ORIGINAL ARTICLE

Mixed Methodological Exploratory Study of Knowledge, Attitude and Practice among Healthcare Practitioners on the Applications of Precision Medicine in Cancer Patients at Lahore, Pakistan

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ABSTRACT

Introduction: Precision medicine (PM) has revolutionized treatments, particularly cancer. However, this treatment approach is in infancy stage in Pakistan. Therefore, it is important to explore and look into the level of knowledge, attitude and practice by healthcare practitioners (HCPs) especially physicians and pharmacists who are majorly involved in cancer-care. **Methods:** Mixed-method sequential exploratory design, comprising of qualitative and quantitative study was adopted. In qualitative phase semi-structured face-to-face interviews using purposive sampling were audio-recorded, transcribed verbatim and thematically analyzed until data saturation reached. Quantitative study was a cross-sectional survey based upon results from the first phase using convenience sampling technique. Data obtained was then statistically analyzed using SPSS v22. **Results:** In qualitative study the data saturation was reached at fourteen physicians and eleven pharmacists, who despite of having practice constrains and limited resources, possessed enough knowledge regarding PM for cancer treatment and were found to be enthusiastic and optimistic towards learning it. Out of 165 participants, 64.85% of HCPs showed moderate knowledge, 66.06% showed adequate attitude, and 60.60% practice adequately towards the implementation of PM in the country. No significant difference in knowledge, attitude, and practice was found among physicians and pharmacists during the quantitative phase. **Conclusion:** The findings clearly expressed the need for facilitating healthcare practitioners with better knowledge and improving their attitude to bring improvements and advancements in the practice of PM in Pakistan. Provision of financial support, diagnostic equipment, and manufacture of targets at the local level can ensure the best treatment opportunities for every population in Pakistan.

Keywords: Precision medicine; Cancer; Mixed method study; Healthcare Practitioners

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INTRODUCTION

In the twentieth century, the limitations of one-size-fits-all treatment has become the basis of the concept of precision medicine (PM) [1]. PM presents the paradigm of genetically tailored techniques to improve diagnosis and therapeutically targeted treatments [2]. It has proved itself as the most efficient treatment method by minimizing unnecessary diagnostic tests and therapeutic management with the consequent provision of providing better quality of life for patients over a period of few years. This is especially true in the field of oncology.. As with other therapy, individuals respond differently to their prescribed chemotherapy but in any case, the goal of treatment remains established i.e. minimizing extraneous side effects to a particular treatment and improving clinical outcomes for individual patients [3, 4]. The recognition that each type of cancer has a distinct genomic identification structure [3] has transformed the landscape of oncological treatment, shifting from conventional surgical removal of cancer to targeted therapeutic options. [4]. This advancement has notably improved the prognostic outcomes of the cancer patient. [5, 6]. Over time, the concept of PM has evolved from organ-specific targeted therapy to a more refined focus on molecular precision in cancer treatment [7].

PM is still at its infancy stage [8, 9]. Knowledge of genetic contribution in cancer may help in discovering the most effective treatment possibilities [10]. Healthcare practitioner's (HCP) understanding on PM may help with PM establishment in their setting. With the evolving times, HCPs seem more interested in utilizing genomic data for treatment and individualized patient care where genomic sequencing has already helped them diagnose cancer at molecular level [11]. They are more concerned in improving drug efficacy

through dose adjustment and reducing adverse drug reactions (ADR) by utilizing PM properly [8]. Acquisition of latest advancements in the field of PM establishes their long-standing role as trusted counselor. However, despite the agreement of their active role, studies have shown that due to ambiguity of knowledge on PM, accessibility to database, professional practice gap and lack of practicing opportunities have made HCPs less confident and incapable of implementing pharmacogenomics (PGx) principals [12-15].

Study still needed to explore the literacy and practice of PM for cancer treatment among HCPs in Pakistan. This is important as they are the backbone of the healthcare system that would determine the effectiveness of implementing and delivering PM to Pakistan population.

MATERIALS AND METHODS

The current study utilized mixed method study design comprising of qualitative and quantitative research methods . Observations from qualitative phase and findings from the quantitative phase combined together to provide valid and most reliable results. We selected sequential exploratory design using qualitative study followed by the quantitative study. For both phases of the study, oncologists and pharmacists working for at least 8 hours in cancer-specialized hospitals or hospitals with special oncology department were included . The study was conducted in Lahore, Pakistan. It is the capital of province Punjab and second largest metropolitan city of Pakistan having 110 million inhabitants [16]. We targeted government hospitals with oncology department namely Mayo Hospital, Jinnah Hospital and Institute of Nuclear Medicine and Oncology (INMOL Hospital) for our study. Among private hospitals; Shaukat Khanum Memorial Cancer (Trust) Hospital and Research Center and Hameed Latif Hospital were selected.

