Prospective of healthcare professionals regarding pharmacogenomics

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Background and objective
Pharmacogenomics is an emerging branch and its application in clinical practice will improve healthcare delivery in India. For the promotion and adaptation of pharmacogenomics, we need baseline data from healthcare professionals (HCPs). So, this study was planned to know the prospective of HCPs in India regarding pharmacogenomics.
Patients and methods
The printed copies of the pretested and validated, single-response or multiple-response self-administered questionnaire, were distributed to the HCPs. There was a total of 19 questions to access knowledge, attitude, and practices regarding pharmacogenomics. Data obtained were entered in Microsoft Excel 2013 spreadsheet for statistical analysis and percentages were calculated for concerned responses.
Results
Out of 134 responses, 126 responses were found to be eligible for analysis. Seventy-eight (61.9%) participants scored more than or equal to 5 to show above-average knowledge. Ninety (71.4%) participants showed a favorable attitude with a score of more than or equal to 3, while 91 (72.2%) participants scored more than or equal to 3 to show favorable practices regarding pharmacogenomics. Hundred and seven (84.9%) participants believed that pharmacogenomics will lead to more effective pharmacotherapy.
Conclusion
Participants showed above-average knowledge; favorable attitude, and practice behavior regarding pharmacogenomics. The survey indicates that conducting Information, Education, and Communication activities may help to increase awareness and knowledge, and to promote the adoption and utilization of pharmacogenomics in clinical practice, which will lead to better pharmacological treatment of disease with maximum efficacy and minimum side effects.

Keywords:
personalized medicine, pharmacogenetics, pharmacogenomics

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Introduction

Pharmacogenomics basically combines pharmacology that is the study of drugs and their action in living tissues with genomics that is the study of genomes and their functions to develop the most effective medications with minimum adverse effects [1–4]. This precision medicine or personalized medicine, which aims to treat each patient individually, is a boon to determining the ideal pharmaceutical therapy [5,6].

Healthcare professionals (HCP) are the backbone for implementing pharmacogenomics in clinical practices. The prospective of HCP regarding pharmacogenomics is needed to make decisions and plan activities for better pharmacogenomic practices to improve healthcare delivery in India.

Aim

To study the knowledge, attitude, and practices regarding pharmacogenomics in HCP.

Patients and methods

This was a cross-sectional, objective-type, questionnaire-based study, conducted among HCPs of Medical College in Central India from June 2022 to August 2022. The study was approved by Institutional Ethics Committee. Doctors and postgraduate students (MD/MS) working in this institute were included in the study. The purpose of the survey was explained and assurance about the confidentiality of the information provided was given to the HCPs. Written informed consent of the HCPs was sought from those who were willing to participate.

Single-response or multiple-response self-administered questionnaires were developed on the

basis of previous literature reviews. It was pretested and validated and printed copies of the questionnaire were distributed to the HCPs. They were given 15 min to answer the questionnaires. There was a total of 19 questions, nine questions to access knowledge, five for attitude, and five for practices regarding pharmacogenomics.

Evaluation of questions about knowledge, attitude, and practices was done using a scoring system. Each correct response was given one point, while incorrect responses were not given any point. A total of nine questions assessed knowledge; the maximum possible score was 9. Participants having a score less than 5 were classified as having below-average knowledge and above-average knowledge with a score more than or equal to 5. Five questions were designed to evaluate attitude. A score was allotted to each question and was considered a favorable attitude with a score of more than or equal to 3 and an unfavorable attitude with a score of less than 3. Five questions were designed to evaluate practices. A score was allotted to each question and was considered as favorable practices with a score of more than or equal to 3 and unfavorable practices with a score of less than 3.

Data obtained were entered in Microsoft Excel 2013 spreadsheet for statistical analysis and percentages were calculated for concerned responses.

Results

Out of a total of 134 distributed questionnaires, 126 responses were found to be eligible for analysis. Incompletely solved questionnaires were not taken into consideration for analysis. Out of a total of 126 participants, 54 (42.9%) were male and 72 (57.1%) were female and all were between 24 and 60 years of age. Age-wise distribution of participants is shown in Table 1.

