Original Article

Assessing Knowledge, Awareness, and Attitudes Towards Personalised, Genomic, and Pharmacogenomics Medicine in Health Students at Umm Al-Qura University A Cross-Sectional Study

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ABSTRACT

Background: personalized medicine is a medical concept that intends to provide individuals with individualized approach preventative and treatment techniques. It is substantially relies on genetic and clinical examination; this aspect of medicine has significantly progressed over the last few decades.

Aims: our study surveyed health students from different health-related colleges in the Makkah region of western Kingdom of Saudi Arabia (KSA). We compared student knowledge, awareness and attitudes toward personalized, genomic, and pharmacogenomics medicine to address a knowledge gap in the literature.

Methodology: an online survey-based study was carried out on health students in different health colleges at Umm Al-Qura University between March 2021 and September 2021.

Results: the number of participants in the current study was 370. Their mean age was 21.05± 1.72 years. Altogether, 68.1% of the participants were male, and 31.9% were female. The majority were second-year students, while intern students were the least represented. The College of Medicine had the largest representation of students. The majority of the students were single. Moreover, there was a correlation found between participants' level of awareness and their gender and college (p, value 0.003, 0.050, respectively). Furthermore, a significant correlation was found regarding students' interest in undertaking a genetic test (p-value, 0.045).

Conclusion: according to the findings of the current study, health care professionals have limited awareness about personalised, genomic, and pharmacogenomics medicine. Furthermore, participants' gender, and college were found to have a significant correlation with their level of awareness, compared with the other demographic categories.

Keyword: knowledge, awareness, personalized medicine, genomic medicine, pharmacogenomics, health students, Saudi Arabia.

Introduction

Personalized medicine has been described as an evolving method incorporating genetic, clinical, and environmental data [1-7]. It aims to deliver optimal healthcare based on patient's requirement [1-7]. Therefore, it depends heavily on the genetic sequencing in diagnosing patients, which is assessed in terms of their clinical profile when deriving a future prognosis [1-7]. Over the last few years, this medical specialty has progressed dramatically, developing new diagnostic tools, one of which is 'genomic biomarkers,' which can predict future health concerns [1, 7, 8, 9, 10]. Furthermore, these biomarkers are intended to aid in the prevention and treatment of diseases in order to provide optimal, focused, cost-effective healthcare,

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Hence improving health outcomes [1, 10, 11, 12]. Simultaneously with this significantly increased contribution to critical advancements in both diagnostics and disease management, national efforts in the 'Saudi Human Genome Project' were made in the Kingdom of Saudi Arabia (KSA) to lay the foundations for genomic research as well as the operationalisation of evidence-based personalized medicine [1,13]. These preparations, however, must be backed up by national surveys that assess local people' readiness for this field [1]. The next step in genomic medicine and pharmacogenomics will necessitate that healthcare professionals have the tools and knowledge to completely apply and implement pharmacogenomics in clinical practice to the greatest extent possible [15-19]. Unfortunately, despite the significance of genomic medicine and pharmacogenomics in clinical practice being emphasized and demonstrated, many health professionals lack confidence in implementing pharmacogenomics in practice [14, 19, 20]. Personalised, genomic, and pharmacogenomics medicine can be attributed to lacking the required education, a widely highlighted barrier [14,20]; thus, health-related students represent the future healthcare professionals, and their perceptions are vital in the aim to raise awareness of the field of genetics [14,17,18,20,21]. Therefore, to increase personalized, genomic, and pharmacogenomics medicine awareness and knowledge as well as changing attitudes among health-related students, their knowledge, attitudes, and practice should be evaluated. There have been insufficient studies that have evaluated health-related students' knowledge and awareness of personalized, genomic, and pharmacogenomics in the Middle East [14, 22] and the KSA [1, 6, 23]. Consequently, the present study aims to determine the knowledge, awareness, and attitudes of health-related students of these three types of medicine at Umm Al-Qura University, Makkah city, KSA.