Ethical approval was obtained from the Humans Ethics Committee (HEC), University College of Pharmacy, University of the Punjab, Lahore, Pakistan (D/82/FIMS).

Phase-I: Qualitative Study
Inline to the objectives of this study; qualitative face-to-face in-depth interviews were a consummate choice in the first phase aimed at exploring concepts of participants on pronounced objectives [17]. Based on an in-depth literature review, a semi structured interview guide was developed. Interview guide comprised of questions related to basic knowledge about PM, attitude of participants towards learning and implementation of PM, their current practices alongside the hurdles they face during its implementation and resources needed for its future implementation. It was then face and content validated by two expert in the

relevant field; one from the Punjab University College of Pharmacy (PUCP), Lahore, Pakistan who was an expert of qualitative research method with a large number of publications and second; oncologist from Hameed Latif Hospital who was an expert of PM practice and showed reasonable research background as well. The validity of the interview guide was established by elaborated critical questioning and reasoning among the main researcher and research expert on each question included. Afterwards, pilot study was performed on 2 physicians and 1 pharmacist who were later excluded from the main study. Participants were recruited using purposive sampling method. 14 oncologists and 11 pharmacists consented prior to participate in the research. Total 25 in-depth face-to-face interviews were conducted after individual appointments with consented participants at their work places. The interviews were conducted in English and each interview lasted for 25 to 30 minutes. Probing questions were asked and participants were given freedom to express additional views and comments. All interviews were audio-recorded and the principal researcher took additional field notes. Interviews were conducted until data saturation in each theme was achieved. Later the interviews were transcribed verbatim. Reliability was assured by preserving scrupulous records of the interviews. Manual thematic analysis was performed for trust worthy and insightful information from data [18]. Based on the method described by Braun and Clarke [19], deductive thematic analysis by in-depth penetration into the interviews was performed on data obtained.

Phase-II: Quantitative Study
Second phase of the study was a self-administered questionnaire-based, cross-sectional survey [21]. Keeping in view the findings from phase I , questions for phase II questionnaire were adapted accordingly from the literature [22, 23]. The questionnaire comprised of four components including; demographic data of participants, knowledge of HCPs on PM, attitude on provision of PM for cancer treatment in current practice and practice changes needed for providing and exercising PM.

In demographic section special attention was paid to gender, age group, education background including type of degree awarding institute and experience in relevant field. Fourteen knowledge questions with the option to select yes or no were added to know the basic information about PM to grasp how much they keep themselves updated. Also since genetic testing is one integral part of PM, questions about genetic testing were also included. Advantages of PM were also included in the knowledge section. Willingness to participate in PM related research and to implement it, confidence of interpreting genetic test results and discussion with patients, and encouragement related questions were included in attitude section. For practice

section, questions regarding their routine treatment and priorities they follow, trainings they have undergone during their practice were included. One other important question was the number of years they anticipate for PM to be completely implemented in the country.

Each correct answer in the knowledge domain carried 1 mark whereas wrong answer carried 0 marks. This gave a total score range of 0 - 14 for knowledge section. Knowledge score was divided into 3 scoring ranges based upon the correct answers they marked: good/adequate knowledge range (10-14 i.e 70% and above), fair/moderate range (7-9 i.e. 50-69%) and poor/inadequate range (1-6.9 i.e. <50%) [24]. The attitude to PM services and practice domains were both evaluated on a Likert Scale. 6 items were included in attitude section with 5 points for each item. (1 being least scored for "strongly disagree" to 5 being highest score for "strongly agree" with 3 for "neutral" answer). The total attitude scored 30 for 6 items. Attitude was further ranged as adequate (21-30 score), moderate (15-20 score) and inadequate (1-14 score) [24]. Practice section was evaluated on 7 questions with 5 marks given for each item (1 being never, 2: rarely, 3: sometimes, 4: frequently, 5: always). Total score for evaluation of each participant was 35 which was then further classified into 3 ranges as adequate (25-35 score), moderate (18-24 score) and inadequate (1-17 score) [24].