The distribution of sources from which participants heard about pharmacogenomics is shown in Fig. 1. Table 2 is showing the number and percentage of participants who gave correct responses to knowledge-based questions. Seventy-eight (61.9%) participants scored more than or equal to five.

Responses to attitude-based questions and practice-based questions are shown in Tables 3 and 4, respectively. Ninety (71.4%) participants showed a favorable attitude with scores more than or equal to 3, while 91 (72.2%) participants scored more than or equal to 3 to show favorable practices regarding pharmacogenomics. Figure 2 shows the percentage distribution of challenges for prescribing pharmacogenomics testing.

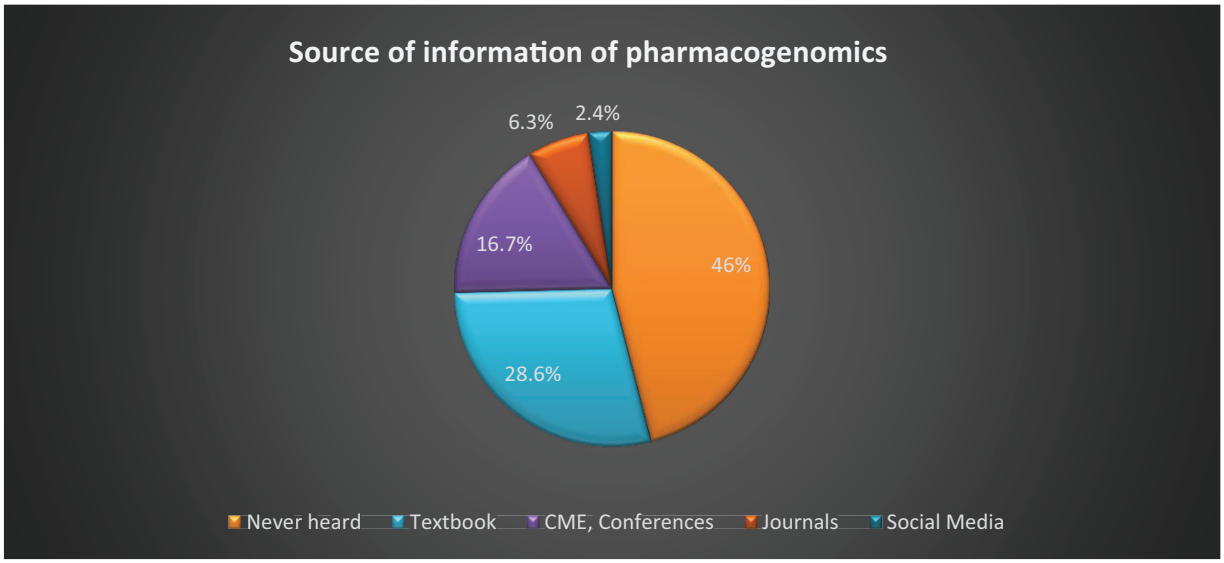
Discussion

Pharmacogenomics is an emerging branch of science that can lead to better pharmaceutical therapy for the

Table 1 Age-wise distribution of participants

Sr. No.	Age	Male (*N*=54) [*n* (%)]	Female (*N*=72) [*n* (%)]
1	24–35	14 (26)	22 (30.6)
2	36–45	22 (40.7)	27 (37.5)
3	46–55	13 (24)	17 (23.6)
4	56–65	5 (9.3)	6 (8.3)

Figure 1



Distribution of source from which participants heard of pharmacogenomics.

