Volume 4, Issue 6, 2026

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

KNOWLEDGE, ATTITUDE, PERCEPTION, AND SELF-REPORTED CONFIDENCE OF COMMUNITY PHARMACISTS TOWARDS PHARMACOGENOMICS SERVICES IN PUNJAB, PAKISTAN

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DOI: https://doi.org/10.5281/zenodo.20593362

Keywords

pharmacogenomics; community pharmacists; Punjab; Pakistan

Article History

Received: 08 April 2026

Accepted: 20 May 2026

Published: 08 June 2026

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Abstract

Background: *The concept of pharmacogenomics (PGx) involves using genetic data from patients to create personalized treatment plans and improve outcomes. Community pharmacists' role in providing PGx services has gained more attention around the world, but data from Pakistan remains limited. This study examined the knowledge, attitude, perception, and self-confidence of community pharmacists regarding PGx services in Punjab, Pakistan.*

Methods: *A cross-sectional study was conducted with 400 community pharmacists practicing in Punjab, Pakistan. They completed a self-administered questionnaire that had been previously tested in the literature. Results were analyzed using descriptive statistics and inferential statistical methods, including the Mann-Whitney U test and the Kruskal-Wallis test. Bloom's taxonomy criterion scores were used to categorize responses as high, moderate, or low.*

Results: *Four hundred questionnaires were analysed (response rate 100%). Only 15.3% had previous pharmacogenomics training, while 57.3% expressed interest in future training. Overall, respondents demonstrated moderate knowledge of pharmacogenomics (median knowledge score: 11.0 out of 17; 64.7%). The majority demonstrated a good attitude (median attitude score: 7.0 out of 10; 70.0%) and good perception (median perception score: 29.0 out of 45; 64.4%) towards pharmacogenomics services. Median self-reported confidence score was 25.0 out of 40 (62.5%), indicating a moderate level of confidence. Previous pharmacogenomics training was significantly associated with higher knowledge ($p < 0.001$), attitude ($p = 0.010$), perception ($p < 0.001$), and self-reported confidence ($p = 0.001$). The most frequently identified barriers to pharmacogenomics implementation were lack of knowledge/expertise (21.0%), lack of guidelines (19.0%), and lack of reimbursement (19.2%).*

Conclusion: *Community pharmacists in Punjab, Pakistan demonstrate moderate knowledge and self-reported confidence alongside a good attitude and perception towards pharmacogenomics services. Previous pharmacogenomics training was the strongest predictor of higher scores across all four domains. Integration of pharmacogenomics content into pharmacy training curricula and*

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

continuing professional development programmes are recommended to bridge existing knowledge and confidence gaps.

INTRODUCTION

Background

Pharmacogenomics is an emerging branch of personalised medicine that uses a patient's genetic make-up to guide drug selection, dosing, discontinuation, and monitoring to optimise therapeutic outcomes and minimise adverse drug reactions [1, 2]. The promise of pharmacogenomics lies in its potential to tailor drug therapy to individual patients, a concept widely referred to as precision medicine [3]. As one of the most accessible healthcare providers, community pharmacists are well-placed to serve as the first point of contact for pharmacogenomics testing and counseling services. Worldwide, community pharmacists have broadened their responsibilities from dispensing to include medication therapy management (MTM) services, and pharmacogenomics is a natural extension of this work. The strong relationship between patients and pharmacists built through MTM supports the delivery of direct-to-consumer pharmacogenomics services. Successful examples of pharmacist-led pharmacogenomics services have been seen in high-income countries such as the United States, the Netherlands, and Canada. Despite this progress, the implementation of these services in low- and middle-income countries, including Pakistan, remains limited.

Pakistan has one of the largest pharmacy workforces in South Asia, and community pharmacists play a crucial role in delivering primary healthcare. However, the use of pharmacogenomics in routine pharmacy practice in Pakistan faces several challenges, including a lack of educational exposure, no national pharmacogenomics guidelines, and limited reimbursement options. Studies in Saudi Arabia, Kuwait, Malaysia, Nigeria, and Qatar have shown that pharmacists often have poor to moderate knowledge, a good attitude, and positive views about pharmacogenomics services, but they report feeling unsure about providing these services. So far, no study has looked into these areas among community pharmacists in Punjab, which is Pakistan's most populated province and the center of its pharmaceutical industry.