The instrument was tested for content validity by two researchers [25]; one from the School of Pharmaceutical Sciences, Universiti Sains Malaysia, and other from Punjab University College of Pharmacy Lahore, Pakistan. Both were experienced in conducting qualitative and quantitative studies especially in medication use, pharmacy practice and clinical pharmacy and have great research exposure. The questionnaire was revised according to the suggestions and comments received. Face validity was then assessed on 20 participants who were later excluded from the main study.

Using convenience sampling, a total of 382 participants were approached in the listed government and private hospitals. The questionnaires returned were 165 to the main researcher. Response rate was 64.70%, based on returned questionnaires and Google forms. 65 Google forms were filled and the rest of 100 participants filled in the face-to-face questionnaire form.

Data obtained was analyzed using SPSS version 22. Descriptive statistics was used to describe demographics and rest of the data where required. Percentages and frequencies were used for categorical variables, while means and standard deviations were calculated for the continuous variables. Further chi-square test was used for relationship of demographic characters with dependent factors.

Comparison across groups were performed using Mann-Whitney test (two variable) and Kruskal-Wallis test (more than two variables) [26] to examine the significant association between demographic variables and to all major research questions (sections). A p-value of less than 0.05 was considered statistically significant in that case.

RESULTS

Qualitative Interview Results
In this research study, fourteen physicians and eleven pharmacists were included. Almost equal number of male and female participants took part in interviews and most of them were from the age group 30 to 40 years. Around 72% had postgraduate degrees from government institutes (80%). Most of the physicians had more than 10 years' experience in the relevant field. Whereas, most of the pharmacists included were experienced for 6-10 years. Demographic record of the participants according to their profession type is given in Table I.

Thematic Content Analysis (TCA)
Main themes and sub-themes were identified from the data obtained from interviews transcribed. Selected responses on knowledge, attitude and practice on PM are compiled in Table II.

Theme 1: Knowledge about precision medicine (PM) and its availability in Pakistan
Large number of the participants (physicians= 11, pharmacists= 9) were well-versed about PM. They all presented the idea that PM is not the "one size fits all" concept. It was also concluded that in every hospital PM was known by the name of "targeted therapy, gene therapy or immunotherapy". Most of them had comprehensive knowledge about the pharmacogenomics testing and targets available in Pakistan. However, they mentioned that being expensive, PM is less available in government hospitals as compared to the private specialized cancer hospitals. Young physicians with average age of 30 years and less than 5 practicing years were more influenced towards individualized healthcare. They mentioned every benefit of PM from individualizing therapy to improving life expectancy with less treatment ADRs.

Participants highlighted several sources of information including Molecular Tumor Boards (MTBs) and conferences for physicians and different international cancer-societies offering different courses for pharmacist's knowledge. Most of the physicians highlighted that PM was never part of their formal graduation curriculum whereas two pharmacists added that PM was taught to them under the topic of

Table I : Demographic characteristics of healthcare practitioners

Demographic Character	Overall n (%)	Physicians n (%)	Pharmacists n (%)
Age (Years)			
< 30	5 (20)	4 (28.57)	1 (9)
31-40	15 (60)	6 (42.85)	9 (82)
41-50	4 (16)	3 (21.42)	1 (9)
51-60	1 (4)	1 (7.14)	0
Gender			
Male	13 (52)	7 (50)	6 (55)
Female	12 (48)	7 (50)	5 (45)
Education			
Graduate (MBBS, Pharm-D)	7 (28)	5 (35.71)	2 (18)
Post-graduate (FCPS, MPhil, Ph.D)	18 (72)	9 (64.28)	9 (82)
Graduation from			
Government college	20 (80)	10 (71.42)	10 (91)
Private college	5 (20)	4 (28.57)	1 (9)
Number of practicing years			
<5 years	5 (20)	4 (28.57)	1 (9)
6-10 years	10 (40)	4 (28.57)	6 (55)
>10 years	4 (16)	6 (42.85)	4 (36)
Number of patients attended daily			
<25	11 (44)	7 (50)	4 (36)
26-50	10 (40)	6 (42.85)	4 (36)
>50	4 (16)	1 (7.14)	3 (27)
Job type (current)			
Government	8 (32)	5 (35.71)	3 (27)
Private	13 (52)	5 (35.71)	8 (73)
Both	4 (16)	4 (28.57)	0
Working in relevant field			
Oncology Physicians	14 (56)	14 (100)	0
Oncology Pharmacist	5 (20)	0	5 (45)
Non-oncology Pharmacist	6 (24)	0	6 (55)

immunotherapy.