Methods

An observational cross-sectional study was carried out at Umm Al-Qura University (UQU), Makkah, Saudi Arabia, using a self-administered structured survey. After receiving ethical approval from UQU's research ethics committee, the study carried out from March 2021 to September 2021. (Ethical number: HAPO-02-K-012-2021-09-744). To categorise students by gender and college, a random sampling method and a multistage stratification method were used. At UQU, we included the following specialty colleges: the College of Medicine, the College of Applied Medical Sciences, the College of Dentistry, the College of Pharmacy, the College of Nursing, and the College of Public Health and Health Informatics. The sample size was computed using the Stat Calc software from Emory University's Rollin School of Public Health's Open Epi package. Thus, the smallest sample size required to achieve a 5% accuracy with a 95% confidence interval is 353 [24]. The survey was divided into three sections. The students' educational and demographic information was first gathered. Students who answered "yes" in the first question of the second section were then eligible to answer questions about personalized, genomic, and pharmacogenomics medicine in the third section. The third section focused on determining the participants' general levels of awareness. The survey questions were prompted by previous research [14, 23]. In terms of questionnaire final scores, a Modified Bloom's cut off value of 75% was used to determine the students' knowledge levels [25]. As a result, each correct answer received a one, while incorrect answers received a zero. As a result, poor knowledge was defined as total scores less than 75 percent, while total scores greater than 75 percent indicated a good knowledge level. The survey was distributed to the participants following the method of stratification in randomly selected classes between March 2021 and September 2021. All queries of survey participants were promptly answered by the researcher. Participants were asked to give their consent, and they all responded voluntarily to the questionnaire. The collected data were evaluated statistically using statistical methods in SPSS v. 23. Frequency was calculated for categorical variables and mean ± standard deviation for continuous variables. To compare categorical variables, the chi-square test was used.

Results

A total of 370 health-related students were surveyed. (Table 1) shows the students' educational demographic information; about three-quarters of the participants were male (68.1%) while females represented about a third (31.9%). The mean age of the participants was 21.05± 1.72 years; students aged 19 and 20 years old were predominantly represented (20.3% and 25.9%, respectively). The least represented were the 25 and 30 year olds (1.9% and 0.3%, respectively). All age groups are labelled in Table 1. Single participants (272 or 73.5%) were noticeably more represented than married participants (Table 1). Participants at the College of Medicine constituted the largest group (28.4%). On the other hand, the minimal represented collage was the College of Public Health and Health Informatics (1.6%) (Table 1). Moreover, second-year students constituted the largest group (191 or 51.6%), compared with students in their sixth year (15 or 4.1%) (Table 1). In view of

students' levels of awareness of personalized medicine, the majority were not aware (30 or 82.4%), while 65 (17.6%) were aware (Table 1). In contrast, concerning students' level of knowledge, most students had poor knowledge (73.8%). Nine subcategories of questions aimed to evaluate the level of knowledge of personalized, genomic, and pharmacogenomics medicine among students were shown in (Table 2). Most students correspond correctly with questions related to the normal number of chromosomes in human beings (11.1%). However, the question related to "Genetic changes can cause adverse reactions" showed an inadequate level of knowledge 7.3%. The mean-frequency of the terms of personalized, genomic, and pharmacogenomics medicine are labelled in (Figure 1) below. However, (Figure 2) represents the general attitudes of the students concerning these three types of medicine. The associations between students' attitudes concerning personalized, genomic, and pharmacogenomics medicine and their academic year are described in (Table 3), see also (Figure 3) below. A significant correlation was found regarding students' interest in undertaking a genetic test (p-value, 0.045); however, an interest in personalized medicine, and to know if students are at risk in developing a genetic disease, was not found to be significant (p-values 0.789 and 0.226, respectively). Moreover, taking education and training, or taking a course about personalized medicine, was not significant as well (p-values 0.185 and 0.858, respectively). Personalized, genomic, and pharmacogenomics medicine knowledge is diverse among the subcategories linked with the students' demographic data, as described in (Table 4). A significant difference between students' gender and students' college particularly in male participants and collage of nursing (p-values 0.003 and 0.05, respectively), while there was no significant difference between students' marital status, age, and academic year.

