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Staff Education on the Benefits of Pharmacogenetic Testing for Chronic Pain Management

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

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Abstract

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by

Laura A. Robinson

MSN, Walden University, 2018

ADN, Luna Community College, 2005

Project Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Chronic pain management is a growing concern in the medical community with one out of three people in America suffering from chronic pain. This educational practice-focused project identified the value of educating a group of primary care providers (PCP) on pharmacogenetic (PGx) testing offering genetic-based prescribing choices and reducing trial and failure in treating chronic pain patients. The practice-focused question explored if there would be support regarding learning gained by the providers following an evidence-based education process on PGx testing, as shown from pretest to posttest results. The educational model was guided by the analysis, design, development, implementation, and evaluation (ADDIE) model. Due to the COVID-19 pandemic precautions, distant learning via Zoom offered a safe learning platform. This evidence-based education project consisted of 19 PCPs who were invited to participate. The purpose of the project and their role in the project was explained, and they were provided with an access QR code for the Survey Monkey® platform. The data gathering consisted of demographics (n = 18), pretest (n = 19), and posttest (n = 12). The data were analyzed using a descriptive measurement of pretest to posttest questions The PCPs' test results revealed increased comprehension of PGx testing from pretest to posttest, reporting a mean increase of 21.20% of total correct answers. The positive social change gained in this educational practice-focused project improved providers' knowledge and understanding of PGx testing, offering a safe, individualized, patient-centered approach to chronic pain management.

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Section 1: Nature of the Project

Introduction

Pharmacogenetic (PGx) testing is a tool to help treat various health conditions, and chronic pain is one of the conditions that challenge effective treatment. Pharmaceutical treatment choices regarding chronic pain management are often inadequately managed (Gabay, 2019). As healthcare providers contend with governmental regulation changes regarding opioid medications and prescribing practices, finding adequate medication choices, and reducing trial and failure in drug choices for chronic pain management are goals in current healthcare practices (Gabay, 2019). Chronic pain is frequently inadequately treated; often, nurse practitioners refer chronic pain patients to a specialty provider instead of treating them themselves because of the complexity of their treatment needs. The risk of an adverse event or the "trial and failure" scenario in prescribing makes chronic pain treatment problematic in the primary care setting, causing many providers to avoid offering treatment to the patient suffering from inadequate pain control (Haga, 2017).

PGx testing is a new option for treating chronic pain patients (Schwartz et al., 2017). NP's and other providers have failed to use PGx testing as a tool in prescribing medication to treat various patients' health concerns related to an individuals' genetic profile, leading to multiple drug trials before finding a remedy that helps treat the symptoms (Millennium Health, 2020). Educating primary care providers (PCPs) on PGx testing could help empower the providers with information that is individualized to a Patient's metabolism. PGx testing use could potentially create greater patient satisfaction,

reduce medication waste, and decrease the financial burden from failed medicine trials, creating a positive social change in opioid prescribing practices (Genelex, 2019).

Problem Statement

The problem identified in this Doctor of Nursing Practice (DNP) project was the lack of understanding of PGx testing in the rural southwestern portion of the United States and the value of the testing in a primary care setting (Haga, 2017). Evidence in the literature supported the benefit of using PGx testing to identify medication-related problems (Schwartz et al., 2017) regarding chronic pain treatment in the primary healthcare setting (Sharma et al., 2017). PCP i.e., medical doctors ([MDs]), NP's, and physician assistants ([PA's]) lacked access to the use of PGx testing; this problem was related to a gap in knowledge or understanding regarding PGx testing. Implementing an evidence-based educational project on PGx testing has improved understanding of chronic pain treatment through individualized medication management in the concerned patient population. PGx testing is a tool for providers to guide medication choices related to chronic pain management and depression in the primary care setting. Still, this tool is underused in the primary care outpatient setting (Sharp et al., 2011). This educational project's benefit was to offer PCPs informed choices regarding the evidence supporting the value and importance of PGx testing in the primary care setting. In the Southwest, the opioid epidemic is concerning; as of 2018, according to Centers for Disease Control and Prevention (CDC) findings, 63% of the overdose deaths were related to opioid misuse (National Institute on Drug Abuse, 2020, Fig. 1). As PGx testing becomes a tool in chronic pain management, the outcome will be improved pain through prescribing

medications genetically compatible with a person's genetic profile, reducing drug overdose incidence. PGx testing can help the PCP prescribe medications that work effectively in pain management. More medication is not always the best practice, placing the patient at risk of an adverse event.

Teaching PGx evidence-based testing improves the PCPs knowledge base and understanding of how the results help determine conclusively which medications work through deoxyribonucleic acid (DNA) findings in a simple PGx test. This educational project taught providers how PGx testing is a simple, noninvasive test. The test example involved, obtaining samples through a cheek swab, sending the samples to the laboratory, looking at genetic polymorphisms, and then using the readings to develop individualized, genetically compatible pharmaceutical treatment options for the patient in question (Richeimer & Lee, 2017). The providers' teaching improved their understanding of enzyme metabolism and how enzymes play an essential role in medications' ability to work effectively in the chronic pain patient. The providers understood from the information provided that using PGx testing has benefits in preventing adverse drug events (ADEs), the fourth leading cause of death in the United States (United Health Foundation [UHF], 2020). The aim of this educational project was to reduce the PGx testing knowledge gap and explain this tool's benefit in the clinic setting. The PowerPoint gave insight to a group of PCPs regarding the multiple metabolic pathways involved in the metabolism of drugs, according to Trescot and Faynboym (2014), and how PGx testing is essential in effective chronic pain control.

Purpose Statement

The aim of this DNP educational project was to educate a group of PCPs in the southwestern portion of the United States regarding a gap in practice related to the lack of use of PGx testing. My role as the DNP student conducting this project was to educate a group of providers on PGx testing as a tool to help with prescribing choices for the chronic pain patient population according to patients' genetic profiles. The clinic setting is where PGx testing omission is related to a lack of providers' educational opportunities in rural medical communities on newer testing options. Thus, the project offered an additional tool in treating the chronic pain patient population with safe and effective medication management.

Practice Focused Questions

The DNP practice-focused questions guiding this evidence-based educational project on PGx testing were then following:

- What evidence from the literature supports the use of pharmacogenetic (PGx) testing in depression and chronic pain treatment in the primary care setting?
- Will there be a change in understanding gained by the providers related to pharmacogenetic (PGx) testing as shown from pretest to posttest results?

The project's desired outcome was to increase the knowledge base regarding PGx testing and the value of PGx results in a group of PCPs in the rural southwestern portion of the United States.

Content experts (i.e., a medical assistance treatment (MAT) program manager and a behavioral health manager) guided the project, oversaw the process, and evaluated the

outcome of the educational content. The PGx testing process had positive responses regarding the use and benefits of a patient's genetic metabolism, showing that the content created improved understanding through the PowerPoint evidence-based educational project. The results were evident through the providers' knowledge of the use and process of the PGx test and how the test identifies a patient's rate of drug metabolism depending on the person's genetic profile. In addition, the findings could help determine the potential risk of ADEs or of drugs competing for binding sites. Thus, the project goal achieved the intended outcome of educating the providers on the benefits and use of PGx testing to improve chronic pain patient care (Trescot & Faynboym, 2014).

Nature of the Doctoral Project

The nature of this doctoral project involved educating providers on the benefits of PGx testing. For patients who suffer from chronic pain or depression, PGx testing will offer providers evidence-based drug choices through an effective pharmaceutical treatment in managing chronic pain or depression individualized to a person's DNA and metabolic profile (Millennium Health, 2020). Through Walden University's education process, the institution encourages students to create positive change to better people's lives. Adequate pain control allows a person to live each day with less pain and enjoy life, making a positive change. Walden University (2014) states that "positive change today contributes towards long-term changes that improve people's lives in the future." Walden University's literature review matrix offers an organized template for literature used in the project.

Sources of Evidence

This educational project focused on educating providers on the use and benefits of PGx testing (Millennium Health, 2020). The various sources of evidence obtained through the Walden Library using CINAHL, MEDLINE, academic journals, and peer-reviewed scholarly articles, with PGx testing information within the last 6 years. The sources of evidence analyzed from multiple sources regarding PGx testing and compiled in Walden University's literature review matrix template. Using the Johns Hopkins Nursing Evidence-Based Practice: Non-Research Evidence Appraisal Tool offered reliability and validity of the content examined for the project information (Appendix E; Newhouse et al., 2007). The project focused on improving the chronic pain patient regarding pharmaceutical treatment choices and decreasing the "trial and failure" in medicine of the chronic pain population. The evidence-based educational project focused on educating the providers on PGx testing (a tool for treatment) in a southwestern rural primary care clinic.

Approach

The evidence-based educational project used the analysis, design, development, implementation, and evaluation (ADDIE) model (Quigley, 2019). The project followed the procedural steps of planning, implementing, and evaluating as described in Walden University's *Manual for Staff Education.* Walden University offers students an opportunity to transform themselves as scholar-practitioners to effect positive social change (Walden University, 2020). Walden University (2020) defines "positive social change as a deliberate process of creating and applying ideas, strategies, and actions to

promote the worth, dignity, and development of individuals, communities, organizations, institutions, cultures, and societies," noting that positive social change results in the improvement of human and social conditions."

This project involved educating a group of PCPs on the benefits of PGx testing, creating an opportunity to offer improved pain control to patients who suffer from chronic pain or depression. PGx testing helps in identifying pharmaceutical treatment choices regarding managing chronic pain and depression through individualized patient DNA and metabolic profiles (Trescot &Faynboym, 2014). Walden University promotes positive change to better people's lives; when people can live each day with less pain and enjoy daily living, providers have made a positive change (Walden University, 2014).

Planning

The ADDIE model used in planning the doctoral project included conducting literature research and developing an educational plan to understand PGx testing. I created an educational platform for the virtual meeting (Zoom) with approval from the MAT facilitator. To fulfill one of Walden University's academic project requirements, I needed the guidance of a content expert. The behavioral health manager/supervisor, MS, LPCC, LADAC, NCC, offered her guidance. She was working in the medical field and was an educator in the university setting. Additionally, the NP from MAT, who was the manager/associate medical director of the (Extension for Community Healthcare Outcomes (ECHO) care project, had over 30 years of provider experience in caring for patients afflicted with chronic pain and understood issues related to treating the condition. Both content experts offered to guide me in the process to support the

university's requirements. Both managers were a committed part of the patient care process in the clinic and were the persons who evaluated and approved changes regarding patient care in the clinic setting.

Next, I developed an evidence-based educational project PowerPoint on PGx testing, developed a pretest/posttest focusing on PGx testing, and implemented the tests through Survey Monkey regarding PGx testing to present to the providers (Appendix C). After Institutional Review Board (IRB) review and approval, an email invitation with Survey Monkey QR codes was provided to the providers, giving them access to the demographic questionnaires and pretest. An email with information on the PGx testing and sample results was sent to the providers. During the project, the MAT program provided a meeting time to present my PowerPoint to the providers; this process was approved and implemented on October 20, 2021.

The MAT project coordinator approved the evidence-based educational project. The content experts observed the educational PGx testing PowerPoint; I emailed informational examples and the pretest QR code. The demographics link was sent to each participant before the meeting date, allowing time for them to read about the testing process and its benefits. I presented the PowerPoint educational project through a Zoom virtual video conference setting due to the COVID-19 virus and the need for social distance. Questions and answers were available at the end of the educational project, allowing participants time to clarify PGx testing.

Implementation

I disseminated the pretest and posttest to the PCPs via their clinic emails in the implementation stage. After the evidence-based educational project, I gathered the resulting tests from the clinic participating providers through Survey Monkey to assess the change between the pretest and posttest in understanding and knowledge gained from the PGx testing educational project and present the findings. The Survey Monkey test results were gathered and reviewed regarding the providers' understanding of PGx testing and interest in implementing PGx testing (SurveyMonkey, 2020). The information collected was used to document the PGx educational project's findings for the report's publication material and the facilitator's conclusions.

Evaluation

The final step involved the evaluation phase of the educational project, in which I evaluated the participants' change in understanding from the pretest answers to the posttest responses and their objectives. I applied descriptive statistics to analyze the pretest and posttest findings using the Survey Monkey platform (SurveyMonkey, 2020). Through the questions, I evaluated the providers' understanding of the project's PGx testing benefits to treat chronic pain patients in future practice effectively and ran the findings through SPSS to find the difference between pretest and posttest knowledge. The final step in the doctoral education-based project's process is evaluating the findings and presenting the publication results through Walden University (Walden University, 2019). This doctoral project's potential contribution to nursing practice (NPs) in healthcare at this organization include an improved opportunity for knowledge-based choices

regarding pain control in chronic pain patients. Various peer-reviewed studies support the benefits of educating providers on PGx testing, promoting PGx testing as a tool for chronic pain patients, and guiding the provider in medication choices according to the patient's genetic profile. In an article entitled "Pharmacogenetics of Chronic Pain Management," Kapur et al. (2014) described several types of pain occurring in one out of three people in America, contended that decreasing the level of chronic pain improves lives.

