**BACKGROUND**

The healthcare system in the United States has started to increasingly emphasize personalized, patient-centered medicine, resulting in the rapid availability and use of genetic tests. Pharmacogenetics, a subset of pharmacogenomics, is defined as “the study of variations of DNA and RNA characteristics as related to drug response.”1 Pharmacogenetics examines how variation of one single gene may impact how a person responds to a single drug. Meanwhile, pharmacogenomics is defined as “the study of variations in DNA sequence as related to drug response”1, which refers to how all of the genes (the genome) can have an impact on an individual’s response to medications.1,2

Pharmacogenomic testing has allowed the field of medicine to make clinically applicable advances in terms of providing personalized medicine that is tailored to each unique individual’s genetic makeup. Prior to the knowledge gained from the Human Genome Project (HGP), medication therapies were initiated using a “one-size-fits-all” philosophy. The HGP was an international effort to completely map and understand every gene of a human being. After identification of the human genome, researchers and health care providers realized that an individual’s genetic makeup can impact their risks for adverse effects or help to determine patient’s rate of drug metabolism.3

By utilizing a patient’s genetic information, health care providers could understand a patient’s likelihood of adverse drug reactions, eliminate medication trial-and-error waste, reduce the overall health care costs, and ultimately improve patient outcomes by providing a more precise therapy.4 Although it is clear that PGx testing can impact many patient’s lives, it is difficult to determine whether PGx testing services would reach every community. With the lack of education and awareness of such medical advances, there may be significant gaps in knowledge regarding personalized medicine amongst communities with different socioeconomic levels. Pharmacists can help to play a role in educating patients belonging to various “medically underserved areas, different racial/ethnic groups, and socioeconomic levels” to help eliminate barriers to patients receiving personalized care.5

Although medical advances on genetic testing may not be widely known by patients, the idea of having one’s DNA tested is becoming more and more mainstream through direct-to-consumer (DTC) tests provided by companies, such as, Ancestry.com, 23AndMe. These DTC tests can be purchased from online companies, where they send the consumer a sample collection kit to mail back with their sample, in return for their genetic results.6 With such an easy and accessible DNA test available out on the market, there have been both support and concern not only about the accuracy in the genetic information that is provided from one DTC test to another, but also with what happens to their sample and genetic information. Despite the enhancements that can be made in health outcomes with the use of PGx information, privacy may play a huge role in the barriers as to why a PGx testing service offered in a community pharmacy setting may not be successful.7

**OBJECTIVES**

This article will discuss consumer awareness of the types of PGx testing available within the community pharmacy and assess consumer willingness to receive specific types of PGx tests. This article will also identify the barriers of consumers to participate in PGx test(s) if made available in a community pharmacy.

**METHODS**

**Sample**

Consumers were recruited by pharmacy staff at three Safeway and Albertsons pharmacies. A train-the-trainer method was used in training pharmacists, pharmacy technicians, and pharmacy interns at the participating Safeway/Albertsons pharmacies. Pooja (Co-PI) trained the pharmacy staff on how to ask the consumers to complete the survey. Pooja walked through the process of how to hand out the informational card or offer the paper survey based. The pharmacy staff was trained to recruit consumers to participate in the study by identifying whether they met the inclusion criteria of any subject who is 18 years of age or older and who is utilizing Safeway/Albertsons pharmacy services. Consumers’ age was determined based off of the date of birth that is given to the staff as part of their workflow tasks during prescription drop-off and pick-up. Consumers responded to an online or paper survey to assess for their perspectives on PGx testing in a community pharmacy setting. The paper survey and the information cards consisting of the Qualtrics URL for the online survey, were distributed to two Safeway pharmacies and one Albertsons pharmacy to be completed by consumers 18 years of age or older. Both forms of surveys were administered to consumers between January 2019 and March 2019 (8-week data collection). Voluntary consent was provided with the completion of the survey. The first one-hundred respondents received a $10 Safeway/Albertsons gift card as an incentive to participate in the study.

**Measure and data collection**

The survey was an 18-item survey assessing consumer knowledge of PGx testing, their willingness to perform a test in a community pharmacy setting along with receiving appropriate counseling from a pharmacist, and what barriers consumers feel would prevent them from receiving such a test. Section 1 of the survey consisted of 8 questions to help us understand the baseline knowledge that the participants have regarding their DNA and whether they believe individuals respond differently to medications based on their genetics. Section 2 of the survey consisted of 3 questions to help us determine whether the participants would be willing to pay a price to have a quick cheek swab done to obtain their own PGx results, along with speaking to a pharmacist regarding their results and possible medication adjustments. Section 3 of the survey consisted of 2 questions that helps to identify what factors, if any, would contribute to a PGx testing service to not be successful in a community pharmacy setting. Lastly, section 4 consisted of 5 questions regarding demographics and asked about the following: age, identified gender, ethnicity/race, household income and level(s) of education completed.

