma	34	(19)
	Bachelor's Degree	103	(57)
	Doctor of Pharmacy (PharmD) Degree	33	(18)
	Pharmacy Residency PGY-1	1	(1)
	Pharmacy Residency PGY-2	3	(2)
	Master's Degree	7	(4)
	Doctorate Degree	1	(1)
Professional Degree	Pharmacy Technician	36	(20)
	Pharmacist	132	(73)
	Senior Pharmacist	13	(7)
	Consultant Pharmacist	1	(1)
Workplace	Hospital	82	(45)
	Community Pharmacy	61	(34)
	Pharmaceutical Company	14	(8)
	Healthcare Center	13	(7)
	Medical Supply Department in a Hospital	4	(2)
	Medical Supply Department in the Region	4	(2)
	Pharmaceuticals Products Warehouse	1	(1)
	Not Determined	3	(2)
Type of Workplace	Governmental	87	(48)
	Private	83	(46)
	Military	10	(5)
	Not Determined	2	(1)
Years of Experience	Less than 1 Year	43	(24)
	From 1 to 5 years	58	(32)
	Greater than 5 to 10 years	37	(20)
	Greater than 10 to 15 years	26	(14)
	Greater than 15 years	18	(10)
Have you held an administrative position?	Yes	43	(24)
	No	139	(76)

Awareness

Approximately 74% of participants were aware of the term "pharmacoeconomics," 35% had heard about the four types of pharmacoeconomic studies, and 65% knew the definition of pharmacoeconomics. However, only 20% could elaborate on the acronym "ECHO." ECHO refers to economic, clinical, and humanistic outcomes, which are the three main outcomes measured in pharmacoeconomics. The average percentage of total correct answers per participant was 49% (the total number of correct answers divided by the total number of questions and multiplied by 100). These responses are presented **in Table 2**. Only 13% of participants scored 4 out of 4, while an equal percentage scored 0 out of 4. The mean score was 1.95 out of 4.

Knowledge

Of the total participants, 31% and 24% correctly answered the first two questions about the types and costs of pharmacoeconomics, respectively, and 6% knew the tool used to test the robustness of results. Approximately 25% correctly

answered three questions related to the types of studies used to compare the costs of generic equivalents of the same drug entities; measure outcomes in monetary units; and measure quality-adjusted life years (QALY). Furthermore, approximately 26% responded correctly to the question about the application of pharmacoeconomics. The average percentage of total correct answers per participant was 23% (total number of correct answers for all patients divided by the total number of questions and multiplied by 100); these responses are presented in **Table 3**. Out of 182 participants, only one participant scored 7 out of 7, while approximately 36% scored 0 out of 7. The mean score for knowledge-based questions was 1.62 out of 7, which is considered suboptimal.

Table 2. Responses to awareness-based questions (n = 182)

	No. of participants (%)	
	Yes, or correct answer	**No, wrong answer, or "I am not sure"**
Are you aware of the term "pharmacoeconomics"?	135 (74)	47 (26)
Did you hear about the main four types of pharmacoeconomic studies?	63 (35)	119 (65)
Which of the following is correct about pharmacoeconomics?	119 (65)	63 (35)
In pharmacoeconomics, what does ECHO stand for?	37 (20)	145 (80)

Note: The total percentage of yes (and correct answers) to awareness-based questions was 49% (the total number of correct answers for all patients was divided by the total number of questions and multiplied by 100). ECHO: economic, clinical, and humanistic outcomes.

Table 3. Responses to knowledge-based questions (n = 182)

	No. of participants (%)	
	Correct answer	**Wrong answer or "I am not sure"**
Which of the following is NOT a type of pharmacoeconomic study?	57 (31)	125 (69)
Which of the following is NOT a type of costs that are involved in pharmacoeconomic studies?	44 (24)	138 (76)
Which of the following is used to test the robustness of results?	11 (6)	171 (94)
To compare the costs of generic equivalents of the same drug entity, which of the following studies is usually used?	46 (25)	136 (75)
Which of the following studies measures outcomes in monetary units?	45 (25)	137 (75)
Which of the following studies measure the QALYs?	43 (24)	139 (76)
Pharmacoeconomic methods can be applied for all EXCEPT	48 (26)	134 (74)

Note: The total percentage of correct answers to knowledge-based questions was 23% (the total number of correct answers for all patients was divided by the total number of questions and multiplied by 100). QALYs: quality-adjusted life years.