Examples of treatment outcomes from PGx articles, ensured the alignment of the educational project and created an understanding of beneficial results in the treatment of chronic pain patients (Fredrikson & Fasolino, 2020). PGx testing offers an individualized patient-centered approach to pain management. Using a person's genetic and drug metabolite profile improves daily functioning and enhances the quality of life through safer prescribing practices using PGx testing, decreasing ADEs (Fredrikson & Fasolino, 2020). Improving institutional knowledge for community clinic providers is the goal of educating the providers on the PGx testing process, resulting in improved pain management by identifying the drugs that are most compatible with individual patients' metabolic rate.

The benefit of educating providers on PGx testing is the pharmacoeconomics of genotyping-based treatment decisions in patients with chronic pain using PGx testing. In a 1-year study of 1,000 chronic pain patients, using PGx testing, the findings were found to have a cost savings of approximately $5,445,812.00. Half of the participants were PGx tested, while the other half were not. The positive results were based on decreased ADE

cost and reduced failed pharmaceutical utilization within the clinical trials (Morlock & Braunstein, 2017).

Significance

This doctoral project's potential contributions to nursing practice (for NPs) at this organization include an improved opportunity for knowledge-based choices regarding pain control in chronic pain patients. Assorted studies support the benefits of educating providers on PGx testing as a tool for the chronic pain patient and guiding the provider in medication choices according to the patient genetic profile. Kapur et al. (2014) described several types of pain occurring in one out of three people in America. Chronic pain examples include acute, arthritic, chronic neuropathic, neuropsychological, nociceptive, phantom, psychosomatic, radiculopathy, and referred pain. Kapur et al. discussed the benefits and results from implementing PGx testing to decrease the level of chronic pain.

Examples of treatment outcomes from PGx articles, offered insight from experts in the field regarding PGx testing process ensuring an alignment of this educational project and create an understanding of beneficial results in treating chronic pain patients (Fredrikson & Fasolino, 2020). The aim of the project was to educate providers regarding PGx testing and what this tool offers in terms of an individualized, patient-centered approach towards pain management. Understanding a person’s genetic and drug metabolite profile and improving daily functioning and quality of life through safer prescribing practices using PGx testing lead to decreased ADEs (Fredrikson & Fasolino, 2020). Improving the institutional knowledge of community clinic providers was the goal of educating the providers on the PGx testing process, resulting in improved pain

management by helping providers to identify the most compatible drugs with the individual patients' metabolic rate.

The benefit of educating providers on PGx testing is implementing pharmacoeconomics—genotyping-based treatment decisions that improve patient outcomes and decrease cost in chronic pain treatment PGx testing (Morlock & Braunstein, 2017). In a 1,000-patient, 1-year chronic pain study, the PGx testing study found to result in a cost savings of approximately $5,44,812.00. Half of the participants were PGx tested, while the other half were not. The positive results were based on decreased ADE cost and reduced failed pharmaceutical utilization within the clinical trials (Morlock & Braunstein, 2017).

Summary

This educational project focused on educating a group of PCPs in the rural Southwest regarding the PGx testing tool in chronic pain management. My focus was on the provider's understanding regarding the benefits of using PGx testing to treat chronic pain patients as a personalized approach. The genotype-based treatment adds a customized approach to pain management while decreasing the "trial and failure" approach to treating chronic pain patients (Haga, 2017). As PGx testing is new to the healthcare field, educating providers will help to decrease medication waste and improve patient satisfaction while improving chronic pain management. In addition, using PGx testing will reduce the risk of adverse drug reactions due to improper drug metabolism while treating chronic pain (Lynch, 2019). The project's focus in nursing practice is the

theory of self-efficacy derived from the insight gained from knowledge through education of new tools to help treat chronic pain patients.

In Section 2, I address the projected outcome of this educational project, which involves educating a group of PCPs to give them a better understanding of why one drug over another would achieve the ultimate goal of adequate pain control. Educating PCPs about the role of metabolic enzymes, genetic polymorphisms, and how enzymes play an essential role in medication metabolism can help them to identify medications that can effectively treat chronic pain and help prevent ADEs (UHF, 2020).

Section 2: Background and Context

The DNP practice-focused questions guiding this evidence-based educational project on PGx testing were as follows:

- What evidence from the literature supports the use of PGx testing in depression and chronic pain treatment in the primary care setting?
- Will there be a change in understanding gained by the providers related to PGx testing, as shown from pretest to posttest results?

The intended setting for this evidence-based educational DNP project on PGx testing was in rural healthcare clinics in the southwestern United States. The participants included approximately 19 PCPs (consisting of MDs, PAs, and NPs from the participating clinics) from rural southwestern clinics that treat patients who suffer from chronic pain and depression. Due to COVID-19 and the need to socially distance, this evidence-based DNP project was done through Zoom, a virtual internet meeting platform, using the MAT program. Monthly presentations were designed for practitioners to obtain relevant educational information through a virtual learning platform (Zoom). Section 2 addresses the relevance of PGx testing, nursing theory concepts, the learning model, and the power to implement new practice changes in chronic pain management in the primary care setting.

Concepts, Models, and Theories

Concept

Since the Human Genome Project findings over three decades ago, PGx testing in the patient care setting has become an integrated part of treatment for mental health,

chronic pain, and other healthcare areas (Ampong, 2019). PGx testing improves treatment outcomes because 60-70% of psychiatric patients have some form of pharmaceutical treatment resistance; looking at the patient's pharmacogenetic aspect individualizes drug treatment according to the patient's metabolism (Ampong, 2019). Frequent treatment resistance has insurance companies taking notice and providing reimbursement for PGx testing when there is a patient history of treatment resistance or adverse reactions to medications, improving treatment and reducing cost related to treatment failure (Kristin et al., 2019).

Model

As mentioned in Section 1, this evidence-based educational project used the ADDIE model, which entails an analysis, design, development, implementation, and stepwise evaluation approach (Quigley, 2019). The project followed the procedural steps of planning, implementing, and evaluating as laid out in Walden University's *Manual for Staff Education.* The ADDIE model offered an effective educational guide in the learning process. The ADDIE model breaks down the learning goal's objectives, allowing the learner to reflect on what they learned, measure the knowledge gained, and implement it into practice (Quigley, 2019).

Theory

According to Albert Bandura (2015) "self-efficacy theory is the foundation of human inspiration, motivation, performance, accomplishments and emotional well-being" (p. 1). Changing one's actions can alter the motivation, cognitive abilities, affect, and decisions in one's life; providers, can evoke change with the power of medical

advancements and the ability to believe that change is possible to benefit the patients to whom they provide care (Web Design & SEO for Academics, 2017). Self-efficacy theory's basis is on improving a person's daily functioning, decreasing pain and symptoms of depression, and managing chronic pain, which is a challenge in the primary care setting, if education regarding new processes can inspire, motivate, and create positive change (Rowbotham, M., & Owen, R. M., 2015). The change will improve a person's daily function performance, creating a higher sense of well-being in treating patients. Educating providers on PGx testing in the primary care setting can positively influence provider's prescribing choices with chronic pain patients, creating therapeutic opportunities in medication management (Mayo Clinic, 2019). Through individualized mediation choices based on a person's cellular metabolism, decreasing "trial and failure" practice improves patient satisfaction and reduce financial strain from medication waste and possible adverse drug reactions.

ADDIE Model

Analysis

The analysis focused on the group to which I presented the PGx testing information, what educational platform I used, and the preferred method of learning in the adult medical profession in the demanding environment of medicine (Elm Learning, 2020). I understood what problem I was trying to change or improve regarding the chronic pain patient in the clinic setting. I have questioned my DNP educational project in terms of the expectations/results that I wanted to achieve (Elm Learning, 2020).

Design/Development

The design was to educate PCPs on PGx testing benefits. My goal was to help empower providers with information regarding the process of individualized patient prescribing practices through understanding a patient's metabolism (Millennium Health, 2020). I gathered scholarly articles on PGx testing and added them to the literature-review matrix, offering validity to the information provided in this DNP educational project. Next, I discussed the project's plan with content experts. Then, I gathered needed supplies and developed an educational PowerPoint, created PGx testing product results samples to disseminate to interested providers, and emailed the participants regarding PGx testing (Appendix K). I developed pretest and posttest surveys for the assessment method and coordinated a time to present the educational project. I obtained permission to present on the virtual platform (Zoom) to the clinic providers regarding PGx testing for the chronic pain patient (Elm Learning, 2020). The intended objective/outcome regarding PGx testing was to create an improved provider understanding of how PGx testing could offer greater patient satisfaction, reduce medication waste, decrease the financial burden from failed medicine trials, and promote positive social change in opioid prescribing practices (Genelex, 2019).

Implementation

My content experts and medical management team permitted me to present my DNP educational project. I sent an email invitation 5 days before the presentation, so interested providers were allowed time in their schedule to attend. With approval from the MAT program facilitator, I gave a scholarly discussion and PowerPoint through the

virtual discussion platform (Zoom), keeping the production within a 20-minute timeframe. I provided a pretest/posttest survey through Survey Monkey regarding PGx testing to the providers and gathered the evidence-based educational project statistical data.

Evaluation

Evaluation was an ongoing process in every stage of the project. The final step in the evaluation process involved the educational project, evaluating the participants through the change in understanding from the pretest answers to the posttest responses on their objectives. I used descriptive statistics to analyze the test findings and understand the project's PGx testing benefits to effectively treat chronic pain patients in future practice. The final step in the doctoral education-based project's process was evaluating the findings and presenting the publication results through Walden University (Walden University, 2019).

Relevance to Nursing Practice

Knowledge creates power; having a tool to effectively treat a patient's pain and improve their level of functioning is motivating for the patient and the practitioner. Self-efficacy is derived from the insight gained from knowledge through education on new tools to help treat the patient and understand why one medication over another will achieve the goal of adequate pain control. Educating practitioners on the value of PGx testing can improve their confidence level, in that they know that the medications are compatible with an individual's cellular composition, which optimizes practitioners' prescribing practices (Tugsbaatar, 2019). Teaching the benefits of using PGx testing as an

integrated tool for treating chronic pain will positively impact the focused patient population. Pain control management through DNA-based metabolic profiles is a new process in the medical profession. After practitioners have been educated on the benefits of PGx testing and how it can provide an individual patient DNA profile regarding medication treatment choices, the PGx results will aid in appropriate pain control and depression management (Genelex, 2019).

Local Background and Context

According to the National Institute on Drug Abuse (2020), In 2018, New Mexico providers wrote 49.4 opioid prescriptions for every one hundred persons compared to the average U.S. rate of 51.4 prescriptions. New Mexico's current population in 2019 was 2,096,829 New Mexico residents; multiple areas are rural without adequate medical care (United States Census Bureau, 2019). Finding treatment centers within reach for pain management can be an unobtainable option in rural New Mexico. Educating providers on the benefits of PGx testing improves the quality of life in a patient who suffers from chronic pain or depression, finding effective medication treatment options in managing pain and depression through individualized patient DNA and metabolic profile.

This project involved delivering an evidence-based educational project to providers regarding the benefits of PGx testing. The educational information focused on the patient's cellular composition and metabolic rate in drug conversion, increasing treatment efficacy and potentially decreasing the current adverse drug-related events from an accidental opioid overdose. The information regarding the testing procedure and process was obtained by Millennium Laboratory, and a local representative from the

company informed me of the testing process. As the DNP student, I presented the PGx testing improvements in pain control and the safety benefits of the PGx testing process regarding chronic pain patients to the clinic providers as a medical treatment tool.

Role of the DNP Student

My role as the DNP student in this project was to learn how to gather peer-reviewed evidence regarding a topic, effectively present the benefits regarding the subject to the learners and deliver the information in a format that the learners would understand to implement a skilled process or improved knowledge-base. As a leader in the profession, my goal was to enhance current nursing practice and knowledge and teach future generations in the nursing profession the beauty and pride of the world of nursing while providing high-quality patient care to communities. As a DNP student, my role was to gather up-to-date information on a topic, coordinate the presentation/project, and organize the findings to deliver to the adult learner.

As the project leader, I contacted a Millennium Laboratory representative and gathered additional information. The plan regarding the PGx testing process for the evidence-based educational project in the clinic setting was to gain an in-depth understanding of the process and establish a suitable timeframe for the educational presentation. Next, I met with the managers/supervisors from the MAT program to propose a suitable timeframe to present my educational project to the providers in the clinic and gain approval of the project's content from medical management. Finally, I had my content experts, the MAT program manager, and the behavioral health manager (Continuing Medical Education certified educator [CME]) observe my project regarding

PGx testing to comply with a DNP educational project. The educational project had pretest and posttest questionnaires to evaluate the change in knowledge about PGx testing regarding treatment in chronic pain management.