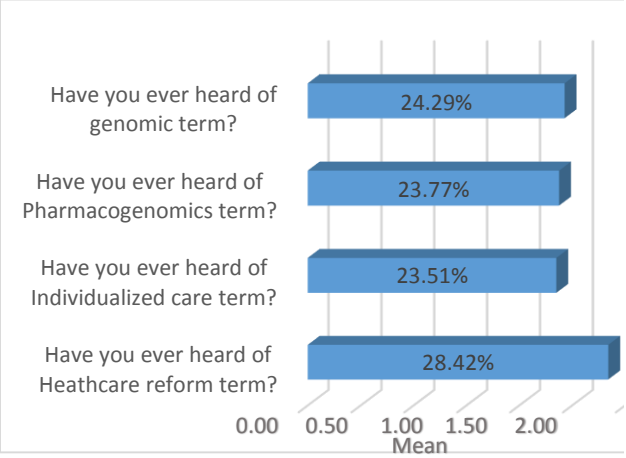

Figure 1 Personalized medicine specific term awareness.

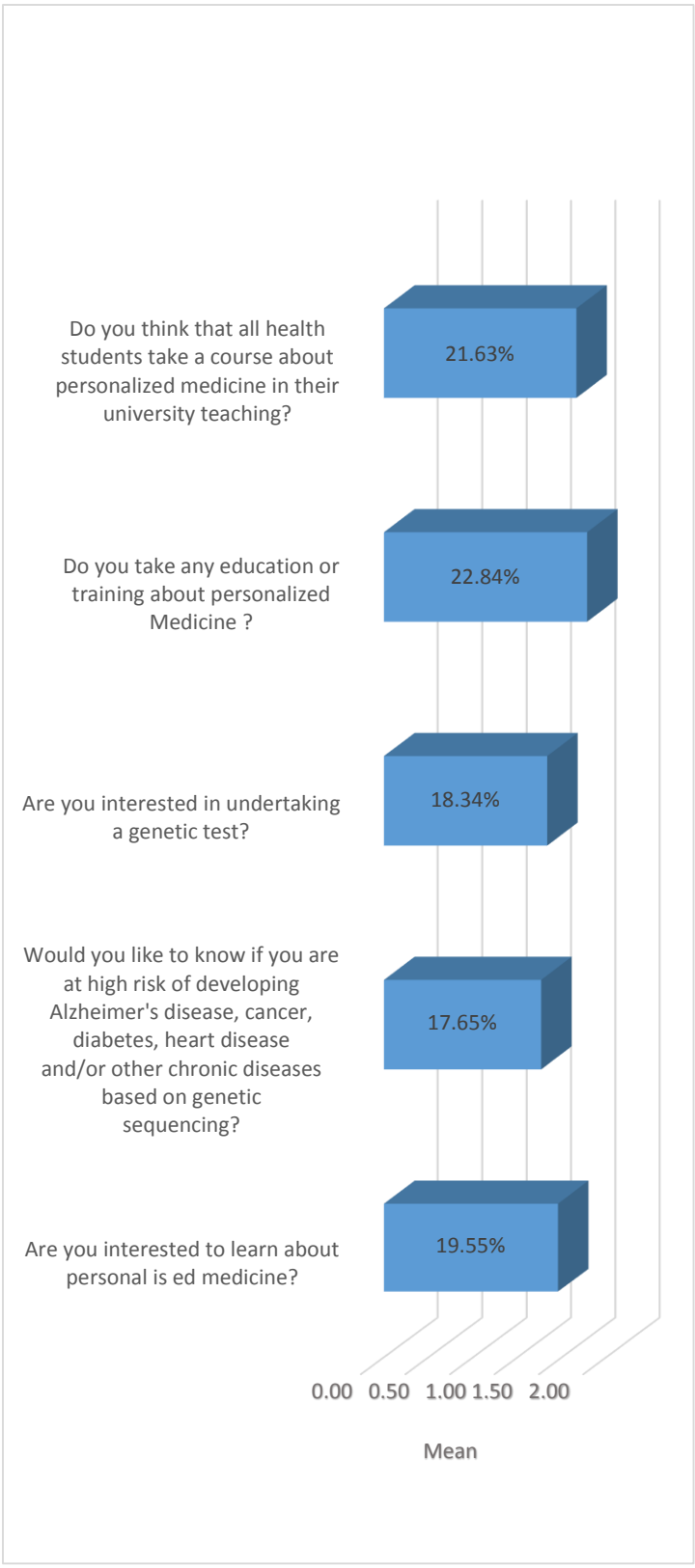

Figure 2 Students' attitudes regarding personalized medicine.