Attitude

Approximately 85% of participants had not attended training or workshops on pharmacoeconomics. Regarding sources of information, 27%, 12%, 2%, and 2% relied on the Internet, experienced colleagues, scientific journals, and scientific conferences, respectively, to learn about pharmacoeconomics. The remaining participants selected more than one method. For example, 11% selected both the Internet and experienced colleagues; 7% selected the Internet and scientific journals; 5% selected the Internet, experienced colleagues, and scientific conferences; and approximately 12% selected all four methods. Regarding how pharmacists should acquire knowledge about pharmacoeconomics, 12% selected self-involvement and interest, 8% chose pharmacoeconomics courses in educational curricula, 5% chose pharmacoeconomics in continuous medical education, and 4% mentioned specialization. The remaining participants selected more than one method, and 21% selected all four methods. Regarding their opinions about which departments or workplaces should train their staff in pharmacoeconomics, 13% selected only one department/workplace and an equal percentage selected all seven departments/workplaces. Finally, approximately 93% of participants thought that applying pharmacoeconomics in healthcare would improve the healthcare system's performance. These responses are presented in **Table 4**.

Discussion

To be consistent with the Saudi National Vision 2030, healthcare organizations in Saudi Arabia should help maximize health gains through the efficient use of resources.[19] Pharmacoeconomics can act as a decision-making aid for healthcare professionals to improve the cost-efficiency and equity of resource allocation, consequently reducing the economic burdens on patients and third-party payers, such as the government.[3,6–8] Previous studies, such as that by Al-Jazairi et al.,[1] showed that some barriers challenge the application of pharmacoeconomics for decision-making, such as the lack of quality data on the Saudi population and scarce clinically relevant and unbiased published cost-effectiveness data when a new drug is considered for addition to the formulary. However, this study shows that pharmacists, who are key resource allocators in healthcare, have suboptimal awareness and knowledge of pharmacoeconomics. The overall average scores for awareness and knowledge were 1.95 out of 4 and 1.62 out of 7, respectively, which are suboptimal. Although 93% of participants thought that applying pharmacoeconomics in healthcare could improve the health system, only 15% had attended training or workshops on the subject. To investigate factors influencing suboptimal awareness and knowledge, subgroup analyses were performed.

Table 4. Responses to attitude-based questions (n = 182)

		No. of participants (%)	
		Yes	**No**
Did you attend any training/workshop on pharmacoeconomics?		27 (15)	155 (85)
How do you get information about pharmacoeconomics?	Internet	49 (27)	
	Experienced colleagues	21 (12)	
	Scientific journals	3 (2)	
	Scientific conferences	3 (2)	
	All	21 (12)	
In your opinion, how should pharmacists acquire knowledge on pharmacoeconomics?	Self-involvement and interest	21 (12)	
	Addition of pharmacoeconomics in undergraduate/postgraduate/residency curricula	14 (8)	
	Addition of topics about pharmacoeconomics in continuous medical education	9 (5)	
	Specialization	7 (4)	
	All	39 (21)	
In your opinion, the staff of which of the following departments/workplaces should have knowledge about pharmacoeconomics?	Clinical pharmacy departments	5 (3)	
	Medical supply departments	4 (2)	
	Pharmaceutical companies	3 (2)	
	Pharmaceutical and herbal products Manufacturers	3 (2)	
	Hospital pharmacy departments	2 (1)	
	Drug information centers	2 (1)	
	Community pharmacies	1 (1)	
	Pharmaceuticals warehouses	1 (1)	
	All	24 (13)	
Do you think applying pharmacoeconomics in healthcare will improve the health system's performance?		170 (93)	12 (7)

Additional comments

One participant suggested conducting pharmacoeconomics workshops in hospitals and distributing brochures about the subject to pharmacists in the field.

Subgroup analyses

First, subgroup analysis based on gender showed that women scored higher in both awareness and knowledge than men (2.44 and 2.37 versus 1.69 and 1.23, respectively). Moreover, those who occupied administrative positions scored lower in both