Role of the Project

The project's role was to teach the medical practitioners the PGx testing process for finding a person's genotype (AA, AG, and GG) and metabolic profile. The target focus group was health care providers, including- MDs, PAs, and NPs. The project focused on understanding the PGx test results and the benefits of improved chronic pain control through medication management. The clinic providers can apply the PGx test results toward a medicine-based compatibility process, optimizing chronic pain control and reducing depression symptoms through genetic findings (Morlock & Braunstein, 2017). The teaching focus in the PGx evidence-based testing helps PCPs determine which medicine will work effectively in the patient of concern, as determined through the patient's DNA findings. A simple PGx test offers a decreased risk of medication toxicity, adverse reactions, inadequate treatment response, and treatment failure, along with increased provider awareness regarding patient medication compatibility (Genelex, 2019). The goal was to teach providers how PGx testing is a simple, noninvasive test, obtain samples through a cheek swab, and then send the samples to the laboratory to look at the genetic polymorphisms (Richeimer & Lee, 2017). The purpose of educating the providers on the role of the CYP2D6 enzyme and how enzymes play an essential role in medications was to gain the ability to work effectively or prevent an ADE, which is the fourth leading cause of death in the United States (UHF, 2020). The purpose of this

evidence-based DNP project was to plan, implement, and evaluate an educational project on PGx testing for providers in a rural primary care setting. The educational project was developed to reduce the PGx testing knowledge gap and explain this tool's benefit in the clinic setting. According to Trescot and Faynboym (2014), teaching PCPs about the various metabolic pathways involved in the metabolism of drugs is essential in PGx testing for effective chronic pain control, increased patient safety, and decreased waste from failed medication choices (Kristin et al., 2019).

Summary

As mentioned at the beginning of Section 2, knowledge creates power. Teaching providers about PGx testing as a tool to aid in medication choices based on a patient's genetic profile will improve pain management in the chronic pain patient, decrease ADEs, and decrease the cost to the patient from failed drug choices. Section 3 addresses this DNP project's research method, the collection of information, and how the results were analyzed in the educational project regarding PGx testing and the change in knowledge in the focused group of providers.

Section 3: Collection and Analysis of Evidence

There is a lack of PGx testing use in the primary care setting in the southwestern region of the United States. The concern was a gap in knowledge or understanding of the PGx testing process. A wide variety of evidence in the literature supports the benefit of using PGx testing to identify medication-related problems (Schwartz et al., 2017) regarding chronic pain treatment in the primary healthcare setting (Sharma et al., 2017). Introducing this process to a group of PCPs (i.e., MDs, NPs, and PAs) could benefit chronic pain patients who are currently not achieving adequate pain control. With the opioid epidemic concern in New Mexico and throughout the nation, closing the knowledge gap in practice and improving understanding of PGx testing could become a valued tool in chronic pain treatment (National Institute on Drug Abuse, 2020, Fig. 1). The current practice of multiple "trial and failure" in making prescribing choices needs to become the exception instead of the usual practice in chronic pain management (Haga, 2017). The collection and analysis of evidence in this educational project regarding PGx testing focused on a group of PCPs in the southwestern portion of the United States.

- The presentation included a pretest of the providers' current knowledge base on PGx testing.
- The next steps were the educational project information, teaching sample collection, and analysis of the test results.
- After the evidence-based educational project, a posttest evaluated the providers' new knowledge and evaluated their new understanding of PGx testing use for the chronic pain patient's pharmaceutical choices.

The pretests and posttests were submitted, and the test results were analyzed regarding the change in the participating providers' understanding of PGx testing benefits. Educating PCPs on PGx testing empowers providers with information on an individualized approach to a patient's metabolism. PGx testing can potentially create greater patient satisfaction, reduce medication waste, and decrease the financial burden from failed medicine trials, potentially creating a positive social change in opioid prescribing practices (Genelex, 2019).

Practice-Focused Question(s)

The following DNP guided practice-focused question(s) identified a gap in practice, the focus on PGx testing through an educational project: (a) What evidence from the literature supports the use of PGx testing in depression and chronic pain treatment in a primary care setting? (b) Will there be a change in the providers' understanding of PGx testing as shown from pretest to posttest results? The project's desired outcome was to increase the knowledge base regarding PGx testing and the value of PGx results in a group of PCPs in a rural primary care setting. This DNP educational project's practice-focused questions were developed to provide insight into the current knowledge base and measure the providers' knowledge gained post educational project. I applied the ADDIE model and supplied PGx testing information to the learning process. The projected outcome was an increase in the providers' knowledge-base and awareness of PGx testing benefits regarding the chronic pain patient and PGx tools in treatment. This PGx testing educational project aimed to improve the providers' knowledge and understanding

regarding PGx testing; the process resulted in planning, implementing, and evaluating the educational DNP project, gathering the evidence through pretest and posttest results.

Sources of Evidence

This project involved educating providers on the use and benefits of PGx testing (Millennium Health, 2020). Multiple sources of evidence regarding PGx testing were compiled in Walden University's literature review matrix template (Appendix A). I used the Johns Hopkins Nursing Evidence-Based Practice: Non-Research Evidence Appraisal Tool to validate the reliability and validity of the content examined for the project (Appendix E) (Newhouse, 2007). The information was obtained from the Walden University Library and other internet sources using Cumulative Index to Nursing & Allied Health Literature (CINAHL), MEDLINE, academic journals, and peer-reviewed scholarly articles. All information focused on PGx testing within the last 6 years (2014 – 2021), supporting a knowledgeable and well-informed presentation. I offered insight into the testing process and how the test results explain a patient's metabolic pathway, suggesting prescription choices and increasing safety through decreased ADEs. The benefits included supplying education for PCPs while improving chronic pain patients' medication treatment options and potentially reducing the "trial and failure" in medicine in the future (Haga, 2017). The evidence-based project educated the providers on PGx testing (a tool for treatment) in a group of primary care clinics in a virtual educational setting. This project's areas of interest were compiled into themes regarding; Adverse drug-related events, pain, depression, drug metabolism, PGx testing.

Adverse Drug-Related Events

Adverse drug-related events are a constant concern in medicine; an article in the *Pain Reports Journal* found pharmacoeconomics focusing on genotyping-based treatment decisions in patients with chronic pain reduced adverse drug-related events (Morlock & Braunstein, 2017). Examining a budget impact model finding reduced adverse drug-related events was contributed to the implementation of PGx testing in chronic pain patients (Morlock & Braunstein, 2017). In addition, the National Institute on Drug Abuse (NIDA, 2020) has stated that effective pain control in chronic pain patients helps to decrease ADEs.

Chronic Pain and Depression

Chronic pain and depression were the focus of a literature review in the *Journal of the American Association of Nurse Practitioners.* DeFeo et al. (2014) discussed PGx testing and how it can be used as a tool to help improve pharmaceutical choices according to the patient's genetic profile. The provider needs the understanding that chronic pain and depression are often present as a dual diagnosis in the chronic pain patient, as the provider should treat the dual diagnosis to supply effective pain control. In addition, the review highlighted the benefits of optimizing medication management in the chronic pain population, decreasing adverse events, removing the "trial and failure" factor in prescribing practices, increasing patient satisfaction, and optimizing treatment outcomes (DeFeoet al., 2014).

A literature review published in Mental Health Clinician included findings from a 10-year study on PGx testing and the benefits of its use. PGx testing, as a treatment tool

for neuropsychiatric medications in treating depression and chronic pain, is helpful in medication selection (Gross & Daniel, 2018). In PGx testing, the test helps identify medication transporters in a person's system through gene codes to determine which medications are best suited to the individual's genetic makeup (Gross & Daniel, 2018).

Another component of pain and depression is neuroplasticity. Pain and depression are closely correlated between brain regions and the neurological function system. A study by Sheng et al. (2017) showed that chronic pain may lead to depression, causing some opioid-based medications to enhance synaptic plasticity and achieve antidepressant-like therapy through adjustment of neurotransmitter systems.

Drug metabolism involves on how a person's metabolism breaks down and utilizes a drug. Each person metabolizes medication at a different rate. The cytochrome P450 (CYP450) enzyme includes the CYP2D6 enzyme focus of opioid and antidepressant medication breakdown and utilization into the chronic pain patient. There are multiple other enzymes in the system that play a role in drug metabolism. The medications that people take have metabolic pathways; these pathways include CYP1A2, CYP2B6, CYP2D6, CYP2C8, CYP2C9, CYP2C19, CYP3A4, CYP3A5, CYP3A7, CYP2E1, CYP450, COMT (Catechol-O-methyltransferase), OPRK1, OPRM1(m-opioid receptor gene), GABA, UGT, MCH1, ABCB1, P-glycoprotein, 5HTR1A, 5HTR2A, MTHFR, CACNA2D2, and 5-HTTLPR, to make medications effective in the system (Trescot & Faynboym, 2014). CYP2D6 enzyme plays an essential role in allowing drugs to work effectively or causing an ADE (the fourth leading cause of death in the United

States); 80% of patients who had an ADE had poor CYP2D6 metabolizing ability (Genelex, 2019).

Identifying the metabolism rate of a chronic pain patient is a tool in the treatment process. A chronic pain patient may be a slow, normal, or ultra-metabolizer; finding the metabolic rate can help the provider determine which medicine will work best. The PGx information can help decrease the risk of adverse drug-related events, improving patient care (Kirsh et al., 2014). PGx testing can identify the patient who is an ultra-metabolizer of medications, causing a decrease in prescriptions' effectiveness because the person's body metabolizes the drug too quickly (Kirsh et al., 2014).

The benefits of individualizing medicines focus on the patient's DNA profile; for example, a person who is an ultra-metabolizer will have increased metabolic activity due to two copies of the CYP2C19 gene. The two copies of the gene cause the drug to be metabolized too quickly for effectiveness; the finding may change drug choice or how the medication is prescribed (Kirsh et al., 2014). PGx testing examines drug metabolism and responses that affect various factors, including pharmacogenetics, with genetics explaining an individual's response to different drugs (Kapur et al., 2014).

Pain Reports Journal explained how the pharmacoeconomics of genotyping-based treatment helped providers make drug choices for patients with chronic pain. Using the genotyping-based medicine offers control over cost and drug choices, understanding the genetic polymorphisms and analgesic efficacy, improving safety and satisfaction in the chronic pain patient through improved daily living quality (Morlock & Braunstein, 2017). In addition, Lynch (2019) observed that the patient's rate of metabolism affected

the availability of drugs and the effectiveness of controlling pain. Genelex Laboratories (2019) focused on observing the benefits of PGx testing through individualizing medications based on the patient's DNA profile, improving patient outcomes.

Pharmacogenetic PGx Testing

Millennium Health (2020) and Genelex (2019) provide testing and supplies for PGx testing. The focus treatment tool focuses on observing the benefits of PGx testing through individualizing medications based on the patient's DNA profile. Teaching PGx testing is a valued service in the primary care setting to help improve care, decrease adverse events, and increase patient satisfaction (Sharp et al., 2011).

Ever since the Institute of Medicine released "To Err Is Human" back in 1999, the goal has been to decrease errors and protect the population that seeks medical care (Bates & Singh, 2018). Providers, vow to do no harm, yet prescribed medicines may cause unintentional harm due to adverse effects. As a result, medications may fail to provide adequate results; the statement "trial and failure" becomes a reality. PGx testing would improve patient satisfaction and safety due to customizing drug choices based on the patient's genetic profile, resulting in less "trial and failure" regarding a medication not working because of poor metabolizing of an individual (Haga, 2017). In addition, chronic pain can be challenging for providers because they need to find the right balance between drugs and other modalities to treat chronic pain and depression while keeping safety in mind.

Approach or Procedural Steps for Institutional Review Board Approval

The approach was to implement the presentation and use the ADDIE model for analysis, design, development, implementation, and stepwise evaluation (Quigley, 2019). In addition, the project followed the procedural steps of planning, implementing, and evaluating as laid out in Walden University's Manual for Staff. Furthermore, as mentioned in the Walden University manual for staff education, recognizing the need to identify the gaps in knowledge about the adult learner is imperative. Introducing relevant literature in the clinic setting offers a cohesive learning environment for the adult learner (Walden University, 2019).

After IRB approval (IRB # 08-13-21-0645704), I scheduled a meeting with my content experts to set up the virtual PGx testing educational project and PowerPoint time and date (October 20, 2021). In addition, I met with the facility's informational technology (IT) group from the clinic. I provided the PowerPoint virtual information on the PGx testing topic uploaded as a virtual project. Using Survey Monkey, I gathered statistical data on how many clinic providers understood PGx testing pre-education. I found whether any had performed PGx tests in their practice setting. I obtained demographics (Appendix B) and pre-education surveys from the providers (Appendix C). I distributed surveys through a QR code in the email invitation to the providers regarding chronic pain management in their practice setting and the provider's knowledge and use of PGx testing to aid in prescribing medications for chronic pain and depression in the local patient population. The aim was to provide education to the providers in the virtual setting that included an emailed handout of informational pamphlets and other learning

material regarding the PGx testing and evidence-based educational project (Appendix H, Appendix K). Post-project offered a post-survey evaluation through a QR code provided to the providers. Allowing the providers to offer their input about the PGx testing for chronic pain management, asking if the participants had gained knowledge/awareness of the process, names, and identities withheld from the provider's privacy of the participants.

Ethical Considerations

After approval from the IRB, the evidence-based information obtained regarding PGx testing supported and organized using the literature review matrix (Appendix A). The PGx testing information regarding the use and benefits of the testing process was graded with permission (Appendix D) using the John Hopkins nursing evidence appraisal tool (non-research; Appendix E). As the presenter, I consulted the Millennium Laboratory representative and content experts regarding PGx testing to guide this educational project and its content. The two content experts reviewed the PowerPoint and completed a validity assessment on the educational content before the project; then, the PowerPoint was uploaded to the Zoom platform for the day of the project. A letter was emailed to the providers providing informed consent and inviting them to take part in the PGx education, as well as thanking all participants for their time. Five days before the project, the voluntary participants were emailed a demographics questionnaire and the pretest survey with a QR code to access the survey questions through Survey Monkey (Appendix C, J). The information was compiled through Survey Monkey, ensuring the privacy of all participants. A question-and-answer segment followed the PowerPoint to

clarify the PGx testing benefits. At the end of the educational project, the participants accessed the posttest (Appendix C) through the QR code to enter Survey Monkey, allowing providers to evaluate the learning experience. Information such as income, career, address, or disabilities was not needed; any printed information obtained will be kept in a locked file not to leave the clinic for the safety and integrity of the information from the study. Participation from the providers was voluntary; the providers could take part in the process as they felt comfortable and willing.