Table 2 Responses to knowledge-based questions

Knowledge-based questions	Number of correct responses (*N*=126) [*n* (%)]
Genetic factors that determine the drug response keep changing over an individual's lifetime	103 (81.7)
What does pharmacogenomics deal with?	83 (65.9)
US FDA recommends pharmacogenomic testing for some drugs	78 (61.9)
Are pharmacogenomics tests available in India?	55 (43.7)
Warning about altered metabolism in individuals with specific genetic variants is given on the package insert of warfarin	70 (55.6)
Genetic variations influence the occurrence of hemolytic anemia in G6PD-deficient	109 (86.5)
Genetic variation affects the pharmacological action of isoniazid	79 (62.7)
The benefits of pharmacogenomics	73 (57.9)
What is PharmGKB	66 (52.4)

G6PD, glucose-6-phosphodiesterase enzyme; PharmGKB, pharmacogenomics knowledge base; US FDA, United States Food and Drug administration.

Table 3 Responses to attitude-based questions

Attitude-based questions	Number of favorable responses (*N*=126) [*n* (%)]
There is a need for conferences and CMEs on pharmacogenomics to increase awareness	121 (96)
Pharmacogenomics will help us to make our drug therapy more effective	107 (84.9)
The clinical application of pharmacogenomics will increase the cost of therapy	71 (56.3)
The new drug development process should use pharmacogenomics	58 (46)
Do you believe that pharmacogenomics and pharmacovigilance be linked together for better drug safety?	92 (73)

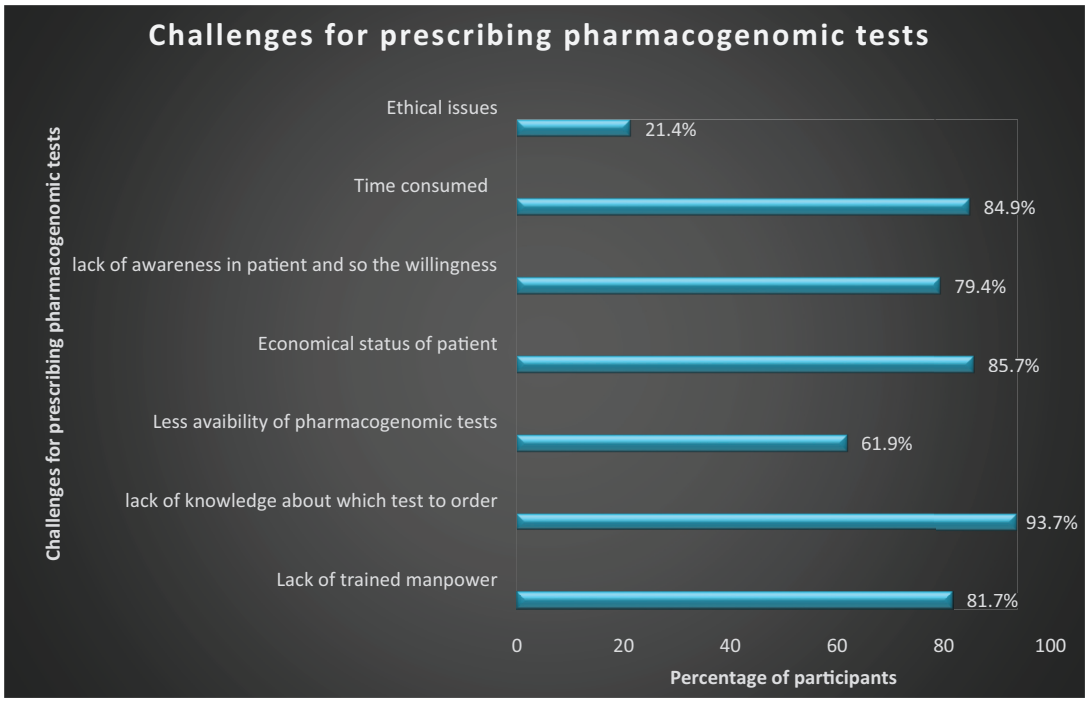
Table 4 Responses to practices-based questions