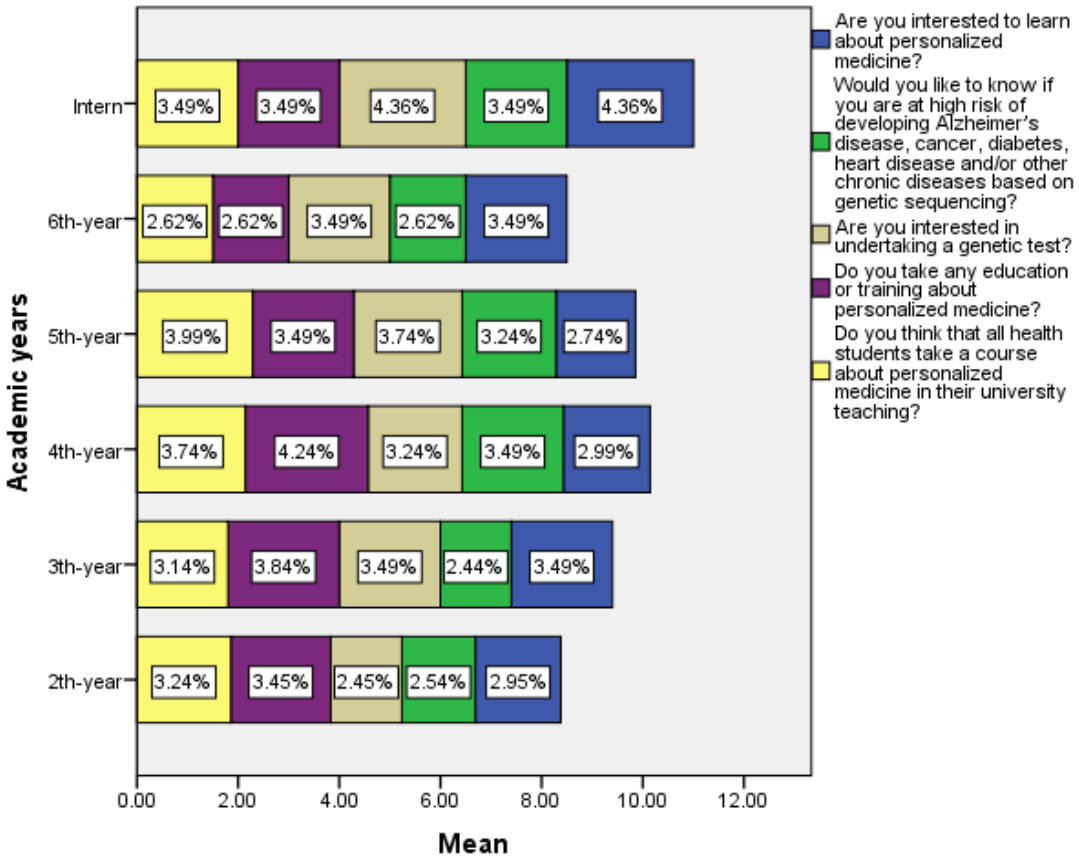

Figure 3 Association between students' attitudes and academic year. There was a significant association between students' desire to take a Genetic test (p-value, 0.045).

Table 1: Demographic data.

Variable	Category	Frequency (%)
Age (mean [SD])	**21.05 ± 1.72**	
Age	19	75 (20.3%)
	20	96 (25.9%)
	21	60 (16.2%)
	22	46 (12.4%)
	23	60 (16.2%)
	24	25 (6.8%)
	25	7 (1.9%)
	30	1 (0.3%)
Gender	Male	252 (68.1%)
	Female	118 (31.9%)
Academic year	2nd year	191 (51.6%)
	3rd year	50 (13.5%)
	4th year	56 (15.1%)
	5th year	41 (11.1%)
	6th year	15 (4.1%)
	Intern	17 (4.6%)
College	College of Medicine	105 (28.4%)
	College of Applied Medical Sciences	46 (12.4%)
	College of Dentistry	112 (30.3%)
	College of Nursing	72 (19.5%)
	College of Pharmacy	29 (7.8%)
	College of Public Health and Health Informatics	6 (1.6%)
Marital status	Single	272 (73.5%)
	Married	98 (26.5%)
Have you heard about personalised medicine?	Yes	65 (17.6%)
	No	305 (82.4%)
Knowledge levels of personalised, genomic, and pharmacogenomics medicine	Good knowledge	17 (26.2%)
	Poor knowledge	48 (73.8%)

Table 2: Knowledge of personalized, genomic, and pharmacogenomics medicine.