Analysis and Synthesis

In the first step of the project, emails were sent out to the providers in the clinic through the clinic email inviting fellow providers to take part in the PGx testing educational project and asking for their participation in the demographics, pretest, and posttest for the project. The Survey Monkey platform was used to administer the pretest and posttest surveys, allowing anonymity to the participants (Appendices J, and K; SurveyMonkey, 2020). The PGx project was conducted through a Zoom meeting; next, the providers submitted the demographics, pretest, and posttests into Survey Monkey. The test results analyzed through the Survey Monkey service for the findings and data results of the DNP project. The test findings evaluated the provider's understanding of the project's PGx testing benefits in effectively treating chronic pain patients in future practice.

The PGx educational project pretest and posttest (Appendix C) were in a dichotomous scale and multiple-choice format for simplistic participation regarding the providers, respecting their busy schedules. The pretest and posttest findings were

analyzed using descriptive analysis. Analysis of the results decreased bias, offering insight into the research interpretation (Sutton & Austin, 2015). The content experts in my project inspected the pretest and posttest results to ensure that there were no identifying data and to uphold the project's integrity. Then gathered data from the survey platform were sorted and analyzed using SPSS statistical software. The last step in the doctoral education-based project was evaluating the findings and presenting the publication results through Walden University (Walden University, 2019). Any information obtained will not be discussed for the study's safety and integrity and the participants' data.

Summary

Section 3 has presented the plans for the DNP project, including the gathering and analysis of the evidence for the project by using the literature review matrix as evidence to confirm the learning information for scholarly delivery. The data outcome from the project findings gave an anonymous, unbiased evaluation of the participating providers' learning experience and a look into the future of PGx testing to improve prescribing choices for chronic pain patients. As the project proceeds to Section 4, the project will explore the findings and implications of the future implementation of PGx testing. Understanding the gaps in practice related to PGx testing and promoting the testing process with various insurance constraints will be acknowledged. The goal is to share the strengths and limits of the PGx testing process and the barriers to the provider's ability to use the tool to improve care for chronic pain patients. In Section 4, the findings will

identify limitations and implications regarding the process of this evidence-based educational project.

Section 4: Findings and Recommendations

The gap in practice that prompted this DNP project was the lack of understanding and use of PGx testing in chronic pain patients. Inadequate pain management in the chronic pain patient population inspired this educational project to educate PCPs on the benefits of PGx testing. The DNP practice-focused question(s) guiding the project on PGx testing in the primary care setting focused on educating and gaining an improved understanding of the PGx testing benefits: (a) What evidence from the literature supports the use of PGx testing in depression and chronic pain treatment in a primary care setting? (b) Will there be a change in the practitioners' understanding of PGx testing as shown from pretest to posttest results? After the PGx testing presentation, the project's outcome increased the providers' understanding of the benefits and value of the process. Content experts reviewed the provided plan, educational PowerPoint, and sources of evidence and graded the information provided. The educational PowerPoint renewed interest regarding PGx testing and the value of PGx testing from pretest to posttest results/findings in the group of PCPs in primary care. Participation was voluntary on the online platform, supplying anonymity for participants. Using the Survey Monkey platform, this project applied descriptive statistics to analyze the pretest/posttest findings. The gathered data were sorted and analyzed using SPSS statistical software (SurveyMonkey, 2020). In Section 4, I examine the educational project findings and explore suggestions and implications of the educational virtual PowerPoint on PGx testing in chronic pain patients.

Findings and Implications

The two content experts involved in this project were the behavioral health manager/supervisor and the MAT NP manager/associate medical director of the ECHO care project. The two content experts determined whether the educational objectives were met or not met (Table 1) and completed the validity assessment form (Appendix F). The content experts evaluated the pretest and posttests for the relevance of the content in relation to the outcome of the project (Table 2) using the provided content experts' evaluation staff education project form (Appendix G). The project's desired outcome was to increase the knowledge of PGx testing and the benefits of the lab test findings for chronic pain patients in the primary care setting.

Content Experts' Evaluation of Curriculum Objectives

Table 1 shows the content experts' evaluation of the objectives of the content and whether the goals were met or not met. In the findings from the content experts' evaluation of the curriculum objectives, they both scored the educational objectives as "met"

Table 1

Content Experts' Evaluation of the Curriculum Objectives

Objective statement	Content Expert 1	Content Expert 2
Participants will be able to describe uses for PGx testing in the primary care setting	Met	Met
Participants will gain understanding of how PGx testing can be a tool in adverse drug-related events	Met	Met
Participants will gain understanding the benefit of PGx testing as a personalized medicine	Met	Met
Participants be able to identify at least two positive attributes in the use of PGx testing in the chronic pain patient	Met	Met
Participants will gain understanding of how PGx testing can identify potential drug antagonists	Met	Met
Participants will learn that PGx testing is a simple, noninvasive test process	Met	Met

Pharmacogenetic Testing Pretest/Posttest Questionnaire:

Content Experts' Validity Assessment

The content experts assessed the curriculum objectives (Appendix G); they examined the questions and their validity and whether the presentation met the expectations of the educational goals. In Table 2, the scoring was determined by met or not met; in Table 3, the scoring was measured as 1= *not relevant*, 2 = *somewhat relevant*,

3 = *relevant*, and 4 = *very relevant*. The results displayed in the tables with the lowest score at 10 and the highest at 40.

Table 2

Pharmacogenetic Testing Pretest/Posttest Questionnaire Results

Objective statement	Content Expert 1	Content Expert 2
1. How can pharmacogenetic (PGx) testing be helpful in the primary care setting?	4	4
2. Does a patient's metabolic rate (slow metabolizer, normal metabolizer, or ultra-metabolizer) affect medication prescribing choices, duration, or dosage when deciding prescriptions in current prescribing practice?	4	4
3. Does PGx testing help identify a person's genotype (AA, AG, and GG) and metabolic profile pathways playing an essential role in medications' ability to work effectively or drugs' bioavailability in the chronic pain patient?	4	4
4. Will PGx testing identify potential risks of adverse drug events or potential drugs competing for binding sites?	4	4
5. When counseling a patient about their pharmacogenetic (PGx) test results, the following statement is most acceptable to use:	3	4
6. Does pharmacogenetic (PGx) testing encompass pharmacoeconomics regarding a patients' medication cost savings?	3	4
7. Pharmacogenetic (PGx) testing can help improve pharmacotherapy by identifying patients:	4	4
8. What are the four main Pharmacokenetic process steps?	4	4
9. After learning the benefits of pharmacogenetic (PGx) testing as an individualized approach towards treating chronic pain patients, would you use this tool in your patient care?	3	4
10. What is the purpose of using pharmacogenetic (PGx) testing?	4	4
M	3.7	4.0

1 = not relevant; 2 = somewhat relevant; 3 = relevant; 4 = very relevant.

The educational topic, PGx testing, was evaluated and met both content experts' expectations regarding approach and educational content, scoring thirty-seven points from Content Expert 1and 40 points from Content Expert 2. The pretest and posttest questions validity assessment evaluation and scoring resulted in 3 *relevant* and 4 *very relevant* regarding each content expert's opinions. According to the content experts' and providers' feedback, the PowerPoint was informative and sparked interest in the PGx testing, meeting the objectives of the educational goals.

Data Questions and Findings from Survey Monkey Questionnaire: Demographics

Figures 1-5 represents participants' responses regarding age, gender, ethnicity, years in practice, and formal education before the PGx testing educational project. Figure 1 shows data for the question concerning the age group of the participants, indicating that the majority were in the 36–65 age group. Figure 2 indicates that 55.56% of the participants were female and 44.44% were male. Figure 3 shows data for ethnicity, indicating that 66.67% were Caucasian, 22.22% were Hispanic/Latino, 5.56% were Black/African, 5.56% were Asian, and 0% Native American, and 0% Others. Figure 4, depicting data on number of years in practice indicated that 38.89% selected 0–5 years, 22.22% selected 21 years or more, 16.67% selected 16 – 20 years, 11.11% selected 6 – 11 years, and 11.11% selected 11 – 15 years. Figure 5, showing data for participants' formal educational pathway indicates that 38.89% chose NP, 27.78% chose PA, 22.22% chose MD, 0.0% chose Doctor of osteopathy and 0.0% indicated Other The findings show that the most significant majority were mid-level providers.

Figure 1

Demographics—Age

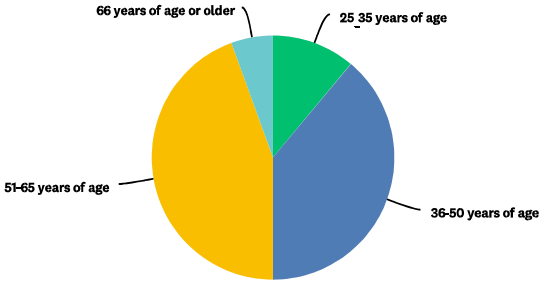


Figure 2

Demographics—Gender

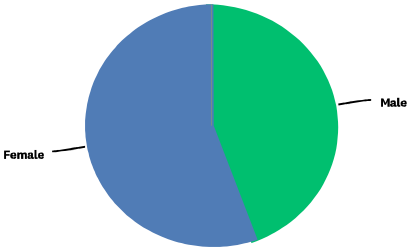


Figure 3

Demographics—Ethnicity

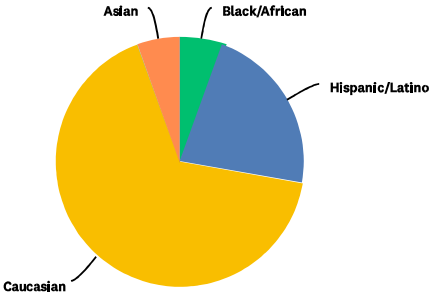


Figure 4

Demographics—Years in Practice

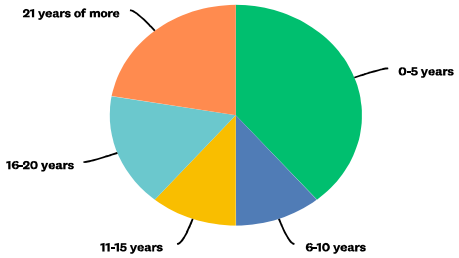
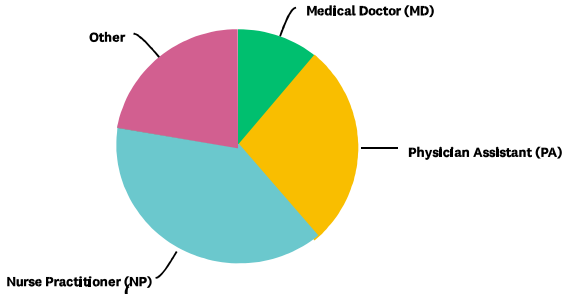


Figure 5

Demographics—Formal Educational Pathway



Pharmacogenetic Testing Pretest/Posttest Questionnaire

For the project's outcome findings, as shown in the PGx testing pretest/posttest questionnaire results (Table 3) indicate an increased understanding and knowledge base regarding PGx testing and the value of PGx results/findings in the group of participating PCPs. As previously mentioned, this project applied descriptive statistics to analyze the pretest and posttest findings using the Survey Monkey platform, and the gathered data were sorted and analyzed using SPSS statistical software (SurveyMonkey, 2020). At the beginning of the PGx testing project, there were nineteen participants; at the end of the

study, only twelve participants completed the posttest. Although a small group remained for the survey, the answers showed an improved understanding of PGx testing benefits. The pretest and posttest result findings from the educational project show improved knowledge regarding PGx testing as a tool for chronic pain patients. The providers showed an overall increased interest in using the PGx testing from the pretest to the posttest, reporting an increase of 21.20 % interest in the testing process (see Figure 6).

Providing improved pain control through individualized medicine according to a patient's genetic profile could offer positive outcomes through improved chronic pain management and decreased adverse drug-related events (Trescot & Faynboym, 2014). Improving how providers prescribe opioids based on the patient's metabolic rate positively influences how medicine is prescribed and reduces potential risk; an improved knowledge was shown in the data for Question 3, which offers an increased understanding of PGx testing, measuring 52.63%. The data for Question 4 shows a 21.05% positive change in knowledge, suggesting that the PGx testing tool helps increase prescribing confidence for providers and reduces "trial and failure" approach to prescribing practices, decreasing medication waste due to failed medication results (Haga, 2017). As the constant concern for opioid safety impacts communities, providing a tool to help improve patient safety is a positive social change in prescribing practices and creating informed providers.