Practices-based questions	Number of favorable responses (*N*=126) [*n* (%)]
Are you interested in activities aimed at increasing awareness among healthcare workers and patients regarding pharmacogenomics?	123 (97.6)
Would you like to have your pharmacogenomics profile?	73 (57.9)
Have you ever prescribed pharmacogenomics to your patient?	3 (2.4)
Are you interested in prescribing pharmacogenomics testing to your patients?	68 (54)
Are you interested in participating in genetic research?	91 (72.2)

individual patient. With the help of pharmacogenomic testing, we can choose the most effective medicine with minimal side effects for the individual patient. It also helps medical faculties to determine the dose of a drug for each patient. It decreases the time consumed in a trial-and-error method in the pharmacotherapy of many diseases like neoplasia, cardiovascular disorders, and neuroleptic disorders in which time is a crucial factor to determine the prognosis. Baseline data of knowledge, attitude, and practices about pharmacogenomics will be useful to administrators and policymakers to plan necessary interventions to increase its clinical application in India.

In the present study, out of a total of 126, 58 (46%) participants never heard of pharmacogenomics that shows poor awareness of the same. Agrawal *et al.* [7] in a study conducted on second-year medical students reported that 79.7% of participants heard of pharmacogenomics. This higher percentage might be due to the recent inclusion of pharmacogenomics topic in academics of second-year medical education. Textbook (28.6%) was the most common source of information regarding pharmacogenomics followed by Continue Medical Education (CMEs) and conferences (16.7%), while social media was the least common source, which implies that we should arrange more CMEs and conferences on pharmacogenomics and use social media more efficiently to create its awareness. Only 55 (43.7%) participants of this study were aware of the availability of pharmacogenomics testing in India, while Agrawal *et al.* [7] found the same awareness in 82% of participants in their study. This variation in the result maybe because of the difference in the study population, which is HCPs in our study, while second-year medical students later who have pharmacogenomics topics in their academics. In our study, 78 (61.9%) participants knew that

Figure 2



Percentage distribution of challenges for prescribing pharmacogenomics testing.

pharmacogenomic testing is recommended by United States Food and Drug Administration (US FDA) for certain drugs. Agrawal *et al*. [7] reported that 58% of participants were aware of the pharmacogenomic information requirements by the US FDA for labels of some drugs. Rahma *et al*. [8] and Arafah *et al*. [9] in their study of pharmacogenomics in healthcare workers and pharmacy students, respectively, reported that 66.3 and 58.2% of participants respectively knew that FDA asks for a pharmacogenomic test for some drugs.

In the current study, the role of genetics in the therapy of warfarin and isoniazid was known by 70 (55.6%) and 79 (62.7%) participants, respectively. Although warfarin and isoniazid are very commonly used in India for coagulation disorders and tuberculosis, respectively, the role of genetics in their response variation was known to the relatively low number of participants. In total, 109 (86.5%) participants were aware of pharmacogenomics relation of hemolytic anemia with glucose-6-phosphodiesterase enzyme deficiency, which is very common in India, and drugs causing it are frequently used in India for the treatment of malaria (Primaquine, Quinidine), bacterial infection (Sulfonamides, Quinolones, and Nitrofurantoin), and inflammatory disorders (NSIADs). In contrast to our findings, Agrawal *et al*. [7] in a study reported the role of pharmacogenomics in isoniazid therapy and hemolytic anemia in glucose-6-phosphodiesterase enzyme deficiency was known by 40 and 80% of participants, respectively. This difference in the results might be due to a varied sample population.

In the current study, 66 (52.4%) participants knew the long form of PharmGKB that is a pharmacogenomics knowledge base. It is an interactive resource that extracts knowledge regarding drug response variation due to genetic variability. PharmGKB is a tool with a website linked to it, which generates, stores, and provides summaries of pharmacogenomics relationships along with data that support it, to the scientific community [10].