This study aimed to assess the knowledge, attitude, perception, and self-reported confidence of community pharmacists regarding pharmacogenomics services in Punjab, Pakistan, and to identify factors related to these outcomes.

Methods

Study design and setting

This study was a cross-sectional analysis carried out among community pharmacists in the Punjab province of Pakistan. Punjab hosts over 60% of the registered pharmacists in the country and includes both major urban areas (such as Lahore, Faisalabad, and Rawalpindi) as well as vast rural populations, providing a representative context for examining community pharmacy practices on a national level.

Inclusion and exclusion criteria

Fully registered community pharmacists practicing in Punjab who provided informed consent were eligible for inclusion. Pharmacy assistants, pharmaceutical company representatives, hospital pharmacists, and those with provisional registration were excluded.

Study instrument

A self-administered questionnaire adapted from a validated instrument used in similar studies was employed [12, 15]. The questionnaire comprised five sections: Section 1 (socio-demographic and general information, 10 items); Section 2 (knowledge of pharmacogenomics, 9 items); Section 3 (attitude towards pharmacogenomics services, 5 items); Section 4 (perception towards pharmacogenomics services, 10 items including a barriers sub-section); and Section 5 (self-reported confidence to implement pharmacogenomics services, 8 items). Multiple-choice options (Yes, No, Don't Know) were used for knowledge and attitude items. A 5-point Likert scale was used for perception and self-reported confidence items. The questionnaire was reviewed by clinical

ISSN: (e) 3007-1607 (p) 3007-1593

pharmacy experts for content validity before administration.

Data collection

Community pharmacists were recruited using a convenience sampling approach. The questionnaire was distributed in person across community pharmacies in multiple districts of Punjab. Participants had the option to complete the questionnaire on-site or return it at an agreed time. The average completion time was approximately 10–15 minutes.

Data analysis

Data were analysed using SPSS version 27.0 (IBM Corporation, Armonk, NY, USA). Categorical variables were reported as frequencies and percentages. Continuous scores were reported as medians with ranges as data were not normally distributed. Non-parametric tests (Mann–Whitney U test for two groups; Kruskal–Wallis test for three or more groups) were used for inferential analysis. A p-value of less than 0.05 was considered statistically significant. Responses were transformed into scores as follows: one point for each correct knowledge answer (maximum 17); 0–2 per attitude item (maximum 10); 1–5 per Likert item for perception (maximum 45) and self-reported confidence (maximum 40), with negative items reverse-coded. Total percentage scores were categorised using Bloom's taxonomy cutoff points: high (80–100%), moderate (60–79%), and low (below 60%). A modified Bloom's cutoff of ≥60% was applied to classify attitude and perception as positive/good or negative/poor.

Results

Demographic characteristics

A total of 400 community pharmacists completed the questionnaire. The majority were male (65.0%), and most were in the 20–29 (37.8%) or 30–39 (36.3%) age groups. More than half held a Doctor of Pharmacy (Pharm.D) degree (59.0%), with the remainder holding a Bachelor of Pharmacy (B.Pharm) degree (41.0%). All participants graduated from Pakistani institutions. Only 15.3% had previously attended pharmacogenomics training, while 57.3% expressed interest in attending future pharmacogenomics training. Two-thirds were full-time pharmacists (66.8%), and slightly more than half worked in independent pharmacies (54.8%). Demographic details are summarised in Table 1.

Table 1. Demographic characteristics of community pharmacists.

Variable	Frequency (n = 400)	Percentage (%)
Gender		
Male	260	65.0
Female	140	35.0
Age group		
20–29	151	37.8
30–39	145	36.3
40–49	79	19.8
50 and above	25	6.3
Years of working experience		
Less than 5	155	38.8
5–10	126	31.5

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ISSN: (e) 3007-1607 (p) 3007-1593

11–15	52	13.0
More than 15	67	16.8
Highest educational qualification		
Bachelor of Pharmacy (B.Pharm)	164	41.0
Doctor of Pharmacy (Pharm.D)	236	59.0
Country of graduation		
Pakistan	400	100.0
Attended pharmacogenomics training previously		
Yes	61	15.3
No	339	84.8
Interested in attending pharmacogenomics training in future		
Yes	229	57.3
No	79	19.8
Don't know	92	23.0
Position		
Owner	70	17.5
Manager	63	15.8
Full-time Pharmacist	267	66.8
Type of community pharmacy		
Chain	181	45.3
Independent	219	54.8