awareness and knowledge than those who had never held an administrative position (1.63 and 1.28 versus 2.04 and 1.72, respectively), even though administrators are supposed to be decision-makers. Nearly 84% of participants who had held administrative positions had more than five years of experience, while only 32% of those who had never held administrative positions had more than five years of experience. Hence, pharmacists with fewer years of experience, who were more recent graduates, would have been exposed to pharmacoeconomic courses in the near past and hence remember the material better. This was consistent with the results of the subgroup analysis based on participants' years of experience. It indicates that less experience was associated with higher mean scores for awareness and knowledge. Mean scores for awareness and knowledge were 2.65 and 3.05 among those with less than a year of work experience, 2.03 and 1.47 among those with between one and five years of work experience, and 1.51 and .96 among those with more than five years of experience. In addition, 52% of participants who had attended pharmacoeconomic workshops had less than one year of experience; 33% had one to five years of experience; and only 15% had more than five years of experience. Participants who had attended pharmacoeconomic workshops scored higher in both awareness and knowledge (2.74 and 3.02 versus 1.81 and 1.37, respectively). Therefore, in addition to emphasizing the importance of integrating pharmacoeconomics courses into pharmacy colleges at the undergraduate and postgraduate levels and in residency programs, these results show the importance of incorporating pharmacoeconomics into continuous medical education to update pharmacists. Moreover, pharmacists who specialize in pharmacoeconomics would be crucial for decision-makers who deal with drug formularies and drug use policies/guidelines in healthcare organizations.

Reasons for suboptimal awareness and knowledge

Based on the findings of this research study, the following are the reasons for the suboptimal knowledge and awareness of the surveyed pharmacists:
Since pharmacoeconomics is a new concept, older pharmacists may not have studied it, and they may lack interest in learning about pharmacoeconomics as they may not be aware of its importance.
There is a lack of education about pharmacoeconomics in continuous medical education.
There is a lack of practical exercises in university courses. A study by Catić and Skrbo[22] found that pharmacy students are familiar with the basic concepts of pharmacoeconomics. However, they are not able to conduct, understand, or adopt published studies. Moreover, they lack technical knowledge.

Recommendations

Here are some recommendations to enhance pharmacists' awareness and knowledge of pharmacoeconomics and its application:
In addition to including pharmacoeconomics courses in undergraduate and postgraduate curricula to improve knowledge and interest among students, practical exercises should be added to the courses.
Yearly continuing medical education and workshops may be conducted in hospitals and universities to enhance pharmacists' awareness of updates in pharmacoeconomics.

Healthcare institutions such as hospitals should include pharmacists who specialize in pharmacoeconomics, especially in their Pharmacy and Therapeutics committees, to apply pharmacoeconomics techniques in decision-making about drug formularies and drug use policies/guidelines.
Policy implementation using pharmacoeconomics should be available in healthcare institutions.

Limitations

Most of the participants were from Al-Madinah, with only 15% being from other cities, and this study was conducted in only one region of Saudi Arabia. Thus, further studies should be conducted in the remaining regions of Saudi Arabia.

Conclusion

The findings of this study indicate that pharmacists' awareness and knowledge of pharmacoeconomics are below optimal levels. However, it is encouraging to note that pharmacists exhibit positive attitudes toward pharmacoeconomics, suggesting an opportunity to enhance understanding and implementation in practice. Addressing this gap could involve policy implementation within healthcare organizations, integrating pharmacoeconomics courses into undergraduate/postgraduate/residency curricula and continuous medical education, and supporting pharmacists' self-directed learning initiatives. These measures have the potential to optimize healthcare resource allocation and alleviate the economic burden on healthcare systems.

Abbreviations

ECHO: economic, clinical, humanistic outcomes; QALY: quality-adjusted life years

References

[1] Al-Jazairi AS, Al-Qadheeb NS, Ajlan A. Pharmacoeconomic analysis in Saudi Arabia: an overdue agenda item for action. *Ann Saudi Med*. 2011;31(4):335-341. doi: 10.4103/0256-4947.83201.

[2]Vincent Rajkumar S. The high cost of prescription drugs: causes and solutions. *Blood Cancer J*. 2020;10(6):71. doi: 10.1038/s41408-020-0338-x.

[3]Rascati KL. Essentials of Pharmacoeconomics. 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2013.

[4]Wineinger NE, Zhang Y, Topol EJ. Trends in prices of popular brand-name prescription drugs in the United States. *JAMA Netw Open*. 2019;2(5):e194791. doi: 10.1001/jamanetworkopen.2019.4791.

[5]Abdulsalim S, Unnikrishnan MK, Manu MK, et al. Impact of a clinical pharmacist intervention on medicine costs in patients with chronic obstructive pulmonary disease in India. *Pharmacoecon Open*. 2020;4(2):331-342. doi: 10.1007/s41669-019-0172-x.