Theme 2: Attitude of healthcare practitioners for implementing PM

Attitude was assessed in participants to check their willingness and motivation towards learning and implementing PM in Pakistan regardless of their current knowledge in this field. Participants showed affirmative attitude towards implementation of PM in the country. They were well-motivated to learn and practice PM in their settings. They declared learning PM treatment as a need of the hour for betterment of patient and healthcare system of the country as well.

They also showed willingness to implement PM in the country by addressing patient's concerns about PM and convince them about adopting it. According to them, PM testing or treatment method steers clear of problems like religious sentiments, personal information breach, loss of activity by gene mutation or worsening of disease condition.

As compared to physicians, pharmacists were more convinced about educating masses in the community. They also presented the idea of utilizing patient support groups for cultivating PM knowledge and its use as treatment option among public. Physicians were in favor of progressive education starting from training and education of their own colleagues first. They also mentioned that educating masses would be helpful only when complete resources for PM treatment and testing made available in the country and every patient would be able to opt for it.

Theme 3: Practice of PM in Pakistan: Current practice of healthcare practitioners and their hopes in future

Cost of treatment, education and training among HCPs were some of the main challenges presented by majority of the participants. Availability of drug was also mentioned as one of the biggest challenges

Table II : Responses of HCPs about precision medicine

No.	Main Theme	Sub-theme	Selected quotes from respondents
1	Knowledge	Basic knowledge	"*These are the medications that use the information of patient gene and protein for treatment or diagnosis for preventive strategies*" [RPh#5]. "*It is being used but in a limited number of cases in government hospitals like we are giving atezolizumab and bevacizumab in metastatic HCC (hepatocellular carcinoma) to treat advanced metastatic hepatocarcinoma and in private setups more of the therapies are been used as these therapies are expensive and cost issues are there. So they are less used in the government and more commonly used in private sectors*" [PH#3].
		Benefits of precision medicine	"*It can individualize the healthcare*" [PH#14] "*It is used for treatment as well as for diagnostic purposes through genetic testing. Also it can improve patient compliance towards long term treatment*" [Rph#9].
		Source of information	"*We do have Molecular Tumor Board comprising of different presentations on different cases and agents being used in our hospital every Saturday session. And we also discuss different regimes and their doses with the seniors and their toxicity levels and how to decrease the dose of these agents*" [PH #8] "*Yes, they do discuss topics in our curriculum like immunotherapy*" [Rph#7]
2	Attitude	Personal will to learn	"*It is extremely important to know about its use as it is a new way of treating patients who were previously incurable. One must know about its use and administration along with side effects of every single drug used for this purpose. Otherwise we can harm the patient as well as lose the drug*" [PH#10].
		Willingness to implement	"*Yes I think patients are convinced about it if you discuss it in detail and tell them because its consequences are better than the conventional chemotherapy*" [PH#3] "*I don't think so. There are lesser side effects associated with targeted therapies. So disease worsens only if a patient is not responding to targeted therapy*" [PH#5]. "*As the current literature is available it hasn't caused any mutation but still it is used successfully. But let's see for further literature what it will say in 10-years. I cannot say anything*" [Rph#1].
		Education in community	"*I think in our country where there are not many people who are well-versed with such ideas, it would be difficult to educate them. But in medical communities we certainly can tell a medical staff including the nurses, the pharmacists, and health physicians about this. And they should know, but not the general public*" [PH#2]. "*Education is lacking in all aspects. Partially to educate patients and family. Because the loss of will power and fear of losing life years actually hinders treatment. PSG (Patient support group) may help with psychological counseling of patients*" [Rph#9].
3	Practice	Challenges faced and resources required	"*Basically the test should be done locally because currently the majority of these tests are being done internationally and there are some companies which outsource these tests to help us get these tests from the international centers. So if the tests will be done locally, obviously the cost will be reduced. So funding is needed in that. Secondly drugs should be registered. Thirdly drug should be manufactured at local level. So that overall costs should be reduced. The funding can be used in pharmaceutical industry, funding can be used for the laboratories to reduce the cost of the test*" [PH#11]. "*There is huge support required from government and pharma companies who need to provide specifically economical drugs and at the same time I expect from the drug regulatory authorities and relevant bodies so that they can make available biosimilar drugs in cheaper brands. It will be a huge help*" [Rph#3]
		Current practice and time required for complete implication	"*Currently due to cost issues we are not welcoming the people with warm hands about that precision medicine*" [PH#7] "*I think it varies from institute to institute. Like major private institutes are very well trained for developing precision medicine and providing services where as in government hospitals this element is relatively compromised and require further refinement*" [Rph#3] "*I hope in next 10 years we will be at some point of providing this facility to our all patients*" [PH# 6].
		Need for betterment of HCP's role	"*Physicians should strive harder to learn and practice more about it. It should be included as major part of MBBS for training doctors at earliest level*" [PH#10]. "*They should realize the value of their role as patient counselor and should build their skills keeping this role in mind. It is the physician, who tries to give the best care to the patient, but there are certain things physicians cannot do, and they definitely want to share their burden, but no one is there to share. A pharmacist must come forward and they must at least share the burden related to medications, related to its administration, its preparation, and its monitoring even after administration*" [Rph#11].