Table 3

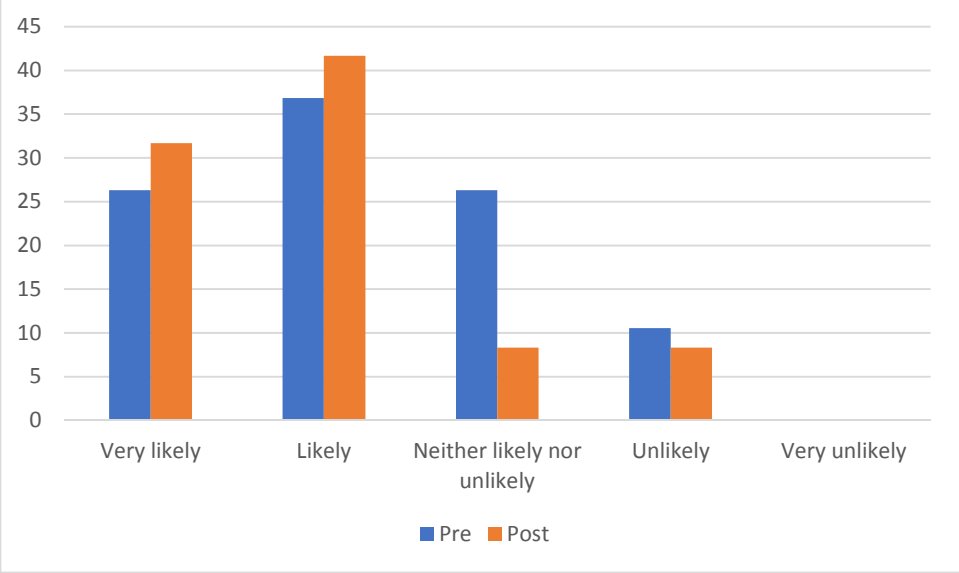
Pharmacogenetic Testing Pretest/Posttest Questionnaire Results

	pre		post		% change
Item number	n	%	n	%	
1	18	94.74	12	100.00	5.26
2	11	57.89	11	91.67	33.78
3	9	47.37	12	100.00	52.63
4	15	78.95	12	100.00	21.05
5	10	52.63	12	100.00	47.37
6	11	57.89	10	83.33	25.44
7	19	100	12	100.00	0.00
8	18	94.74	12	100.00	5.26
10	19	100	12	100.00	0.00
M		76.02		97.22	21.20

Note. Item 9 not included.

Figure 6

Pre and Post Rating of Likelihood of Using PGx Testing Tool



Result Findings Item 9

Before the presentation, the participants reported likelihood of using PGx testing as an individualized approach to treating chronic pain patients as very likely (26.32%), likely (36.84%), neither likely or unlikely (26.32%), unlikely (10.53%), and very unlikely (0.0%). Following the presentation, they reported that they were very likely (41.67 %), likely (41.67%), neither likely or unlikely (8.33%), unlikely (8.33%), and very unlikely (0.0%) to use the testing. The percentage of participants who were likely or very likely to use the PGx testing following the education increased by 20.18%.showing a positive change in interest regarding PGx testing as a tool in chronic pain management.

Implications

Frequency assessments were conducted regarding the demographic variables before the presentation from the Survey Monkey platform. There were nineteen participants at the beginning of the project; the demographics included age, gender, ethnicity, years in practice, and formal educational pathway as a provider (Appendix B). At the end of the presentation, there were twelve volunteer participants due to time constraints or personal preference in participation in the testing process; six participants did not submit the posttest questionnaire (with no reason given). Demographics, pretest, and posttest information was collected and analyzed through Survey Monkey; each section was separate for comparison. Due to the small group size, there was limited data comparison regarding future content evaluation. Question assessment was available through Survey Monkey regarding the project's demographics and PGx pretest/posttest

questionnaires, creating participant privacy. The Survey Monkey platform provided the PGx project's data process and SPSS statistical software findings.

Recommendations

In this educational presentation regarding PGx testing, the providers identified the value of PGx testing to help decrease trial and failure in medication choices and create an informed understanding of the patient's metabolism (Haga, 2017). PGx testing was considered and implemented a few years ago in the clinic but had limited support due to a lack of understanding of the benefits. Additionally, the medical management team declined to continue the concept years ago due to a lack of insurance reimbursement and the client base's limited financial resources to pay out of pocket for testing. After the educational presentation regarding PGx testing, there was a renewed interest in reintroducing the idea of individualized medicine to the medical management team and the providers. The clinic's implementation of PGx testing will require medical management to reach out to various insurance plans and determine which programs will cover this cost-saving concept due to the concern that many of the patients are of limited income (Genelex, 2019). Providing healthcare in rural America has challenges and limitations; implementing PGx testing as a tool can help create cost savings through decreased trial and failure in medication choices. The focus towards positive change in healthcare is excellent patient care. The focus is to provide positive change through effective pain control, improving patient safety by reducing ADEs.

Contribution of the Doctoral Content Experts

My content experts were a positive aspect in the support and guidance of this PGx educational project. Their advanced knowledge helped ensure the academic project content was relevant to the patient population and provided insight from past use of the content. The behavioral health manager/supervisor offered guidance throughout my project, using Survey Monkey and how the platform provides real-time data. The NP from MAT, manager/ associate medical director of the ECHO care project, with over 30 years of provider experience and caring for patients afflicted with chronic pain and the issues of treating the condition, offered additional guidance in my project. Their professional skills and former knowledge have helped this project become a renewed interest as a tool to help care for our most vulnerable patients. The behavioral health manager strongly influenced my progression and implementation of the project, helping to block time for medical management to attend the educational project and complete the survey questionnaires. The information gave valuable insight into the benefits of PGx testing for the patients and providers. The information generated a renewed interest in the PGx testing process and the future ability to obtain this tool in the primary care setting.

The limitations in this educational project were the small sample size; eighteen participants at the start of the project; only twelve participants remained to complete the questionnaire by the post-test. Another limitation was the time constraint for the project and the need for social distance due to the current pandemic. The pandemic left the virtual setting as the preferred platform for presenting education and discussion. There

was positive feedback and renewed interest in using PGx testing and adapting the process in the chronic pain patient.

Strengths and Limitations of the Project

The strengths of this project are the continued support of the content experts and medical staff and the renewed interest in PGx testing. After the project, the medical director voiced his approval and renewed interest in the future use of PGx testing for the clinic. After the project, there were additional questions and interest in the PGx testing from the providers. The providers show interest in using PGx testing in many complex patients to improve pain control. The PGx testing information has positive attributes towards improving patient outcomes through individualized medicine.

The limitations of this project are the small sample size of twelve providers completing the posttest. Another weakness in the project was the decreased ability to have face-to-face access with content experts due to the COVID pandemic in our planning and discussions. The COVID pandemic has created remote access towards trial, treatment, and educating chronic pain patients and providers as the preferred method of patient care for the community's safety. Through my project, the laboratory I have consulted with provided me with a wealth of information but has informed me that they have discontinued offering the PGx testing because of reimbursement difficulties. This situation makes the concept difficult to introduce in a clinic that primarily provides care to low-income or no-income individuals; the concern created the need to reach out to a new laboratory for PGx testing.

The guidance from each discipline ensured the project validity and legitimacy of the content and learning objectives of the educational project. The demographics, pretest, and posttest distribution were delivered through Survey Monkey, providing confidentiality of the testing process, compiling the answers, and providing data of the findings through SPSS. The evaluations were emailed to each content expert to evaluate the project. Then the content experts were present to evaluate the PGx testing educational project, measuring the content's strengths and limitations; whether the project provided pertinent information to the audience, their evaluations were sent to the presenter to review the findings.

Summary

The purpose of this educational project on PGx testing of the chronic pain patient aimed to educate a group of providers on the understanding and benefits of PGx testing in the primary care setting (Millennium Health, 2020). The resulting outcome findings from this educational project showed positive results through a pretest and posttest analysis, finding an improved knowledge and renewed interest regarding PGx testing as a tool in treating the chronic pain patient from pre-test to post-test. Due to the current COVID-19 pandemic, the PGx testing educational platform was implemented through the virtual setting. The analysis of evaluating the PGx testing project showed improved knowledge and understanding of the benefits. The methodology used was descriptive statistics through Survey Monkey, providing percentages of the answers given, data sets, providing visual PIE charts for each question results (Appendix: J). The data was sent through SPSS to gather one-sample *t-tests* for the questions comparing the pre and post-test

responses and knowledge. Section 5 will focus on the self-analysis and the future dissemination plan of PGx testing as a tool in the primary care setting.

Section 5: Dissemination Plan

The medical management team and providers have renewed interest in PGx testing and improving care in chronic pain patients. Currently, the medical management team will consider bringing this concept to all the clinics within the organization when time and financial support allow; now, the pandemic is the priority in the healthcare settings. The COVID pandemic has created the need to focus on controlling the spread of the virus and treating affected patients; the plan to implement PGx testing is a future idea. Until I have permission from the medical management team to disseminate the PGx testing throughout the clinics, I will work independently to implement PGx testing on chronic pain patients I currently treat. For some of my patients, struggling with infective pain management is a constant concern; improving outcomes is a positive change that I strive for as a provider. As I implement PGx testing, I will enhance my understanding of the process, become more familiar with and confident in the findings, and navigate the process through health insurance and available laboratories. In this way, I will serve as a resource person to whom fellow providers can reach out for answers. Patients struggling with infective pain management are a constant concern; improving outcomes is a positive change in medicine.

As I have gained valuable knowledge of PGx testing as a tool in treatment, disseminating the findings regarding its benefits toward patient safety and satisfaction is my goal. My first opportunity to share my knowledge has come from the ECHO project, which has invited me to present my work through the Opioid Use Disorder (OUD) ECHO project through the University of New Mexico to present the PGx testing process. The

next goal is to publish my findings in ProQuest. I also desire to post in the American Society of Addiction Medicine (ASAM) and *The Journal for Nurse Practitioners* (JNP).

The struggles of balancing multiple medicines to help a person overcome substance use disorder often bring additional overlooked medical concerns; PGx testing is a beneficial tool in medication choices (ASAM, 2021). Finding the medication that works best for a patient can be a challenge, and PGx testing can be a valuable tool in treatment. As an NP, I am proud and passionate about my love of healing and caring for my community. I would be excited to publish my knowledge in multiple venues because PGx testing is a future tool for medicine that is available now.

Analysis of Self

As an NP, I want to provide high-quality care; I always strive to be the best in my field and a resource to others. I was a cosmetologist for 20 years and loved making people feel good outside. So, when I became a nurse, I focused on healing the whole person - mind, body, and soul. I mention my past career because, with patience, determination, and the ability to believe in oneself, anything is possible, as my educational journey proves. As I precept future NPs, it is rewarding to offer my knowledge to prospective providers.

This PGx testing concept has allowed me to develop an idea into an educational preoject and share my knowledge with others. From the beginning, with an idea, gathering the scholarly information, and fact-checking the information are essential parts of the educational experience. As the project developed, it was my duty as a leader to put the data into a format that interested the viewer. After the university's approval, next was

the need to coordinate with the clinic's medical team and IT to schedule a date to implement the educational PowerPoint. The invitation was emailed 5 days before the PGx testing project, including QR codes for the PowerPoint data collection to the providers to respond to the questionnaires. On the project day, I received positive feedback and valuable data to measure the findings, which showed a positive response for the future of this PGx testing implementation. I gained valuable leadership skills through this process and will take this learning experience into my future roles.

Since the project, I have taken a lead role in my clinic, advancing my leadership duties to the regional assistant medical manager in my organization; this advancement allows me to understand corporation responsibilities on the business level. When I graduate with my Doctor of Nursing Practice degree, my focus will be to give back to the profession and teach future nurses while providing high-quality healthcare to the communities I serve. I am proud to be a Walden graduate and tell nurses to continue their education because we need more providers to care for rural America. The challenge of this project was daunting, teaching me patience and learning how to write in a literary form. Understanding the time and skill it takes to create an educational project was a challenge, but the pride from the responses was worth the frustration from my impulsive mind. I have seen the change in my writing skills and how I read a scholarly article thoroughly instead of skimming through the data. This DNP journey has made me proud to be an NP; I hope to create a noticeable presence for the future of nursing.

Summary

Walden University strives for its students to create positive social change. Through the school's teachings and focus, I create positive changes in my community and help to improve the health of those who seek medical care. This doctoral project has taught me to understand the theory in nursing practice and how we can invoke change through education. As nurses, we give so that others can give back. Bringing people back to optimal health helps those around them; when we care for one, we help many. Caring is the pride of the nursing field.

Chronic pain is a debilitating disease; finding effective treatment options with a safety focus is a personal goal. Since becoming an NP, I have seen in rural America that I am the first person to treat chronic pain patients, and in some remote areas, I am the only person to help treat discomfort. PGx testing is a future tool that I want to incorporate in my clinic setting to provide a safe and effective plan to treat chronic pain patients. For now, I will continue to teach future NPs and provide high-quality care with the pride that Walden University has instilled in me.