In the current study, 121 (96%) participants showed the need for CMEs and conferences to increase awareness of pharmacogenomics. Pharmacogenomics that will lead to more effective pharmacotherapy is believed by 107 (84.9%) participants, while 71 (56.3%) participants thought that it will cause an increase in the cost of therapy. Fifty-eight (46%) participants believe that the new drug development process should use pharmacogenomics. Similar to our study, Muzoriana *et al*. [11] in a study conducted on pharmacists and pharmacy students reported that 62% of participants linked drug development with pharmacogenomics, while Agrawal *et al*. [7] in a study conducted on

medical students reported that 68% of participants had no idea about the role of pharmacogenomics in new drug development. Ninety-two (73%) participants believed that linking pharmacogenomics and pharmacovigilance will provide better drug safety. Pharmacovigilance, which reports adverse drug reactions, and pharmacogenomics, which deals with the genetic basis for variation in drug response, may help scientists to search for the genetic cause that leads to adverse drug reactions.

In the present study, the majority of participants 123 (97.6%) were interested in activities aimed at increasing awareness, but only 73 (57.9%) were interested in having their pharmacogenomics profile to be done. Arafah *et al*. [9] in their study of pharmacogenomics in pharmacy students reported that 61.2% of participants were interested in attending activities regarding pharmacogenomics and 80% were interested in having their genetics collected by biobank. Agrawal *et al*. [7] reported that 68% of the participants were interested in performing their pharmacogenomic profile. This difference in the result is due to different sample study populations, the inclusion of pharmacogenomics in academics in some places, and most importantly lack of awareness even among members of the medical field. Although only three (2.4%) participants of the present study have ordered pharmacogenomic testing for their patients, 68 (54%) were willing to prescribe it in the future. The low percentage of participants who have been prescribed pharmacogenomic tests may be due to the inclusion of nonclinical, paraclinical staff, and lack of awareness of pharmacogenomics tests, lack of confidence to prescribe a test, and lack of detailed knowledge about pharmacogenomics tests. But it is good to report that more than fifty percent of participants are willing to prescribe it in the future. In this study, 91 (72.2%) are interested in genetic research. Arafah *et al*. [9] mentioned that 56.2% of participants were interested in genetic research, in their study of pharmacy students.

Lack of knowledge about which test to order (93.7%) was found to be the most common challenge followed by the economic status of patients, which implies the cost of tests as a major barrier to practicing pharmacogenomic tests. Rahma *et al*. [8] reported the cost of tests as the main barrier to the implementation of pharmacogenomics in clinical practice, while Albassam *et al*. [12] reported a lack of training and guidelines for pharmacogenomic testing as a top barrier. In the present study, ethical issue (21.4%) was the least common challenge in practicing pharmacogenomics.

In the current study, participants had adequate knowledge and a favorable attitude, and the majority of them were willing to practice it. This indicates that participants will respond well to the pharmacogenomics program. Pharmacogenomics topic is now included in the academic curriculum of phase-II undergraduate medical students of MBBS, which will help to create awareness of pharmacogenomics in future healthcare workers of India. Conducting Information, Education, and Communication activities through lectures, seminars, posters, and pamphlets, showing videos, arranging workshops, CME, and conferences may help to further improve the awareness and knowledge of HCPs. Case-based modules as learning recourse material should be prepared, which will help physicians to learn the pharmacogenomic point of view of a particular disease at hand. Government, academia, and clinical practitioners should come forward and work together to prepare programs and guidelines for the clinical practice of pharmacogenomics. Government should provide training, grant funding, and implement programs to encourage genetic research and its clinical use to provide better pharmacotherapy to the patient with maximum efficacy and minimum side effects.

This is a single-centered, cross-sectional study with a small sample size, the reliability of answers is not known, and so the generalizability of the results may get affected. These issues call for further research and analysis.

Conclusion

In this study, participants showed above-average knowledge, favorable attitude, and practice behavior regarding pharmacogenomics, which indicates that conducting Information, Education, and Communication activities may help to increase awareness and knowledge, and at the same time promote the adoption and utilization of pharmacogenomics in clinical practice, which will lead to better healthcare delivery to society.

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drafting the article, or revising it critically for important intellectual content.

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Conflicts of interest
There are no conflicts of interest.

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