Table III : Demographic characteristics of participants' healthcare practitioners

Characteristics		Total n(%)	Physicians n(%)	Pharmacists n(%)
Gender	Male	77 (46.66)	43 (46.24)	34 (47.22)
	Female	88 (53.33)	50 (53.76)	38 (52.77)
Age in years	Less than 30	38 (23.03)	26 (27.95)	12 (16.66)
	31-40	73 (44.24)	40 (43.01)	33 (45.83)
	41-50	36 (21.81)	18 (19.35)	18 (25)
	More than 50	15 (9.09)	9 (9.67)	6 (8.33)
Marital status	Married	110 (66.66)	59 (63.44)	51 (70.83)
	Single	55 (33.33)	34 (36.56)	21 (29.16)
Address from last 5 years	Urban	149 (90.30)	86 (92.47)	63 (87.50)
	Rural	28 (16.96)	7 (7.52)	21 (29.16)
Year of graduation	Less than 5 years	39 (23.63)	27 (29.03)	12 (16.66)
	6-10 years	57 (34.54)	33 (35.48)	24 (33.33)
	11-20 years	50 (30.30)	22 (23.65)	28 (38.89)
	More than 20 years	19 (11.51)	11 (11.83)	8 (11.11)
Institute of graduation	Government	115 (69.69)	65 (69.89)	50 (69.44)
	Private	45 (27.14)	26 (27.95)	19 (26.38)
	International	5 (3.03)	2 (2.15)	3 (4.16)
Highest qualification	MBBS	39 (23.63)	39 (41.93)	0 (0)
	FCPS	39 (23.63)	39 (41.93)	0 (0)
	Pharm. D	18 (10.90)	0 (0)	18 (25)
	M. Phil	43 (26.06)	3 (3.22)	40 (55.55)
	Ph.D.	14 (8.48)	0 (0)	14 (19.44)
	Other doc degree	11 (6.66)	11 (11.83)	0 (0)
Job type	Government	83 (50.30)	45 (48.38)	38 (52.78)
	Private	67 (40.60)	38 (40.86)	29 (40.28)
	Both	10 (6.06)	10 (10.75)	
Experience in relevant field (oncology)?	Less than 1 year	11 (6.66)	11 (11.83)	
	1-5 year	47 (28.48)	47 (50.54)	
	6-10 year	23 (13.94)	23 (24.73)	
	More than 11 years	9 (5.45)	9 (9.67)	
	No experience	3 (1.81)	3 (3.23)	
Daily patient exposure	Less than 25	22 (13.33)	22 (23.65)	
	26-50	51 (30.91)	51 (54.84)	
	51-100	17 (10.30)	17 (18.27)	
	More than 100	3 (1.81)	3 (3.23)	

Table IV : Frequency difference of knowledge, attitude and practice ranges in target population

Variable	Range	Frequency	%	Mean	S.D
	Adequate	18	10.91		
Knowledge	Moderate	107	64.84	7.86	1.57
	Inadequate	40	24.24		
	Adequate	109	66.06		
Attitude	Moderate	47	28.48	22.14	4.86
	Inadequate	9	5.45		
	Adequate	100	60.60		
Practice	Moderate	42	25.45	25.43	6.326
	Inadequate	23	13.93		

Table V : Knowledge of healthcare professionals

Questions		Frequency (n)	Percentage %
Genetic testing helps determine family medical history	Yes	143	86.7
	No	22	13.3
Every individual's genetic profile governs its therapeutic response to prescribed medicine	Yes	146	88.5
	No	19	11.5
Precision medicine can decreases mortality rate	Yes	115	69.7
	No	50	30.3
Precision medicine can predict disease in advance	Yes	79	47.9
	No	86	52.1
There is enough research present to implement precision medicine in cancer patients	Yes	56	33.9
	No	109	66.1
Precision medicine provides more benefits then risks to patients.	Yes	144	87.3
	No	21	12.7
Some personal information is needed for precision medicine. Select only relevant option (s) which you think are necessary to know for precision medicine provision (genetic information).	Yes	143	86.7
	No	22	13.3
Body measures	Yes	115	69.7
	No	50	30.3
Residential area	Yes	20	12.1
	No	145	87.9
Income	Yes	31	18.8
	No	134	81.2
Medical records	Yes	116	70.3
	No	49	29.7
Health insurance claim data	Yes	33	20.0
	No	132	80.0
Life style	Yes	80	48.5
	No	85	51.5
Bio-specimens (blood, tissues)	Yes	116	70.3
	No	49	29.7