Community pharmacists' knowledge of pharmacogenomics

The majority of respondents correctly identified that pharmacokinetics and pharmacodynamics of medications may be affected by genetic make-up (85.5%), that pharmacogenomics testing can predict medication safety and efficacy (89.0%), and that PGx results can be used to change drug therapy (87.8%) or adjust doses (87.0%). However, only 22.3% correctly identified that genetic determinants of drug response do not change over a person's lifetime. Warfarin (64.0%), paroxetine (49.2%), and clopidogrel (46.5%) were the most frequently identified medications requiring PGx testing. The median total knowledge score was 11.0 out of 17 (64.7%), corresponding to a moderate level of pharmacogenomics knowledge. Table 2 presents the full knowledge findings.

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Table 2. Number of community pharmacists that have correct answers for questions assessing the knowledge of pharmacogenomics.

Variable	Frequency (n = 400)	Percentage (%)
The pharmacokinetics and pharmacodynamics of a medication may be affected by an individual's genetic make-up	342	85.5
Pharmacogenomics testing can be used in predicting medication safety and efficacy	356	89.0
Genetic determinants of drug response may change over a person's lifetime (correct answer: No)	89	22.3
Genetic variants can account for as much as 95% of the variability in drug disposition and effects	178	44.5
Results from pharmacogenomics testing can be used as an indication to change drug therapy	351	87.8
Results from pharmacogenomics testing can be used as an indication for dose adjustment	348	87.0
Results from pharmacogenomics testing can be used as an indication for discontinuation of a drug	298	74.5
Indication(s) for pharmacogenomics testing (you can select more than one option)		
Ineffective therapy	312	78.0
To prevent adverse drug reaction (ADR)	331	82.8
To guide initiation of therapy	298	74.5
Medications that require pharmacogenomics testing		
Paroxetine	197	49.2
Simvastatin	112	28.0
Cefuroxime[a]	143	35.8
Pantoprazole	89	22.3
Clopidogrel	186	46.5
Ibuprofen[a]	98	24.5
Warfarin	256	64.0

[a]Medications that do not require pharmacogenomics testing.

Community pharmacists' attitude towards pharmacogenomics services

The large majority of respondents (90.5%) indicated willingness to recommend pharmacogenomics testing if it could predict drug efficacy. A total of 83.5% were willing to receive and interpret PGx results, though they required prior training. Similarly, 88.8% were willing to advise patients on treatment choices based on PGx results, and 82.0% were willing to make recommendations to physicians. Approximately 74.2% expressed interest in providing PGx testing services. The median total attitude score was 7.0 out of 10 (70.0%), reflecting a good attitude

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towards pharmacogenomics services. Attitude findings are detailed in Table 3.

Table 3. Attitude of community pharmacists towards pharmacogenomics services.

Variable	Frequency	Percentage
	(n = 400)	(%)
Would you recommend pharmacogenomics testing to your patients if those tests could predict that a specific drug could be efficacious in their case?		
Yes	362	90.5
No	18	4.5
I don't know	20	5.0
Are you willing to receive and interpret the pharmacogenomics testing results of your patients?		
Yes, immediately	49	12.2
Yes, but after having training on the subject	334	83.5
No	3	0.8
I don't know	14	3.5
Are you willing to advise your patient on a treatment choice based on their pharmacogenomics testing result?		
Yes	355	88.8
No	23	5.8
I don't know	22	5.5
Are you willing to make recommendations to a physician based on a patient's pharmacogenomics testing result?		
Yes	328	82.0
No	46	11.5
I don't know	26	6.5
Are you interested in providing pharmacogenomics testing services?		
Yes	297	74.2
No	63	15.8
I don't know	40	10.0

Community pharmacists' perception towards pharmacogenomics services

Approximately 40.5% of respondents agreed or strongly agreed that community pharmacists are well-placed to provide PGx services, while 31.8% remained neutral. Similarly, 40.5% agreed/strongly agreed on the feasibility of community pharmacist-led PGx testing. A notable proportion agreed/strongly agreed that physicians and community pharmacists should collaborate to offer PGx testing (39.2%), and that incorporation of PGx screening into MTM will optimise

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ISSN: (e) 3007-1607 (p) 3007-1593

pharmacotherapy (38.2%). Regarding barriers, lack of knowledge/expertise was the most frequently identified barrier (21.0%), followed by lack of guidelines (19.0%) and lack of reimbursement (19.2%). The overall median perception score was 29.0 out of 45 (64.4%), indicating a good perception towards pharmacogenomics services (256 respondents, 64.0%). Perception findings are described in Table 4.