[6]Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Stoddart GL. Methods for the Economic Evaluation of Health Care Programme. 3rd ed. Oxford, United Kingdom: Oxford University Press; 2005.

[7]Gupta R, Malhotra P. Evaluation of awareness about pharmacoeconomics in postgraduate students of a tertiary care teaching hospital: a questionnaire based observational study. *Int J Basic Clin Pharmacol*. 2017;6(10):2459-2462. doi: 10.18203/2319-2003.ijbcp20174376.

[8]Tahashildar J, Kota KK, S, Tahashildar J, Mohanty L, Ahmed SY. Assessment of the knowledge and perceptions about pharmacoeconomics among medical postgraduate students and healthcare professionals at a tertiary care teaching hospital, Udaipur, India. *Int J Curr Res Acad Rev*. 2015;3(2):135-142.

[9]Mori AT, Robberstad B. Pharmacoeconomics and its implication on priority-setting for essential medicines in Tanzania: a systematic review. *BMC Med Inform Decis Mak*. 2012;12:110. doi: 10.1186/1472-6947-12-110.

[10]Dickson M, Hurst J, Jacobzone S. *Survey of Pharmacoeconomic Assessment Activity in Eleven Countries*. OECD health working Papers, No. 4. Paris: OECD Publishing; 2003. doi: 10.1787/678644556018.

[11]Garrison LP Jr. Cost-effectiveness and clinical practice guidelines: have we reached a tipping point?—an overview. *Value Health*. 2016;19(5):512-515. doi: 10.1016/j.jval.2016.04.018.

[12]Schrogie JJ Jr, Nash DB. Relationship between practice guidelines, formulary management, and pharmacoeconomic studies. *Top Hosp Pharm Manage*. 1994;13(4):38-46.

[13]Almazrou SH, Alaujan SS, Al-Aqeel SA. Barriers and facilitators to conducting economic evaluation studies of Gulf Cooperation Council (GCC) countries: a survey of researchers. *Health Res Policy Syst*. 2021;19(1):71. doi: 10.1186/s12961-021-00721-1.

[14]Ben-Ajepe T, Nwogu IB, Olaoye DQ, Mustapha AA, Uwizeyimana T, Adebisi YA. Pharmacoeconomics in Africa: needs, prospect and challenges. *J Pharm Policy Pract*. 2021;14(1):47. doi: 10.1186/s40545-021-00328-5.

[15]Doherty J, Kamae I, Lee KK, et al. What is next for pharmacoeconomics and outcomes research in Asia? *Value Health*. 2004;7(2):118-132. doi: 10.1111/j.1524-4733.2004.72330.x.

[16]Li H, Ngorsuraches S. Revisit what is next for pharmacoeconomics and outcomes research in Asia. *Value Health Reg Issues*. 2014;3:1-4. doi: 10.1016/j.vhri.2013.04.001.

[17]Pandey P, Pandey RD, Shah V. Evaluation of quality of pharmacoeconomic studies in Asia-Pacific region and identification of influencing variables. *Value Health Reg Issues*. 2018;15:70-75. doi: 10.1016/j.vhri.2017.07.007.

[18] Hamad A, Alsaqa'aby M, Alruthia Y, Aldallal S, Elsisi GH. Overview of Procurement and Reimbursement of Pharmaceuticals in Saudi Arabia, United Arab Emirates, Qatar, and Egypt: Challenges and Opportunities. *Glob J Qual Saf Healthc*. 2023;6(4):127-136. doi:10.36401/JQSH-23-1

[19]Al-Omar HA, Attuwaijri AA, Aljuffali IA. Pharmaceutical companies' views on a health technology assessment (HTA) entity in Saudi Arabia. *Saudi Pharm J*. 2020;28(6):662-668. doi: 10.1016/j.jsps.2020.04.006.

[20]Jayasree D, Uppu B, Devi B. A study on awareness of pharmacoeconomics among post graduates in a tertiary care teaching hospital. *Int J Res Med Sci*. 2016;4(5):1597-1603. doi: 10.18203/2320-6012.ijrms20161233.

[21]Savkar K, Bhat N, Deepika G, Shwetha. Evaluation of pharmacoeconomics awareness among post graduates: a questionnaire-based studies. *Indian J Basic Appl Res*. 2014;3(3):135-142.

[22]Catić T, Skrbo S. Pharmacoeconomic education for pharmacy students in Bosnia and Herzegovina. *Mater Sociomed*. 2013;25(4):282-285. doi: 10.5455/msm.2013.25.282-285.