faced in the country for PM implementation. They also highlighted that the government should work in collaboration with relevant authorities, practitioners and patients for providing better facilities.

Many of them wanted to practice it fully but few showed reluctance due to unavailability of targets, proper practice set ups, availability of cost-efficient medicine and lack of knowledge in their own setups. Nevertheless, cancer specialized hospitals are already practicing it as much as they could as compared to government hospitals. More than half of the population was hopeful that it may take the next 10 years to get familiar with PM and then to implement it completely.

Most of them responded with different requirements to bring better policies and better treatment services to their system and people. Education and training of HCPs was one most important factor highlighted by all the respondents. PM must not only be provided during their practice but it should be part of their basic curriculum as well. Pharmacists highlighted their roles as counselor as well other than being just medicine experts.

Quantitative Questionnaire-Based Results

A total of 382 questionnaires were distributed among the oncology physicians and pharmacists working in the government and private hospitals in Lahore. The questionnaires returned to main researcher were 165 giving the response rate of 64.70%.. Study population constituted male HCPs, 46.7% (n=77) less than female HCPs, 53.3% (n=88). Majority of respondents were of the age group 31- 40 year 44.2% (n=73) with mean age 38.839. Most of the participants (69.7% i.e., n=115) graduated from government institutes in different regions of Pakistan. Physicians were more in number (n=93, 56.36%) as compared to pharmacists (n=72, 43.63%). Half of the total population 50.3% (n=83) were employed in government hospitals. It was seen that 47.9% (n=79) have worked for 1-5 years in the relevant field and more than half 53.9% (n=89) of the population informed that they attend to 26-50 patients on daily basis in the wards and OPDs as described in Table III. Overall results of quantitative study of knowledge, attitude and practice ranges in target population is summarized in Table IV.

Knowledge of healthcare practitioners on precision medicine

Keeping in view the answers on uses of PM inquired in other questions of this section, 87.3% of the population showed promising response on benefits of PM use. But only 33.9% were certain about enough research data for PM implementation. Most of them had broad idea about necessary factors and information needed for PM provision but more than half (51.1%) of the population was unaware of the importance of life style knowledge of cancer patient for

PM provision. Using cross tabulation, we concluded that majority of the population (n=107) had moderate knowledge (Table IV, V).

Attitude of healthcare practitioners on precision medicine and its use

Approximately 60% of population agreed to spend longer duration of time to discuss their patient's genetic profile . More than half (51.5%) of participants were confident about their counseling skills. A large population (70%) was willing to participate in PM related research and to encourage their other colleagues to get involved in similar activities. (Table VI)

Practice of healthcare practitioners on precision medicine

Healthcare practitioner's conventional practices were evaluated on Likert scale. And to our surprise majority of the population marked 'rarely' on attending additional PM training at the time of the study and being part of PM related research before it. Two aspects showed future-optimistic results as compared to other items. Approximately half of the population agreed they shall only prescribe genetic testing and interpretation to their patients if given enough time and they shall prefer PM as compared to conventional methods for cancer treatment in future (Table VII).

All the study participants were asked to comment about the time period required for complete implementation of PM in the country keeping in view their experience and resources available in the country. Most of them were hopeful that within a few years (8.44±5.624) every population in Pakistan will be able to receive this treatment option.