Question (n=65)	Mean	Standard deviation	Correct answer (%)
Humans have 48 chromosomes.	1.87	0.59	11.1
Adenine (A) only pairs with cytosine (C), and Thymine (T) only pairs with Guanine (G).	1.96	0.66	10
Pharmacogenomics seeks to individualise therapy based on	1.64	0.77	9.5

patient's genetic profile.			
Genetic changes can cause adverse reactions.	1.89	0.85	7.3
Pharmacogenomics testing is recommended by FDA for certain drugs.	1.89	0.86	7.6
Genetic changes can affect the patient's response to certain drugs.	1.63	0.76	9.5
Genes can be activated or deactivated by other genes.	1.8	0.83	8.1
Every cell of the body contains the whole genome.	1.6	0.7	6.2

Table 3: The correlation between student's attitude and academic year.

	students attitude	***p*-value**
Academic year (n. 65)	Are you interested to learn about personalized medicine?	0.789
	Would you like to know if you are at high risk of developing Alzheimer's disease, cancer, diabetes, heart disease and/or other chronic diseases based on genetic sequencing?	0.226
	Are you interested in undertaking a genetic test?	0.045*
	Do you take any education or training about personalized medicine?	0.185
	Do you think that all health students take a course about personalized medicine in their university teaching?	0.858

Table 4: Association between levels of awareness and demographic data.

Variable	Level of knowledge		*p*-value
	Poor n (%)	**Good n (%)**	
Age			
19	2 (100.0%)	(0%)	0.093
20	3 (100.0%)	0 (0.0%)	
21	9 (90.0%)	1 (10.0%)	
22	10 (100.0%)	0 (0.0%)	
23	12 (57.1%)	9 (42.9%)	
24	10 (62.5%)	6 (37.5%)	
25	2 (66.7%)	1 (33.3%)	
Gender			
Male	31 (64.6%)	17 (35.4%)	0.003*
Female	17 (100.0%)	0 (0.0%)	
Collage			
College of Medicine	3 (100%)	0 (0.0%)	0.050*
College of Applied Medical Sciences	9 (100%)	0 (0.0%)	
College of Dentistry	8(88.9%)	1 (11.1%)	
College of Nursing	16 (55.2%)	13 (44.8%)	
College of Pharmacy	11 (78.6%)	3 (21.4%)	
College of Public Health and Health Informatics	1 (100%)	0 (0.0%)	
Marital status			
Single	34 (68.0%)	16 (32.0%)	0.090
Married	14 (93.3%)	1 (6.7%)	
Academic year			
2nd year	26 (61.9%)	16 (38.1%)	0.088
3rd year	4 (80.0%)	1 (20.0%)	
4th year	7 (100.0%)	0 (0.0%)	
5th year	7 (100.0%)	0 (0.0%)	
6th year	2 (100.0%)	0(0.0%)	
Intern	2 (100.0%)	0 (0.0%)	

Discussion

The presented study demonstrates that most students had heard of personalized medicine (17.6%). This is different from another recent Saudi study in which 52.34% of the participated students had not heard of it [23]. In addition, an earlier Saudi study stated that most respondents had heard of these terms [1]. Our study demonstrated a significant correlation between an interest in a genetic test and academic year (p-value, 0.045). The variation between these studies [1, 23] and our study could be explained by significant differences between students' academic years. A survey-based study conducted in the United Arab Emirates (UAE) demonstrated substantial statistical differences between undergraduate students' levels of knowledge on genomic medicine in terms of their academic year [14]. Similarly, the current study showed differences among students of all academic years, including undergraduate students [1]. Furthermore, in confirming a previous assumption, in one of the Saudi studies [1], the targeted students who took clinical teaching courses at the hospital had heard of personalized medicine. The current study demonstrates a poor level of knowledge regarding personalized, genomic, and pharmacogenomics medicine (73.8%). This is strongly consistent with previous survey findings; a survey-based Saudi study [23] showed that 68.75% of the respondents had poor knowledge. Similarly, a study conducted in Kuwait and UAE demonstrated low-level knowledge regarding pharmacogenetics and pharmacogenetics testing [22, 14]. Concerning the general attitudes expressed in the current study, most of the students had a positive attitude regarding their interest in personalized medicine as a specialty, with a desire to learn more about genetic sequencing in the case of congenital diseases and undertake a genetic test. This is consistent with another Saudi study [23], which found that 76.56% of the participants had the interest to learn about personalized medicine; 89.06 % expressed that they would like to know if they were at high risk of developing a chronic disease, and 60.94 % showed an interest in undertaking a genetic test. Additionally, a survey-based study conducted in UAE [14] demonstrated that the majority of the students (82.7%) had a positive attitude towards having a genetic test to discover their upcoming risk of developing a genetic disease, and 74.7% had a positive attitude regarding whether they would like to know if they were susceptible to contracting certain diseases.