Table 4. Perception of community pharmacists towards pharmacogenomics services.

Variable	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	Frequency (%)				
Community pharmacists are well-placed within the healthcare system to provide pharmacogenomics services.	28 (7.0)	83 (20.8)	127 (31.8)	112 (28.0)	50 (12.5)
It is feasible for community pharmacists to provide pharmacogenomics testing services.	20 (5.0)	72 (18.0)	146 (36.5)	116 (29.0)	46 (11.5)
Community pharmacists have the expertise to interpret and adjust medication doses based on patient's pharmacogenomics results.	23 (5.8)	79 (19.8)	131 (32.8)	116 (29.0)	51 (12.8)
Community pharmacists need training in pharmacogenomics.	25 (6.2)	82 (20.5)	133 (33.2)	110 (27.5)	50 (12.5)
Physicians and community pharmacists should collaborate to offer pharmacogenomics testing.	15 (3.8)	82 (20.5)	146 (36.5)	120 (30.0)	37 (9.2)
Pharmacogenomics testing will prevent your patient from taking the inappropriate medicine or the wrong dose.	24 (6.0)	87 (21.8)	138 (34.5)	102 (25.5)	49 (12.2)
Incorporation of pharmacogenetic screening into medication therapy management will optimise pharmacotherapy.	20 (5.0)	76 (19.0)	151 (37.8)	115 (28.7)	38 (9.5)
Pharmacogenomics testing will become a routine in clinical practice in the future.	23 (5.8)	70 (17.5)	148 (37.0)	117 (29.2)	42 (10.5)
Pharmacogenomics-guided treatment is cost-effective.	28 (7.0)	76 (19.0)	155 (38.8)	88 (22.0)	53 (13.2)
Barriers to implementation of pharmacogenomics services in community pharmacy is/are:					
Lack of knowledge/expertise	n = 84 (21.0%)				
Lack of reimbursement	n = 77 (19.2%)				

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Lack of time	n = 63 (15.8%)
Lack of guidelines	n = 76 (19.0%)
Lack of ethical considerations (who owns the genetic data)	n = 45 (11.2%)
Resistance from other healthcare professionals	n = 34 (8.5%)
Non-acceptance by patients	n = 21 (5.2%)

Note: Responses use a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Barriers data (most significant barrier selected by each respondent).

Self-reported confidence in providing pharmacogenomics services

Approximately 30.8% of respondents were not confident at all or not very confident in identifying patients for whom PGx testing is appropriate. About 33.3% lacked confidence in performing point-of-care PGx testing. The majority were somewhat confident or above in providing patient counselling (74.2%) and communicating PGx information to patients (69.0%). The median self-reported confidence score was 25.0 out of 40 (62.5%), corresponding to a moderate level of self-reported confidence in providing pharmacogenomics services. Table 5 presents the self-reported confidence findings.

Table 5. Self-reported confidence to provide pharmacogenomics services among community pharmacists.

Variable	Not confident at all	Not very confident	Somewhat confident	Very confident	Extremely confident
	Frequency (%)				
To identify patients for whom pharmacogenomics test is appropriate.	40 (10.0)	83 (20.8)	126 (31.5)	104 (26.0)	47 (11.8)
To identify medicines that need pharmacogenomics screening.	41 (10.2)	90 (22.5)	132 (33.0)	88 (22.0)	49 (12.2)
To provide counselling to patients who need pharmacogenomics testing.	34 (8.5)	69 (17.2)	133 (33.2)	119 (29.8)	45 (11.2)
To perform point-of-care pharmacogenomics testing.	35 (8.8)	98 (24.5)	138 (34.5)	84 (21.0)	45 (11.2)
To interpret pharmacogenomics test results.	31 (7.8)	90 (22.5)	119 (29.8)	106 (26.5)	54 (13.5)
To communicate pharmacogenomics information to a patient.	36 (9.0)	88 (22.0)	113 (28.2)	128 (32.0)	35 (8.8)
To use pharmacogenomics data to make drug therapy recommendations to the prescriber.	30 (7.5)	88 (22.0)	132 (33.0)	101 (25.2)	49 (12.2)