DISCUSSION

As far as PM is concerned; it is a relatively new method of treatment for cancer patients in Pakistan. Although a few studies have been conducted on personal genomics or genomic testing in Pakistan in recent years, [27] none reported on the use of PM for cancer treatment in Pakistan and the view point of HCPs on adopting and practicing this treatment approach. Providing better knowledge and improving attitude of healthcare practitioners may lead to better implementation of PM in any country's healthcare system [28, 29]. Our study revealed good knowledge of HCPs on PM concept even if partially practiced in our country as compared to other studies performed around the globe. In our face-to-face interviews physicians and pharmacists with experience more than 10 years showed better knowledge on use of PM in oncology than those in the field with less experience. Our study was contrary to ones conducted in Canada where young and recently graduated doctors had better knowledge on progress in PM and better trained to employ it in cancer treatment as compared to the seniors [30]. This could be due to the

Table VI : Attitude of healthcare professionals

Questions		Frequency (n)	Percentage %
I am willing to spend a longer time to discuss about genetic testing and its result with my patient	Strongly Disagree	3	1.8
	Disagree	28	17.0
	Neutral	36	21.8
	Agree	59	35.8
	Strongly Agree	39	23.6
I am confident enough to interpret genetic tests results	Strongly Disagree	3	1.8
	Disagree	31	18.8
	Neutral	54	32.7
	Agree	47	28.5
	Strongly Agree	30	18.2
I am confident enough to counsel my patients regarding their treatment based on the genetic result.	Strongly Disagree	7	4.2
	Disagree	28	17.0
	Neutral	45	27.3
	Agree	50	30.3
	Strongly Agree	35	21.2
I am willing to undergo additional training on precision medicine	Strongly Disagree	1	0.6
	Disagree	20	12.1
	Neutral	34	20.6
	Agree	66	40.0
	Strongly Agree	44	26.7
I am willing to participate in precision medicine -related research	Strongly Disagree	1	0.6%
	Disagree	19	11.5%
	Neutral	29	17.6
	Agree	56	33.9
	Strongly Agree	60	36.4
I would encourage my colleagues to participate in precision medicine-related research or training.	Strongly Disagree	0	0.0
	Disagree	17	10.3
	Neutral	33	20.0
	Agree	67	40.6
	Strongly Agree	48	29.1

difference in the education curriculum structure of both countries as it was found that pharmacogenomics was not part of the undergraduate curriculum in Pakistan. All young HCPs were inspired by its individualized approach of treatment. HCPs were also convinced for its use for disease free survival outcomes with increased life expectancy [31]. In our quantitative findings a significant number of HCPs had clear knowledge about relevance of genetic testing of patients with family history [32]. Within the study group a large number of population was affirmative with the fact that using PM reduces the mortality rate [33].

However, only 33.9% of health practitioners believed that sufficient literature and research are needed to implement precision medicine in their routine treatment. Our interviews also revealed that HCPs knowledge and experiences greatly influence their role for PM implementation. For this reason reliable and updated sources of information including web-based sources and educational sessions by experts must be provided [34].

Participants were confident about the need of implementing PM in Pakistan's healthcare system. For

Table VII : Practice of Healthcare-practitioners

Questions		Frequency (n)	Percentage %
I have changed some of my patient's treatment based on their genetic result during my practice.	Never	13	7.9
	Rarely	29	17.6
	Sometimes	33	20.0
	Frequently	61	37.0
	Always	29	17.6
I have recommended some of my patients to undergo genetic test during my practice.	Never	19	11.5
	Rarely	21	12.7
	Sometimes	46	27.9
	Frequently	45	27.3
	Always	34	20.6
I will only counsel my patients on genetic testing and its result if I have enough time.	Never	3	1.8
	Rarely	27	16.4
	Sometimes	48	29.1
	Frequently	62	37.6
	Always	25	15.2
I will usually prescribe/recommend conventional therapy over precision medicine-related treatment in my patients.	Never	25	15.2
	Rarely	57	34.5
	Sometimes	38	23.0
	Frequently	26	15.8
	Always	19	11.5
I have participated in precision medicine-related research during my practice	Never	47	28.5
	Rarely	49	29.7
	Sometimes	38	23.0
	Frequently	17	10.3
	Always	14	8.5
I have attended additional training in precision medicine during my practice	Never	20	12.1
	Rarely	52	31.5
	Sometimes	12	7.3
	Frequently	58	35.2
	Always	23	13.9
I have encouraged my colleagues to participate in precision medicine-related research or training.	Never	12	7.3
	Rarely	24	14.5
	Sometimes	23	13.9
	Frequently	80	48.5
	Always	26	15.8

this purpose, they were willing to devote themselves for learning new guidelines and skills about genetic testing and PM, and working on patient treatment plan taking in loop. They were optimistic in line with other HCPs around the world [35]. They were willing to learn more about it and practice it in a better way in their settings and at bigger scale if properly guided and facilitated since all of them believe in its better outcomes than conventional therapy [13, 23, 36]. Pharmacists were of the opinion that learning PM is not the choice of