Increased awareness of the value and details of personalized medicine is essential to overcome certain obstacles in patients' treatment and intervention [1, 26, 27, 28, 29]. Therefore, as far as the medical students in this study are concerned, it is an indispensable part of their program to focus on personalized medicine, such as in their lectures, large rotations, and even rotations, promoting the adoption of this emerging discipline and thus improving their medical expertise [1, 26, 27, 28, 29].

Limitation of the study

A possible limitation is that the results do not represent all health-related students in KSA; therefore, this study needs further investigation. Furthermore, the College of Public Health and Health Informatics was the lowest responding college among all colleges.

Conclusion

These outcomes indicate that most of the students had poor knowledge regarding Personalized, Genomic, and Pharmacogenomics Medicine. However, there is a significant correlation between student’s gender and college; the majority of the students had a positive attitude regarding their interest in personalized medicine as a specialty, wanting to learn more about genetic sequencing in the case of potentially inheriting genetic diseases, and with an interest in undertaking a genetic test. Moreover, additional plans must be formulated to raise the public's awareness to manage this dilemma better. In addition, more training and awareness campaigns are required in Saudi Arabia to support its implementation. Furthermore, more emphasis on this topic should be put into the curricula of health colleges.

Conflict of Interest

None

Funding

None

References

1- Altayyari S, Omer A, Aljifri H, Magadmi B, Nemri A, Basheikh M, et al. Knowledge and awareness on personalised medicine amongst medical students: A cross-sectional survey. Journal of Health Specialties. 2017;5:171.

2- Emmert-Streib F. Personalized medicine: Has it started yet? A reconstruction of the early history. Frontiers in Genetics. 2012;3:313.

3- Auffray C, Chen Z, Hood L. Systems medicine: The future of medical genomics and healthcare. Genome Med. 2009;1(1):2.

4- Chen R, Mias GI, Li-Pook-Than J, Jiang L, Lam HY, Chen R, et al. Personal omics profiling reveals dynamic molecular and medical phenotypes. Cell. 2012;148(6): 307-1293.

5- Ginsburg GS, Willard HF. Genomic and personalized medicine: Foundations and applications. Translational research: The Journal of Laboratory and Clinical Medicine. 2009;154(6):87-277.

6- Paik S, Tang G, Shak S, Kim C, Baker J, Kim W, et al. Gene expression and benefit of chemotherapy in