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To identify reliable sources of information regarding pharmacogenomics for healthcare professionals and patients.	38 (9.5)	91 (22.8)	135 (33.8)	95 (23.8)	41 (10.2)

Differences in knowledge, attitude, perception, and self-reported confidence among community pharmacists

Community pharmacists with previous pharmacogenomics training had significantly higher knowledge scores (9.0 [3–12] vs 8.0 [1–13], p < 0.001), attitude scores (9.0 [5–10] vs 8.0 [2–10], p = 0.010), perception scores (32.0 [22–43] vs 28.0 [15–43], p < 0.001), and self-reported confidence scores (27.0 [12–39] vs 24.0 [10–37], p = 0.001) compared to those without prior training. Those interested in attending future pharmacogenomics training had significantly higher self-reported confidence scores (26.0 [11–39] vs 24.0 [10–39], p = 0.025). A statistically significant difference in attitude scores was observed across age groups (p = 0.044), with respondents aged 50 and above reporting the lowest median attitude score (7.0 [5–9]). No significant differences were found by gender, years of experience, highest qualification, position, or type of pharmacy across any domain. Table 6 summarises these findings.

Table 6. Differences in knowledge, attitude, perception and self-reported confidence towards pharmacogenomics services among community pharmacists.

Variable	Total knowledge score		Total attitude score		Total perception score		Total self-reported confidence score	
	Median (range)	P value	Median (range)	P value	Median (range)	P value	Median (range)	P value
Gender								
Male	9.0 (1–13)	0.261	8.0 (3–10)	0.557	29.0 (15–43)	0.836	25.0 (10–38)	0.960
Female	8.0 (2–13)		8.0 (2–10)		29.0 (15–43)		24.0 (11–39)	
Age group								
20–29	8.0 (3–12)	0.534	9.0 (2–10)	0.044	29.0 (15–42)	0.375	24.0 (11–37)	0.314
30–39	8.0 (1–13)		8.0 (3–10)		29.0 (15–43)		24.0 (10–39)	
40–49	8.0 (2–12)		9.0 (3–10)		29.0 (15–43)		25.0 (10–39)	
50 and above	9.0 (3–12)		7.0 (5–9)		27.0 (18–41)		29.0 (17–38)	
Years of working experience								
Less than 11	8.0 (2–13)	0.397	8.0 (2–10)	0.733	29.0 (15–43)	0.742	25.0 (10–39)	0.182

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ISSN: (e) 3007-1607 (p) 3007-1593

11 or more	8.0 (1–13)		9.0 (3–10)		29.0 (15–41)		24.0 (10–39)	
Highest qualification								
B.Pharm	8.0 (1–13)	0.561	7.5 (3–10)	0.525	29.0 (15–43)	0.355	25.0 (11–39)	0.779
Pharm.D	8.0 (3–12)		9.0 (2–10)		29.0 (15–43)		24.0 (10–38)	
Attended pharmacogenomics training previously								
Yes	9.0 (3–12)	<0.001	9.0 (5–10)	0.010	32.0 (22–43)	<0.001	27.0 (12–39)	0.001
No	8.0 (1–13)		8.0 (2–10)		28.0 (15–43)		24.0 (10–37)	
Interested in attending pharmacogenomics training in future								
Yes	9.0 (2–13)	0.111	8.0 (2–10)	0.603	29.0 (17–43)	0.415	26.0 (11–39)	0.025
No/Don't know	8.0 (1–12)		8.0 (3–10)		29.0 (15–43)		24.0 (10–39)	
Position								
Owner	8.0 (1–12)	0.755	7.0 (4–10)	0.679	30.0 (15–43)	0.206	23.0 (11–39)	0.344
Manager	8.0 (3–13)		9.0 (3–10)		30.0 (15–42)		24.0 (10–37)	
Full-time pharmacist	8.0 (2–13)		8.0 (2–10)		28.0 (15–41)		25.0 (10–37)	
Type of community pharmacy								
Chain	8.0 (1–12)	0.756	7.0 (2–10)	0.380	29.0 (15–40)	0.641	24.0 (10–39)	0.520
Independent	8.0 (2–13)		9.0 (3–10)		29.0 (15–43)		25.0 (10–39)	

Note: Bold font denotes statistical significance. [a]Mann–Whitney U test. [b]Knowledge score: 0–17; Attitude score: 0–10; Perception score: 0–45; Self-reported confidence score: 0–40.