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Appendix A: Literature Review Matrix

Author/ Date	Theoretical/ Conceptual Framework	Research Question(s)/ Hypotheses	Methodology	Analysis & Results	Conclusions	Implications for Future research	Implications For practice
Carvalho, A. S., Martins Pereira, S., Jácomo, A., Magalhães, S., Araújo, J., Hernández-Marrero, P., Costa Gomes, C., & Schatman, M E. (2018).	Ethical decision making in pain management : a conceptual framework	To establish the bioethics can serve as a framework addressing challenges and issues regarding pain, from theoretical to practical approaches, bioethical analysis can context-ualize the problem regarding uncontrolled pain	Pain management and its under-treated are ethical issues	An ethical framework in pain management will result in improved quality of life	Developing an ethical framework for pain management will result in enhanced quality of care, linking the epistemic domains of pain management to their anthropological foundations, thereby making them ethically sound	Ethical obligations in the management of pain	Regulatory restrictions regarding opioid treatment in the management of pain
Dahlhamer, J., Lucas, J., Zelaya, C., Nahin, R., Mackey, S., DeBar, L., Kerns, R., Von Korff, M., Porter, L., Helmick, C. (2018).	Identifying increased prevalence of pain regarding different populations	What are the implications of chronic pain?	Cross-sectional study	Socio-economic status created a higher prevalence in the level of chronic pain	Chronic pain is a growing health concern	Socio-economic disadvantages regarding the chronic pain population	Health coverage for the concerned population
DeFeo, K., Sykora, K., Eley, S., & Vincent, D. (2014).	Examining the difficulty regarding managing the chronic pain patient adequately	Does PGx testing hold value in treating chronic pain patients?	Literature review	PGx testing improves disease risk and drug response through genetic profiling	PGx testing removes the "trial and error" out of medicine prescribing	Drug-drug and drug-patient interactions	The practitioner knowledge in the genetic determinants and the patient response
Kapur, B. M., Lala, P. K., & Shaw, L. V. (2014)	Evaluation of pain, pharmacogentic, enzymes, and drug properties	Does PGx testing benefit use in the chronic pain patient?	Literature obtained and examined between 2000 to 2013 using National Library of Medicine	Drug half-life calculations markers can have a positive outcome in prescribing practices	Drug metabolism and responses are affected by many factors, including pharmacogenetics, with genetics	Many factors can affect the drug, with genetics offering only a partial explanation of an individual's response	PGx testing is a functional marker looking at cumulative effect of drug–drug interactions and pathophys-iological interactions

			database, PubMed		offering only a partial explanation of an individual's response		could affect the treatment medicine effectiveness
Kirsh, K. L., Ehlenberger, E., Huskey, A., Strickland, J., Egan City, K., & Passik, S. D. (2014)	Personalized medicine	Is there a need for personalized medicine in the chronic pain population?	Retro-spective analysis	Abnormal metabolizers were found in expert-level pain clinic patients; finding the PGx testing should be on the "radar screen" regarding expert-level pain practitioners	Further studies needed	There is the need for prospective study and larger sample size to	Cost verses potential benefits
Levy, K.D., Wu, R.R., Goto, D. *et al*. (2020)	How genomic variations influence drug response	Why is there lack of adoption of PGx testing into clinical practice setting, is it due to a lack of evidence of clinical effectiveness or limited reimbursement	Online survey of funded and non-funded, Data from the online surveys was consolidated and analyzed with results being tabulated for key findings	Due to limited sample size, statistical analysis was forgone, results should be considered directional in nature.	Encouragement regarding adopting and reimbursement in PGx testing will require development of national PGx testing registry to develop strong and large databases of clinical evidence, a focus on standards in PGx testing and reporting, and the expansion of cost-effectiveness analysis studies to build partnerships with payers	PGx testing is considered investi-gational and not eligible for coverage from many insurance companies	Barriers identified were a lack of provider education and knowledge regarding genomic testing, how to incorporate results into current therapy regimens
Lynch, S. S. (2019)	Genetics and metabolism	What does the drug do to the body?	Informational article	Variations in individual metabolism	Depending on rate of metabolism affects availability of drug	Not a research article	Individualized need
MayoClinic .org (2019)	How genes affect drug metabolism	How does genetics predict the drug profile through pharmacogenomics?	Research studies, clinical studies	Informa-tional article	PGx testing can improve drug therapies effectiveness and prevent adverse drug events	PGx tests are not available for all drugs	Test can only focus on one type of drug

Millen-nium Health (2020)	Gene variants	What informational support does the lab offer?	Informational site	Offers analysis of 14 gene genetic variants	Informational site	Future cost and insurance re-imbursement	Cost and lack of insurance coverage
Morlock, R., & Braunstein, G. D. (2017).	Genetic testing cost /benefits	What is the estimated financial impact from PGx testing implementation?	Sensitivity analysis	Decreased medical and pharmaceutical costs with the use of PGx testing in the chronic pain patients	The cost from genotyping-based treatment is off-set from the decreased failed drug trials and potential adverse drug events	Insurance re-imbursement	Insurance approval for re-imbursement
National Institute on Drug Abuse. (NIDA) (2020)	Opioid-involved deaths and adverse drug events (ADE)	What is the current ADE's in the U.S.?	Informational stats	In 2018 there were 67,367 drug overdose deaths, a 4.1% decrease from 2017	The decrease in opioid prescriptions was the findings	Controlling the opioid epidemic	Adequate pain control in the chronic pain patient
Owen, G. T., Bruel, B. M., Schade, C. M., Eckmann, M. S., Hustak, E. C., & Engle, M. P. (2018).	Chronic pain and opioid therapy in the primary care setting	What role will pain medicine specialist play in management of chronic pain patients?	Journal article review	The article finds general guidelines provided from the Centers for Disease Control and Prevention focusing on the appropriate utilization of opioids, through risk stratification, and patient monitoring	The article concludes that pain medicine specialist plays a vital role in the management of patients who suffer with chronic pain	Not applicable	Generalizeguidelines
Quigley, E. (2019)	A.D.D.I.E. model	What is the ADDIE model?	Instructional design method	Analysis, Design, Development, Implementation, and Evaluation	Educational tool and methodology	Instructional article	Not applicable
Richeimer, S. T., & Lee, J. J. (2017)	The potential promises in genetic testing regarding pain management	How can genetic testing help in identifying the best medicine to help control pain as an individualized approach?	Meta-analysis	Higher intensity of the pain, higher self-reporting pain, lead to longer recovery in patients with low back pain	Decreasing severe pain was associated with improved outcomes	The benefits of personalized are in the beginning stages	Effective pain management improves quality of patient lives

Schwartz, E. J., Turgeon, J., Patel, J., Patel, P., Shah, H., Issa, A. M., Knowlton, O. V., Knowlton, C. H., & Bain, K. T. (2017)	Increasing pharmacist led MTM (medication therapy management) services in the primary care setting	What were the benefits of implementing pharmacist-led MTM (medication therapy manage-ment) services in the primary care setting?	Systematic review	Pharmacogenetic testing (PGx Testing) identified additional medication related issues that would otherwise not have been identified	Personalized medicine decreased cost, improved safety, and patient satisfaction	Increasing the availability of MTM (medication therapy management) services in the primary care setting	A tool to help improve patient care in the primary care setting through PGx testing, creating personalized medicine
Sharma, M., Kantorovich, S., Lee, C., Anand, N., Blanchard, J., Fung, E. T., Meshkin, B., Brenton, A., & Richeimer, S. (2017)	Observational study on the benefits of pharmacogenetic testing in the chronic pain patient	What is the impact of using personalized medicine in the chronic pain patient and improved pain control?	Prospective, longitudinal study	PGx testing is an important part of integrating personalized medicine into practice	Improved pain control using pharmacogenetic testing as a tool for the chronic pain patient	Further research is needed to evaluate health economics impact of using genetic testing to objectively assess components of pain perception	Patent-protected tests, practicality and cost could affect availability and use in the primary care setting
Sharp, R., Goldlust, M. & Eng, C. (2011)	Addressing the gaps in knowledge	What are the gaps in knowledge for providers in implementing genetic testing?	Exploratory study	Practitioners were able to give improvement in treatment advisement with the use os PGx testing	A change in clinical practice when using the findings from genetic testing (PGx) results as an educational tool	Incorporating genetics education into the practitioners training as a tool in patient care	Increasing practitioners' awareness and knowledge regarding PGx testing
Sheng, J., Liu, S., Wang, Y., Cui, R., & Zhang, X. (2017)	Link between depression and chronic pain: neural mechanisms in the brain	What is the correlation between chronic pain and depression?	Multicenter, double-blind, and randomized clinical	Some opioid-based medications may enhance the synaptic plasticity achieving an antidepressant like therapy through adjustment of neurotransmitter systems	Pain and depression are closely correlated from both perspectives of brain regions and the neurological function system, concluding findings, chronic pain may lead to depression	Neuro-plasticity changes regarding pain and depression need further investigation with drug treatment choices	Understanding depression and pain may both need to be addressed in the chronic pain patient
Trescot, A. M., and Faynboym, S. (2014)	The article discusses the genetic influence of nociception, analgesia, and hypo-analgesia	What is the relationship between genetic predisposition and clinical behavior?	Allele-based association studies	Integrating pharmacogentic (PGx) testing in clinical studies will increase the identifying clinical and genetic	Adverse drug events and improved drug treatment may be correlated through the use of PGx	In future, pharmacogenetic (PGx) testing may be to preferred treatment to predict which drug choice may	Personalized medicine (PGx testing), has the potential to change current practice and improve the use and efficacy of current and future pain

				concerns that will be used to predict opioid responses in the personalized patient's genetic profile	testing in patient care	be most appropriate for the patient, providing therapy that has the highest sustained efficacy, and the most reliable adverse effect profile	management treatment options
Wilson, N., Kariisa, M., Seth, P., Smith, H. IV, & Davis, N. L., (2020)	The focus on overdose deaths	What are the current overdose death statistics?	The National Vital Statistics System	There was a 2% decrease in overall opioid deaths between 2017 to 2018	Following the CDC guidelines in opioid prescribing practices, increased distribution of naloxone to the "at risk population" to help reduce overdose related deaths, track emerging threats regarding illicit drug supply, with multisectoral surveillance, prevention, and response regarding overdose deaths	The article found there to be misclassifications regarding of cause of death due to multiple opioid-based drugs metabolizing to morphine causing under reporting of heroin deaths, variation of postmortem toxicology tests, variations in race causing misclassification, and inadequate drug specificity data due to limited state-based analysis in thirty-eight states	Increased Fentanyl-based illegal drugs entering the "at-risk communities"

Appendix B: Demographics

1. What is your current age?
    a. 25-35 years of age
    b. 36-50 years of age
    c. 51-65 years of age
    d. 66 years of age or older

2. What is your gender?
    a. Male
    b. Female
    c. Prefer not to answer

3. What ethnicity do you identify with (Select all that apply)?
    a. Black/African
    b. Hispanic/Latino
    c. Caucasian
    d. Native American
    e. Asian
    f. Prefer not to answer

4. How many years in practice have you provided patient care in the Primary Care setting?

a. 0-5 years

b. 6-10 years

c. 11-15 years

d. 16-20 years

e. 21 years of more

5. What is your formal educational pathway as a Provider?

a. Medical Doctor (MD)

b. Doctor of Osteopathy (OD)

c. Physician Assistant (PA)

d. Nurse Practitioner (NP)

e. Pharmacist (RPh)

f. Psychologist (Psy.D.)

g. Other

Appendix C: Pharmacogenetic Testing Pretest/Posttest Questionnaire with Answer Key

1. How can Pharmacogenetic (PGx) testing be helpful in the primary care setting?

A) The drug variation of a person regarding medication changes

B) Identifying an individual's genetic variation regarding metabolic response to medications

C) Finding the drug response from the foods eaten

D) Teaching how medications help treat different disease processes

Answer: B

2. Does a patient's metabolic rate (slow metabolizer, normal metabolizer, or ultra-metabolizer) affect medication prescribing choices, duration, or dosage when deciding prescriptions in current prescribing practice?

A) Yes

B) NO

C) Not sure

Answer: A

3. Does PGx testing help identify a person's genotype (AA, AG, and GG) and metabolic profile pathways playing an essential role in medications' ability to work effectively or drug's bioavailability in the chronic pain patient?

A) Yes

B) No

C) Not sure

Answer: A

4. Will PGx testing identify potential risks of adverse drug events or potential drugs competing for binding sites?

A) Yes

B) No

C) Not sure

Answer: A

5. When counseling a patient about their pharmacogenetic (PGx) test results the following statement is most acceptable to use:

A) Your DNA is mutated

B) Your DNA is abnormal

C) You have a genetic variation or polymorphism

D) Both A and C

Answer: C

6. Does pharmacogenetic (PGx) testing encompass pharmacoeconomics regarding a patient medication cost savings?

A) True

B) False

Answer: A

7. Pharmacogenetic (PGx) testing can help improve pharmacotherapy by identifying patients:

A) At an increased risk of having no response when prescribed conventional drug therapy

B) At an increased risk of experiencing drug-induced toxicities when prescribed conventional drug therapy

C) Both A and B

D) None of the above

Answer: C

8. What are the four main Pharmacokenetic process steps?

A) Absorption, dissemination, mechanism, excretion

B) Adaptation, distribution, medical, exclusion

C) Absorption, distribution, metabolism, excretion

D) Alignment, digestion, muscle, execution

Answer: C

9. After learning the benefits of pharmacogenetic (PGx) testing as an individualized approach towards treating chronic pain patient, would you use this tool in your patient care?