women with node-negative, estrogen receptor-positive breast cancer. Official Journal of the American Society of Clinical Oncology. 2006;24(23):34-3726.
7- Bombard Y, Abelson J, Simeonov D, Gauvin F-P. Citizens' perspectives on personalized medicine: A qualitative public deliberation study. Eur J Hum Genet. 2013;21(11): 201-1197.
8- McDermott U, Downing JR, Stratton MR. Genomics and the continuum of cancer care. N Engl J Med. 2011;364(4):50-340.
9- Weitzel JN, Blazer KR, MacDonald DJ, Culver JO, Offit K. Genetics, genomics, and cancer risk assessment: State of the art and future directions in the era of personalized medicine. CA: A Cancer Journal for Clinicians. 2011;61(5):59-327.
10- Hudson TJ. Personalized medicine: A transformative approach is needed. CMAJ: Canadian Medical Association Journal. 2009;180(9):3-911.
11- Lyman GH, Cosler LE, Kuderer NM, Hornberger J. Impact of a 21-gene RT-PCR assay on treatment decisions in early-stage breast cancer: An economic analysis based on prognostic and predictive validation studies. Cancer. 2007;109(6):8-1011.
12- Armstrong K. Can genomics bend the cost curve. Jama. 2012;307(10):2-1031.
13- Project Team SG. The Saudi Human Genome Program: An oasis in the desert of Arab medicine is providing clues to genetic disease. IEEE pulse. 2015;6(6):6-22.
14- Rahma AT, Elsheik M, Elbarazi I, Ali BR, Patrinos GP, Kazim MA, et al. Knowledge and attitudes of medical and health science students in the United Arab Emirates toward genomic medicine and pharmacogenomics: A cross-sectional study. Journal of Personalized Medicine. 2020;10(4):191.
15- Higgs JE, Andrews J, Gurwitz D, Payne K, Newman W. Pharmacogenetics education in British medical schools. Genomic medicine. 2008;2(3):5-101.
16- Tsermpini E-E, Stamopoulou T, Kordou Z, Barba E, Siamoglou S, Stathoulias A, et al. Continuous pharmacogenomics and genomic medicine education for healthcare professionals through electronic educational courses. Future Medicine. 2019.
17- Green JS, O'Brien TJ, Chiappinelli VA, Harralson AF. Pharmacogenomics instruction in US and Canadian medical schools: Implications for personalized medicine. Pharmacogenomics. 2010;11(9):40-1331.
18- Gurwitz D, Lunshof J, Dedoussis G, Flordellis C, Fuhr U, Kirchheiner J, et al. Pharmacogenomics education: International Society of Pharmacogenomics recommendations for medical, pharmaceutical, and health schools deans of education. The Pharmacogenomics Journal. 2005;5(4):5-221.
19- McCullough KB, Formea CM, Berg KD, Burzynski JA, Cunningham JL, Ou NN, et al. Assessment of the pharmacogenomics educational needs of pharmacists. American Journal of Pharmaceutical Education. 2011;75(3).
20- Abdela OA, Bhagavathula AS, Gebreyohannes EA, Tegegn HG. Ethiopian health care professionals' knowledge, attitude, and interests toward pharmacogenomics. Pharmacogenomics and Personalized Medicine. 2017;10:279.
21- Gurwitz D, Weizman A, Rehavi M. Education: Teaching pharmacogenomics to prepare future physicians and researchers for personalized medicine. Trends in Pharmacological Sciences. 2003;24(3):5-122.
22- Albassam A, Alshammari S, Ouda G, Koshy S, Awad A. Knowledge, perceptions and confidence of physicians and pharmacists towards pharmacogenetics practice in Kuwait. PLoS One. 2018;13(9):e0203033.
23- Ahmed NJ, Alrawili AS, Alkhawaja FZ. Knowledge and awareness on personalized medicine amongst health care specialists and university students in health colleges in Saudi Arabia. JPRI [Internet]. 24Aug.2020 [cited 19Jun.2021];32(16):83-177. Available from: https://www.journaljpri.com/index.php/JPRI/article/view/30741.
24- Sullivan KM, Dean A, Soe MM. OpenEpi: a web-based epidemiologic and statistical calculator for public health. Public Health Rep. 2009;124(3):4-471.
25- Wildani MM, Triatmono VR, Yo EC, Yosia M, Wahidiyat PA. Study protocol for a cross-sectional study on knowledge, attitude, and practice towards thalassemia among Indonesian youth. medRxiv. 2021:264.
26- Frueh FW, Gurwitz D. From pharmacogenetics to personalized medicine: A vital need for educating health professionals and the community. Pharmacogenomics. 2004;5(5):9-571.
27- Polivka J, Jr., Polivka J, Karlikova M, Topolcan O. Pre-graduate and post-graduate education in personalized medicine in the Czech Republic: Statistics, analysis and recommendations. EPMA J. 2014;5(1):22.
28- Haiech J, Kilhoffer M-C. Personalized medicine and education: The challenge. Croat Med J. 2012;53(4):298-300.

29- Salari K. The dawning era of personalized medicine exposes a gap in medical education. PLoS Med. 2009;6(8):e1000138.