As an incentive for completing the survey, our sample size of one-hundred subjects received a $10 Safeway/Albertsons gift card and a ‘Thank You’ letter. The funds for the $10 gift cards for our first one-hundred responders received was provided through the American Pharmacists Association Incentive Grant that was awarded for this research project in the amount of one-thousand dollars. The gift cards were mailed to the participants within 10 days after they provided their name and address after completing the survey. The online survey directed the participants to a 2nd survey to provide this information, while the paper survey had a separate document that allowed participants to provide this information. Completed paper surveys and documents containing participant’s names and addresses were collected by pharmacy staff and stored separately in a secure location inside the pharmacy. At the end of each week, Pooja (Co-PI) visited each pharmacy to collect the forms and transported them to Albertsons Companies headquarters in Phoenix, Arizona and were stored inside Dr. Lesser’s office inside a locked cabinet.

**Data analysis**

A 95% confidence interval with a 5% margin of error was determined for this study. Descriptive statistics were used to analyze the barriers that consumers reported would hinder them from receiving a PGx test. Nonparametric data was approached using chi-squared analysis and frequency tables to report the gaps in knowledge and willingness to receive PGx testing in a community pharmacy setting amongst different socioeconomic levels. All statistical analyses were conducted with the use of IBM SPSS Statistics at the Midwestern University College of Pharmacy – Glendale.

**RESULTS**

A total of 53 consumers participated in the survey. One-half of the participants were female (n=28, 52.8%) and roughly two-thirds (n=33, 62.3%) were between the age of 18 – 55 years. A majority of the consumers earned an annual income less than $49,999 and had not completed education further than some college credit (n=31, 59.6%). Approximately one-half of the consumers who participated in the survey were White (non-Hispanic) (n=28, 53.8%). One-quarter of our consumers were Hispanic (n=13, 25%). Consumers who also indicated other races include the following: Asian (15.3%), African American or Black (9.6%), American Indian/Alaskan Indian (1.9%), Hawaiian/Pacific Islander (1.9%) and other (1.9%). One consumer did not prefer to identify their race in the survey.

***Consumer knowledge***

Most consumers who participated in the survey (n=50, 96.1%) reported to agree or strongly agree that a small difference in their DNA can have a big impact on how they respond to their medications. Similarly, most of the consumers (n=48, 92.3%) agreed or strongly agreed that individuals are made up of unique genetic information that require personalized medications to treat each patient. In contrast, only 37 consumers (71.1%) were aware that PGx testing for medications is available as an alternative approach to medicine when patients have failed multiple drug classes.

Consumers were asked a series of questions that assessed what benefits they expected to receive from receiving PGx testing. Significant consistency was observed among surveys in respect to perceived benefits of PGx testing. Fifty-one consumers expected that they would be prescribed safer (98%) and more effective (96.1%) medications after as a result of PGx testing. In addition, 47 consumers expected to experience a reduced risk of adverse drug events and an increase in comfortability in taking their medications (90.3%). Lastly, 45 consumers (86.5%) believed that PGx testing would lead to reduced medication costs.

***Knowledge vs. Education***

A knowledge score was computed based on the values assigned to the answer choices: ‘Strongly disagree’ = 1 point, ‘disagree’ = 2 points, ‘agree’ = 3 points, ‘strongly agree’ = 4 points. Respondents who had a knowledge score between 25 and 32 were considered ‘high-level knowledge’ while a knowledge score between 8 and 24 was considered ‘mid-level knowledge’. This categorization was determined based on a frequency chart that was done on SPSS to find where a majority of the data fell. A chi-square analysis was then done to report the relationship between knowledge and education levels. For analyzing purposes, education levels were collapsed into three categories: high school, some college, and college degree. Of the 17 out of 53 respondents (32%) who had a mid-level knowledge regarding DNA and the effect on medication response, 5 (9.4%) respondents had a high school diploma, 6 (11.3%) respondents had some college credit, and 6 (11.3%) respondents had a college degree. This information was not determined for one respondent, as they had answered ‘prefer not to answer’ to the education demographic question. Of the 35 respondents (66%) who had a high-level knowledge, 6 (11.4%) respondents had a high school diploma, 9 (17%) respondents had some college credit, and 20 (37.7%) respondents had a college degree. When comparing the education level versus the level of knowledge, it was reported that there is no significant difference between consumers’ knowledge of DNA affecting medication response and the amount of education they have received.