A) Very likely

B) Likely

C) Neither nor unlikely

D) Unlikely

E) Very unlikely

Answer: A

10. What is the purpose of using Pharmacogeneting (PGx) testing?

A) To evaluate and identify a patient's sex, race, and age

B) To find additional uses of a medication regarding off-label uses

C) To evaluate and identify a patient's potential response to a medication's therapy

D) To evaluate the heritage of where the patient originated from

Answer: C

11. Post-test Additional Comments or questions:

Appendix D: Johns Hopkins Email Permission Letter

Laura Robinson

Tue 2/9/2021 8:52 PM

To: Mary Rosenberger <Mrosen55@jhu.edu>

Cc: Miki Goodwin <mgoodw14@jhu.edu>

Thank you for the information.

Mary Rosenberger <Mrosen55@jhu.edu>

Tue 2/9/2021 8:07 AM

To: Laura Robinson

Cc: Miki Goodwin <mgoodw14@jhu.edu>

Dear Ms. Robinson:

Please see the response back from the Dean for Clinical Placements at the Johns Hopkins School of Nursing.

Thank you

Mary

From: Miki Goodwin

Sent: Tuesday, February 9, 2021, 9:47 AM

To: Mary Rosenberger <mrosen55@jhu.edu>

Subject: RE: Permission to use

This is publicly published and if correctly cited should be used unless there is a comment to contact the author.

From: Mary Rosenberger <mrosen55@jhu.edu>

Sent: Tuesday, February 9, 2021 9:18 AM

To: Miki Goodwin <mgoodw14@jhu.edu>

Subject: FW: Permission to use

Miki,

Who would this go to?

Thank you

Mary

From: Laura Robinson <laura.robinson2@waldenu.edu>

Sent: Monday, February 8, 2021 8:51 PM

To: Mary Rosenberger <mrosen55@jhu.edu>

Subject: Permission to use

External Email - Use Caution

To whom it may concern,

Hello, my name is Laura Robinson FNP-C, and I am currently working on my DNP project, I found some information and tools that would help me in my project, I am asking for permission to use some of the information from the appendix, the book title:

Johns Hopkins Nursing Evidence-Based Practice Model and Guidelines

MLA (Modern Language Assoc.)

Newhouse, Robin Purdy, et al. Johns Hopkins Nursing Evidence-Based Practice Model and Guidelines. Sigma Theta Tau International, 2007.

APA (American Psychological Assoc.)

Newhouse, R. P., Johns Hopkins University, Sigma Theta Tau International, & Johns Hopkins Hospital. (2007). Johns Hopkins Nursing Evidence-based Practice Model and Guidelines. Sigma Theta Tau International.

Thank you for your time,

Laura Robinson FNP-C

laura.robinson2@waldenu.edu

Appendix E: Johns Hopkins Nursing Evidence-Based Practice Appraisal Tool

John Hopkins Nursing Evidence-Based Practice

Non-Research Evidence Appraisal Tool

Evidence Level & Quality: _____

Article Title:		Number:
Author(s):		Publication Date:
Journal:		
Does this evidence address the EBP question?	□Yes	□No Do not proceed with appraisal of this evidence

Clinical Practice Guidelines: Systematically developed recommendations from nationally recognized experts based on research evidence or expert consensus panel. **LEVEL IV**

Consensus or Position Statement: Systematically developed recommendations based on research and nationally recognized expert opinion that guides members of a professional organization in decision-making for an issue of concern. **LEVEL IV**

• Are the types of evidence included identified?	□Yes	□No
• Were appropriate stakeholders involved in the development of recommendations?	□Yes	□No
• Are groups to which recommendations apply and do not apply clearly stated?	□Yes	□No
• Have potential biases been eliminated?	□Yes	□No
• Were recommendations valid (reproducible search, expert consensus, independent review, current, and level of supporting evidence identified for each recommendation)?	□Yes	□No
• Were the recommendations supported by evidence?	□Yes	□No
• Are recommendations clear?	□Yes	□No
Literature Review: Summary of published literature without systematic appraisal of evidence quality or strength. **LEVEL V**		
• Is subject matter to be reviewed clearly stated?	□Yes	□No
• Is relevant, up-to-date literature included in the review (most sources within last 5 years or classic)?	□Yes	□No
• Is there a meaningful analysis of the conclusions in the literature?	□Yes	□No
• Are gaps in the literature identified?	□Yes	□No
• Are recommendations made for future practice or study?	□Yes	□No

Expert Opinion: Opinion of one or more individuals based on clinical expertise. **LEVEL V**		
• Has the individual published or presented on the topic?	□Yes	□No
• Is author's opinion based on scientific evidence?	□Yes	□No
• Is the author's opinion clearly stated?	□Yes	□No
• Are potential biases acknowledged?	□Yes	□No

Evidence Level & Quality: _____

Organizational Experience:

Quality Improvement: Cyclical method to examine organization-specific processes at the local level. **LEVEL V**

Financial Evaluation: Economic evaluation that applies analytic techniques to identify, measure, and compare the cost and outcomes of two or more alternative programs or interventions. **LEVEL V**

Program Evaluation: Systematic assessment of the processes and/or outcomes of a program and can involve both quantitative and qualitative methods. **LEVEL V**

Setting:	**Sample (composition/size):**	
• Was the aim of the project clearly stated?	☐Yes	☐No
• Was the method described?	☐Yes	☐No

• Were process or outcome measures identified?	☐Yes	☐No
• Were results described?	☐Yes	☐No
• Was interpretation clear and appropriate?	☐Yes	☐No
• Are components of cost/benefit analysis described?	☐Yes	☐No
Case Report: In-depth look at a person, group, or other social unit. **LEVEL V**		
Is the purpose of the case report clearly stated?	☐Yes	☐No
• Is the case report clearly presented?	☐Yes	☐No
• Are the findings of the case report supported by relevant theory or research?	☐Yes	☐No
• Are the recommendations clearly stated and linked to the findings?	☐Yes	☐No
Community Standard, Clinician Experience, or Consumer Preference **Community Standard:** Current practice for comparable settings in the community **LEVEL V** **Clinician Experience:** Knowledge gained through practice experience **LEVEL V** **Consumer Preference:** Knowledge gained through life experience **LEVEL V**		
Information Source(s):	Number of Sources:	
• Source of information has credible experience.	☐Yes	☐No
• Opinions are clearly stated.	☐Yes	☐No
• Identified practices are consistent.	☐Yes	☐No

Findings that help you answer the EBP question:

QUALITY RATING FOR CLINICAL PRACTICE GUIDELINES, CONSENSUS OR POSITION STATEMENTS (LEVEL IV)

A **High quality:** Material officially sponsored by a professional, public, private organization, or government agency; documentation of a systematic literature search strategy; consistent results with sufficient numbers of well-designed studies; criteria-based evaluation of overall scientific strength and quality of included studies and definitive conclusions; national expertise is clearly evident; developed or revised within the last 5 years.

B **Good quality:** Material officially sponsored by a professional, public, private organization, or government agency; reasonably thorough and appropriate systematic literature search strategy; reasonably consistent results, sufficient numbers of well-designed studies; evaluation of strengths and limitations of included studies with fairly definitive conclusions; national expertise is clearly evident; developed or revised within the last 5 years.

C **Low quality or major flaws:** Material not sponsored by an official organization or agency; undefined, poorly defined, or limited literature search strategy; no evaluation of strengths and limitations of included studies, insufficient evidence with inconsistent results, conclusions cannot be drawn; not revised within the last 5 years.

QUALITY RATING FOR ORGANIZATIONAL EXPERIENCE (LEVEL V)

A **High quality:** Clear aims and objectives; consistent results across multiple settings; formal quality improvement or financial evaluation methods used; definitive conclusions; consistent recommendations with thorough reference to scientific evidence

B **Good quality:** Clear aims and objectives; formal quality improvement or financial evaluation methods used; consistent results in a single setting; reasonably consistent recommendations with some reference to scientific evidence

C **Low quality or major flaws:** Unclear or missing aims and objectives; inconsistent results; poorly defined quality improvement/financial analysis method; recommendations cannot be made

QUALITY RATING FOR LITERATURE REVIEW, EXPERT OPINION, COMMUNITY STANDARD, CLINICIAN EXPERIENCE, CONSUMER PREFERENCE (LEVEL V)

A **High quality:** Expertise is clearly evident; draws definitive conclusions; provides scientific rationale; thought leader in the field

B **Good quality:** Expertise appears to be credible; draws fairly definitive conclusions; provides logical argument for opinions

C **Low quality or major flaws:** Expertise is not discernable or is dubious; conclusions cannot be drawn

Appendix F: Evaluation of the Pharmacogenetic Testing PowerPoint by Content Experts

Presenter: Laura Robinson FNP-C

Walden University

Objective Statement: Participants will be able to describe uses for PGx testing in the primary care setting	**Were the objectives met**? **Not met**? Please circle. Yes No	**Comments**:
Participants will gain understanding how PGx testing can be a tool in adverse drug related events	Yes No	
Participants will gain understanding the benefit of PGx testing as a personalized medicine	Yes No	
Participants be able to identify at least two positive attributes in the use of PGx testing in the chronic pain patient	Yes No	
Participants will gain understanding how PGx testing can identify potential drug antagonists	Yes No	

Participants will learn that PGx testing is a simple non-invasive test process	Yes No	
Additional Comments:		

Appendix G: Summary Evaluation Results of the Staff Education Project by Content Experts

INSTRUCTIONS: Please check each item to see if the question is representative of the course objective and the correct answer is reflected in the course content.

Pre/post Test Item #

1. Not Relevant __ Somewhat Relevant__ Relevant __ Very Relevant__

Comments:

2. Not Relevant__ Somewhat Relevant__ Relevant __ Very Relevant__

Comments:

3. Not Relevant __ Somewhat Relevant__ Relevant __ Very Relevant__

Comments:

4. Not Relevant__ Somewhat Relevant__ Relevant__ Very Relevant__

Comments:

5. Not Relevant__ Somewhat Relevant__ Relevant__ Very Relevant__

Comments:

6. Not Relevant__ Somewhat Relevant __ Relevant __ Very Relevant__

Comments:

7. Not Relevant__ Somewhat Relevant __ Relevant __ Very Relevant__

Comments:

8. Not Relevant__ Somewhat Relevant __ Relevant___ Very Relevant__

Comments:

9. Not Relevant__ Somewhat Relevant __ Relevant __ Very Relevant__

Comments:

10. Not Relevant__ Somewhat Relevant __ Relevant __ Very Relevant__

Comments:

I. This project was a

a. Please describe the effectiveness (or not) of this project as related to communication, and desired outcomes etc.

Evaluator A	Evaluator B

b. How do you feel about your involvement as a content expert?

Evaluator A	Evaluator B

c. What aspects of the project would you like to see improved?

Evaluator A	Evaluator B

II. Pre/ post-test

a. Was the pre/ post-test relevant to the content

Evaluator A	Evaluator B

b. Share how you might have changed the project

Evaluator A	Evaluator B

III. The role of the student was to be the team leader.

a. As a team leader how did the student direct the team to meet the project goals?

Evaluator A	Evaluator B

IV. Please offer suggestions for improvement.

Evaluator A	Evaluator B

Moon/May 2020

Appendix H: Pharmacogenetic Testing Education Outline

I. Understanding Pharmacogenetic (PGx) Testing as a Tool in the Chronic Pain Patient

   a. Educational PowerPoint

   b. Introduction

II. Individualized Patient Metabolism

   a. Describe type of metabolizer

   b. Medication, Duration, or Dosage

   c. Genetic profile

   d. Genetic variability

III. Drug Bioavailability

   a. Genotype (AA, AG, and GG)

   b. Adverse drug events

   c. Theory pharmacogenetic (PGx) testing

   d. Pain management

IV. Chronic pain

   a. Variety of different types of pain

   b. Chronic pain examples

V. Pharmacogenetic (PGx) Testing process

    a. Steps include

VI. Pharmacogenetic (PGx) Testing

    a. Benefit of using PGx testing

VII. Personalized Medicine

    a. Physiological factors

    b. Environmental factors

    c. Cytochrome P450

VIII. Drug Metabolism factors to take into consideration

    a. Non-evasive test

    b. Prescribing tool (Individualized)

    c. Improved daily function

IX. Pharmacogenetic (PGx) testing benefits

    a. Customized approach to pain management

    b. Decrease medication waste

    c. Self-efficacy

    d. Metabolic profile tool

X. References

Appendix I: Frequency Table

What is your current age?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	25-35 years of age	2	11.1	11.1	11.1
	36-50 years of age	7	38.9	38.9	50.0
	51-65 years of age	8	44.4	44.4	94.4
	66 years of age or older	1	5.6	5.6	100.0
	Total	18	100.0	100.0	

What is your gender?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	8	44.4	44.4	44.4
	Female	10	55.6	55.6	100.0
	Total	18	100.0	100.0	

What ethnicity do you identify with (Select all that apply)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Black/African	1	5.6	5.6	5.6
	Hispanic/Latino	4	22.2	22.2	27.8
	Caucasian	12	66.7	66.7	94.4
	Asian	1	5.6	5.6	100.0
	Total	18	100.0	100.0	

How many years in practice have you provided patient care in the Primary Care setting?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-5 years	7	38.9	38.9	38.9
	6-10 years	2	11.1	11.1	50.0
	11-15 years	2	11.1	11.1	61.1
	16-20 years	3	16.7	16.7	77.8

	21 years of more	4	22.2	22.2	100.0
	Total	18	100.0	100.0	

What is your formal educational pathway as a Provider?