the HCP nevertheless need of the hour. Their attitude also matched the pharmacist's attitude and willingness from around the world. [37, 38]. HCPs were keen about implementing PM too. HCPs participating in both phases of our study were found to be enthusiastic about counseling patient and adopting PM as treatment option by spending more time with patients telling about benefits of PM in comparison with conventional treatment routine [13, 21, 39]. All the participants presented the verdict that PM does not intervene with patient's personal information or religious principles. Our study results contradicts the findings of a study performed on Alaska Native and American Indian community (ANAI), in which privacy and transparency of using genetic information issues were considered a serious threat for future implementation of PM. [40]. This may be explained by the medical background of the subjects involved in our study, which makes them more receptive towards PM as compared to the ANAI community. Another concern answered by HCPs during interviews was the occurrence of mutation or worsening of disease state from adopting PM. In fact, it would reduce adverse drug reactions (ADRs) caused by drug therapy [23].

Keeping in view of their practice and experience in this field,all of them highlighted cost of treatment, education, knowledge of HCPs and availability of drugs and diagnostic tools to be the major factors interrupting PM's complete implementation. They declared financial burden and cost of treatment the biggest challenges they face. Similar factors were highlighted as challenges for implementation of PM in past researches conducted in South East Asian countries [41][42]. Financial burden was segregated into different forms including healthcare budget of country, local testing facilities and manufacturing targets in the country at cheaper prices, treatment cost and palliative care cost. And to overcome this, financial support should be provided by the government as covered by public insurance in other countries[43], NGOs, pharmaceutical sector [44] and financially sound people of society.

Reviews from around the world including high-income countries like Qatar and Kuwait identified inadequate knowledge and provision of guidelines as the biggest barriers in implementation of PM. [45]. Pharmacists in our study also highlighted the need of CMEs (continuing medical education) for education of HCPs [22]. All of the HCPs especially pharmacists were very much enthusiastic about performing better role in future implementation of PM. [46] Regardless of resource deficit, they highlighted the importance of realizing their own role. They were interested to learn about pharmacogenomics and implement it in better manner as done by other pharmacists in high-income countries [45]. They also considered their responsibility for implementation and strengthen their position

as patient counselor along with medication expert. Several studies support the idea of utilizing pharmacist's skills for the purpose of patient counseling for treatment purpose [47]. Physicians emphasized the need of adding PM in their basic graduation curriculum for building strong concepts from the beginning. We conclude that there is a dire need for clinical oncologist's education to augment patient facilitation [48]. Half of participants in quantitative study decided to prefer PM over conventional method of treatment which indicates situation is not hopeless considering the current economic situation of country's health care system [49,50].

CONCLUSION

This is the first study carried out in Lahore, Pakistan which clearly sheds light on knowledge and preparedness of healthcare practitioners towards PM practices and implementation in Pakistan for cancer treatment. Our research findings have clearly shown and been supported by literature that there has been a growing need for facilitating HCPs with better knowledge and improving their attitude towards PM for improvement and advancements in practice area [28, 29]. They were enthusiastic and showed optimistic attitude to learn more about it willingly. Not just for their own skill-set development but knowing about its importance in the future they were willing to learn it for the betterment of their patients and health system of country hoping that it can lessen the disease burden and financial pressure of the system. There were certain resources needed that were pointed out by HCPs for the furtherance of the current scenario of treatment facilities availability and to endorse PM evolution completely in the country. They were hopeful that provision of financial support, diagnostic equipment and manufacturing local medicine in the country with the collaboration of government, pharmaceutical companies and different stake holders of system including patient and his physician can do miracles and can advance treatment provision in next 10 years.

HCPs in this study also reflected their role as counselor and medical expert. They did not show significant difference of knowledge, attitude or practice in the study. Physicians and pharmacists both in this research supported the complete implementation of PM in the country. Therefore, healthcare practitioners of 21st century should develop and strengthen their role and need to embrace and adapt appropriately with the integration of PM in order to lead them to identify and apply evidence in healthcare practice competently and efficiently.

Clinical and social skill development programs on PM should be initiated including continuous professional development (CDP), continuous medical education

(CME) and continuous pharmacy education (CPE) programs. The universities and institutions should adopt a collaborative and integrated approaches to educate and train the upcoming healthcare professionals for their role in patient care and public health.

The results might represent healthcare practitioner's point of view at a particular point of time but trend over the time was not observed. Besides, no historical data with this perspective in the country was present at that time, therefore, a nationwide study is required in much broader context in order to evaluate the practice, preparedness of health practitioners for practice change, barriers to address for implementation and provision of PM in the country

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