***Consumer willingness***

The second section of the survey assessed consumers’ willingness to receiving a PGx testing if a service was made available in their local pharmacy. Out of the 52 consumers who completed the survey, 44 consumers (84.6%) strongly agreed or agreed that they would be willing to receive a PGx test by their pharmacist if made available at their pharmacy. Responses were consistent with the second willingness question. Forty-six consumers’ (88.5%) strongly agreed or agreed that they would be willing to receive a thorough counseling session from their pharmacist to discuss their PGx test results.

As part of the willingness section, consumers were asked what price they would be willing to pay for a PGx testing service. Fifty consumers out of 52 that responded provided a price that they would be willing to pay Thirty-six consumers (72%) indicated a price that fell in the $0 to $50 price range. Eight consumers (16%) indicated that they would be willing to pay between $51 and $100 and 5 consumers (10%) responded that they would be willing to pay between $101 and $200. Lastly, one consumer indicated that they would be willing to pay a price between $201 and $300 for a PGx test if it were made available at their local community pharmacy.

***Knowledge vs. willingness***

Consumers’ knowledge score was compared to both their willingness to receive a PGx test and willingness to receive a 15- to 30-minute counseling session by their pharmacist. A Pearson chi-square analysis was done to determine whether there is a relationship between knowledge level and their willingness to receive a PGx test. Twelve out of 17 respondents with a mid-level knowledge and 32 out of 36 respondents with a high-level knowledge either strongly agreed or agreed to receive a PGx test by their pharmacist, 70.1% and 88.9%, respectively. When looking at their relationship, there is no significant difference between knowledge level and their willingness to receive a PGx test (P=0.098).

The same analysis was done against their willingness to receive a thorough counseling session by their pharmacist to discuss their genetic results. Twelve out of 17 respondents with a mid-level knowledge and 34 out of 36 respondents with a high level of knowledge either strongly agreed or agreed to receive a 15- to 30-minute counseling session by their pharmacist, 70.1% and 94.4%, respectively. An analysis between this relationship showed that there is a significant difference between the level of knowledge consumers have about DNA affecting medication response and their willingness to sit down with a pharmacist to discuss their genetic results (p<0.05).

***Consumer barriers***

Out of the 52 consumers who completed the survey, 51 consumers indicated whether there are known barriers to receiving a PGx test. Only 14 consumers felt that there are barriers that would prevent them from receiving a PGx test at their local pharmacy. The majority (n=13, 86.7%) felt that privacy would play a role in preventing consumers from receiving this service. Two consumers (13.3%) indicated that cost would be a reason for not wanting a PGx test along with preferring to have the test done by their doctor. Lastly, one consumer (6.67%) indicated in each of the following categories would hinder them from using this service if offer at their local pharmacy: lack of confidence in their pharmacist, fear of knowing their PGx results, and the belief that this test would not benefit them in the treatment they receive.

**DISCUSSION**

The participation in this study was well received by both the pharmacy staffs and consumers, because it allowed community pharmacists to be more aware of possible services that could be implemented into their pharmacies. It also allowed consumers to voice their thoughts and concerns for a new approach to treatment therapies based on their own personal experiences with ineffective therapies.

Many consumers who were interested in participating often times confused PGx testing used to determine genetic mutations affecting medication response with DNA testing that allows us to understand risk for possible health conditions. It is difficult to tell whether participants had asked for clarifications and if a differentiation was made by the pharmacy staff before they responded to the survey. Due to the busy schedules of community pharmacists, they might have also found it challenging to provide more time detailing the difference between other types of DNA testing that is available This may have affected the responses that we received and allowed for misinterpreted results.

**CONCLUSION**

A key strength to this study was that a survey-based approach was made to determine consumers’ thoughts and concerns on a possible PGx testing service in a community pharmacy setting. It allowed us to determine that consumers have the confidence in their local pharmacists in providing a PGx test, as well as, the appropriate counseling to help them understand their genetic results and how they could be applied clinically. Our findings suggest an opportunity to explore the perceptions of consumers on a large scale, as well as, the comfortability of pharmacists in providing a PGx test at their pharmacy.

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