Discussion

This research examined the knowledge, attitudes, perceptions, and self-assessed confidence of community pharmacists regarding pharmacogenomics services in Punjab, Pakistan, representing the largest study of its kind in the

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ISSN: (e) 3007-1607 (p) 3007-1593

country. A majority of the respondents reported having no prior training in pharmacogenomics; however, many expressed a desire to engage in future training, which aligns with findings from comparable studies in Malaysia, Nigeria, and Saudi Arabia [12, 13, 15].

The median knowledge score was 11.0 out of 17 (64.7%), indicating a moderate level of understanding of pharmacogenomics. This score is higher than what was found among community pharmacists in Malaysia (55.9%) [15] and Nigeria [13], but is consistent with research conducted with pharmacists in Saudi Arabia and Kuwait [12, 14]. The comparatively higher level of knowledge in this group may be reflective of the PharmD curriculum in Pakistan, which increasingly integrates pharmacogenomics and personalized medicine.[11]An important discrepancy was recognized regarding the accurate identification of the enduring stability of genetic factors influencing drug response, as only 22.3% responded correctly — highlighting the necessity for enhanced clinical PGx education.

Community pharmacists displayed a positive perspective towards pharmacogenomics services, with a median score of 70.0%. A significant majority expressed their readiness to recommend, receive, interpret, and administer PGx testing after undergoing training. This encouraging attitude aligns with findings from previous studies and indicates a strong willingness to adopt PGx services provided there is sufficient preparation. Notably, those who had previously received PGx training had significantly higher attitude scores ($p = 0.010$), reinforcing the idea that familiarity with PGx content influences pharmacists' professional outlooks. Interestingly, pharmacists aged 50 and older exhibited lower attitude scores, which may indicate generational differences in their openness to new technologies in the field of pharmacy.

The high perception levels (median = 64.4%) recorded in the current research correspond to the findings of other related researches done in Malaysia, Zimbabwe, and Kuwait [12, 15, 16]. Notably, a sizable percentage recognized the importance of physician-pharmacist collaboration when providing PGx services and understood the need to get training on PGx. More importantly, the top three barriers included lack of knowledge/expertise (21.0%), lack of guidelines (19.0%), and lack of reimbursement (19.2%). All the barriers correspond to the global literature [13, 14, 15]. The elimination of these barriers will need a proper policy initiative such as the development of PGx guidelines, PGx inclusion in pharmacy CPD programs, and PGx service reimbursement frameworks.

The level of self-reported confidence was moderate (median 62.5%), higher than the low self-reported confidence among pharmacists from Malaysia (57.5%) and Saudi Arabia [12, 15]. The reason behind the high self-reported confidence could be due to the high representation of PharmD graduates within the study sample, given that the PharmD curriculum provides more clinical knowledge. On the other hand, about one-third of participants showed lack of confidence in conducting the point-of-care test and patient identification. These findings are consistent with the literature in that pharmacists who received previous PGx training had higher levels of confidence ($p = 0.001$) [12, 15].

This study has some limitations that must be mentioned. Convenience sampling was applied, which resulted in potential biases since the study might not be representative of the whole population of pharmacists. Another limitation is associated with the use of self-administered questionnaire as self-reporting is prone to biases due to the social desirability bias. The third limitation is that the data were collected in Punjab only, meaning that results may not generalize to all other Pakistani provinces.

Conclusion

The community pharmacists in Punjab, Pakistan have been found to possess adequate knowledge and confidence, along with a positive attitude and perception about the provision of pharmacogenomics services. Prior exposure to pharmacogenomics education was found to be strongly correlated with better performance in all the four areas, highlighting the revolutionary impact of pharmacogenomics education on community pharmacists. Absence of knowledge, guidelines, and reimbursement emerged as key

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

impediments in the adoption of PGx services by Pakistani community pharmacists. It is suggested that pharmacogenomics education should be incorporated in the curricula of pharmacy undergraduates and postgraduates.

Acknowledgements
The authors would like to express their gratitude to all community pharmacists who took part in this study. The authors also appreciate the validation done by experts in the instrument of this study.

Disclosure Statement
No potential conflict of interest was reported by the authors.

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