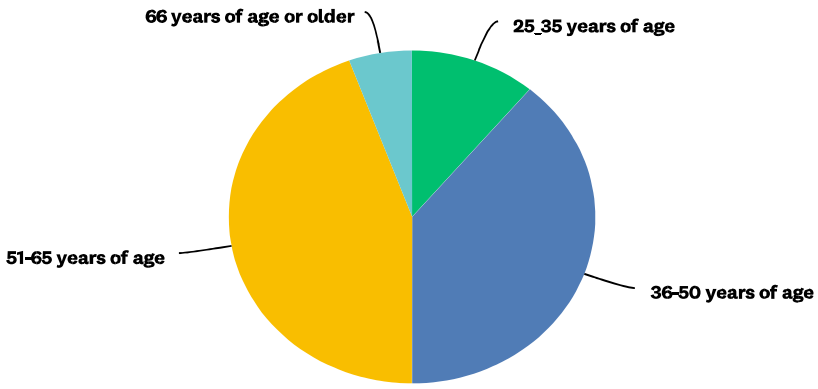
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Medical Doctor (MD)	2	11.1	11.1	11.1
	Physician Assistant (PA)	5	27.8	27.8	38.9
	Nurse Practitioner (NP)	7	38.9	38.9	77.8
	Other	4	22.2	22.2	100.0
	Total	18	100.0	100.0	

Appendix J: Data Questions and Findings from Survey Monkey Questionnaire

Demographics

Q1. What is your current age?

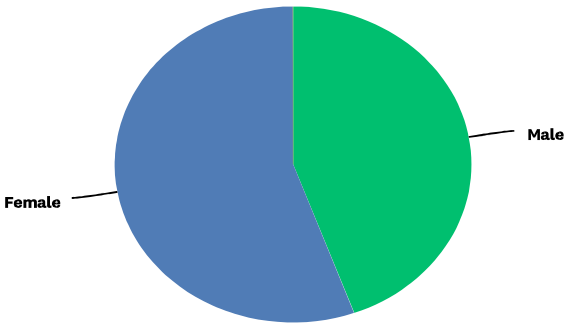
Answered: 18 Skipped: 0



ANSWER CHOICES	RESPONSES	
25-35 years of age	11.11%	2
36-50 years of age	38.89%	7
51-65 years of age	44.44%	8
66 years of age or older	5.56%	1
TOTAL		18

Q2. What is your gender?

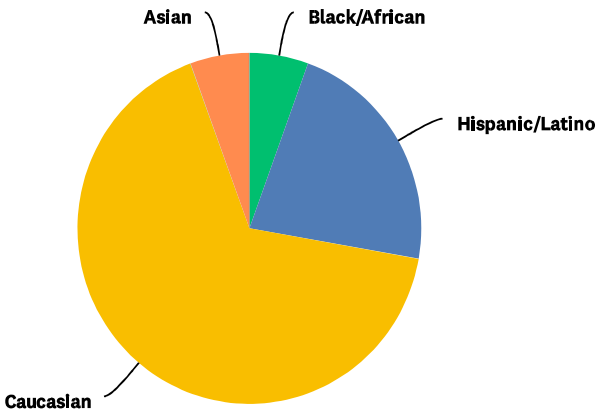
Answered: 18 Skipped: 0



ANSWER CHOICES	RESPONSES	
Male	44.44%	8
Female	55.56%	10
Prefer not to answer	0.00%	0
TOTAL		18

Q3. What ethnicity do you identify with (Select all that apply)?

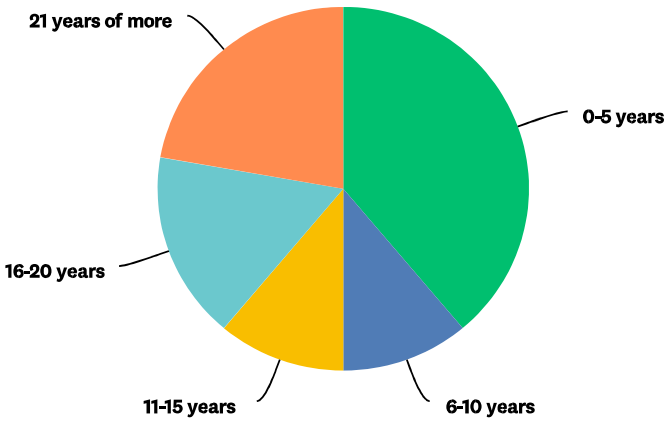
Answered: 18 Skipped: 0



ANSWER CHOICES	RESPONSES	
Black/African	5.56%	1
Hispanic/Latino	22.22%	4
Caucasian	66.67%	12
Native American	0.00%	0
Asian	5.56%	1
Prefer not to answer	0.00%	0
TOTAL		18

Q4. How many years in practice have you provided patient care in the Primary Care setting?

Answered: 18 Skipped: 0

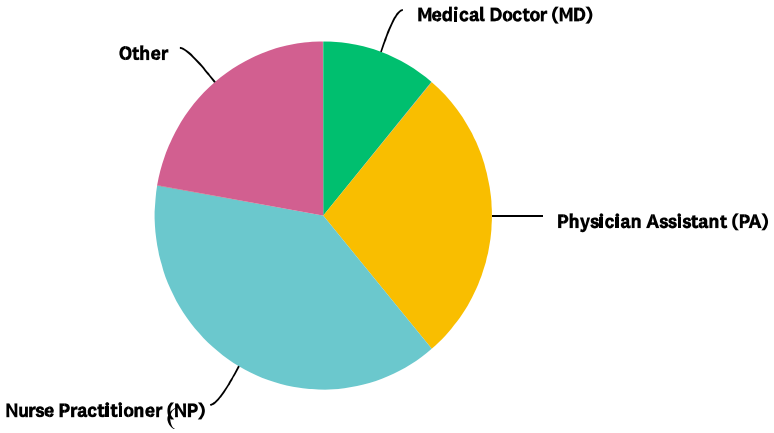


ANSWER CHOICES	RESPONSES	
0-5 years	38.89%	7
6-10 years	11.11%	2
11-15 years	11.11%	2

16-20 years	16.67%	3
21 years of more	22.22%	4
TOTAL		18

Q5. What is your formal educational pathway as a Provider?

Answered: 18 Skipped: 0

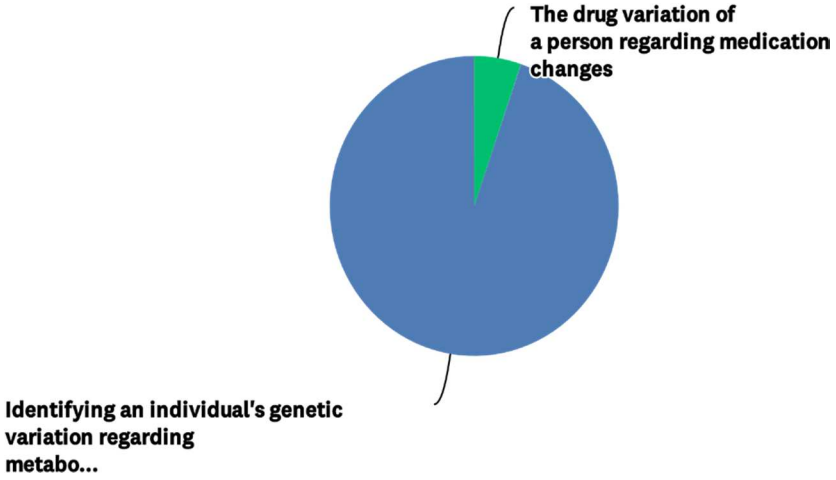


ANSWER CHOICES	RESPONSES	
Medical Doctor (MD)	11.11%	2
Doctor of Osteopathy (OD)	0.00%	0
Physician Assistant (PA)	27.78%	5
Nurse Practitioner (NP)	38.89%	7
Pharmacist (RPh)	0.00%	0
Psychologist (Psy.D.)	0.00%	0
Other	22.22%	4
TOTAL		18

Pre-test Questionnaire

Q1. How can Pharmacogenetic (PGx) testing be helpful in the primary care setting?

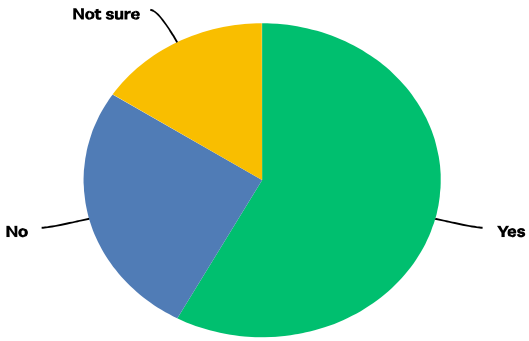
Answered: 19 Skipped: 0



ANSWER CHOICES	RESPONSES	
The drug variation of a person regarding medication changes	5.26%	1
Identifying an individual's genetic variation regarding metabolic response to medications	94.74%	18
Finding the drug response from the foods eaten	0.00%	0
Teaching how medications help treat different disease processes	0.00%	0
TOTAL		19

Q2. Does a patient's metabolic rate (slow metabolizer, normal metabolizer, or ultra-metabolizer) affect medication prescribing choices, duration, or dosage when deciding prescriptions in current prescribing practice?

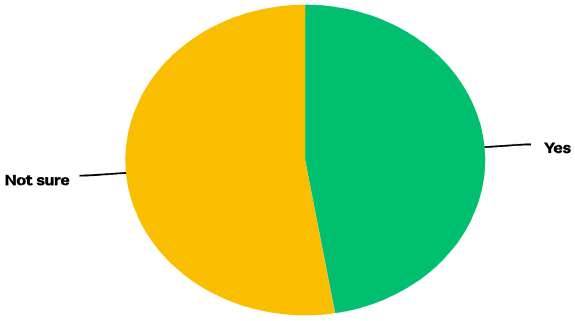
Answered: 19 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	57.89%	11
No	26.32%	5
Not sure	15.79%	3
TOTAL		19

Q3. Does PGx testing help identify a person's genotype (AA, AG, and GG) and metabolic profile pathways playing an essential role in medications' ability to work effectively or drug's bioavailability in the chronic pain patient?

Answered: 19 Skipped: 0

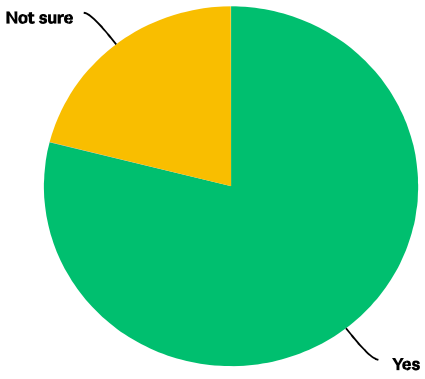


ANSWER CHOICES	RESPONSES	
Yes	47.37%	9

No	0.00%	0
Not sure	52.63%	10
TOTAL		19

Q4. Will PGx testing identify potential risks of adverse drug events or potential drugs competing for binding sites?

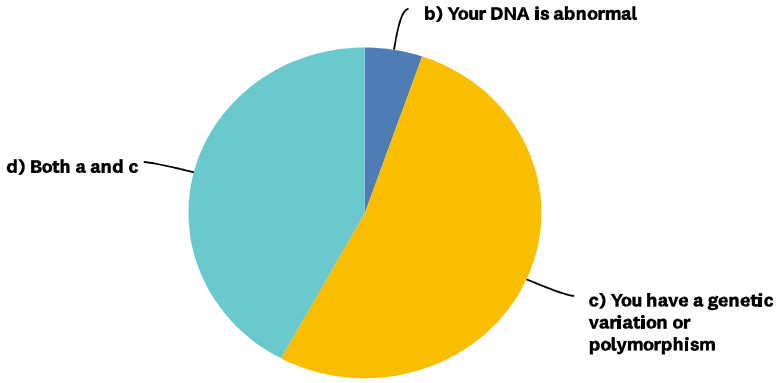
Answered: 19 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	78.95%	15
No	0.00%	0
Not sure	21.05%	4
TOTAL		19

Q5. When counseling a patient about their pharmacogenetic (PGx) test results the following statement is most acceptable to use:

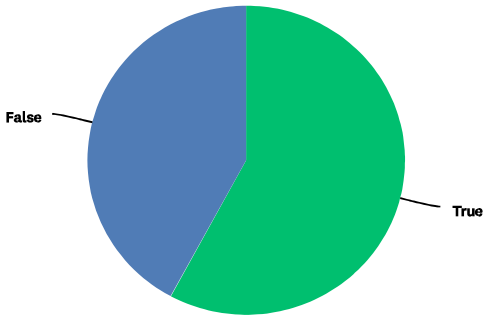
Answered: 19 Skipped: 0



ANSWER CHOICES	RESPONSES	
a) Your DNA is mutated	0.00%	0
b) Your DNA is abnormal	5.26%	1
c) You have a genetic variation or polymorphism	52.63%	10
d) Both a and c	42.11%	8
TOTAL		19

Q6. Does pharmacogenetic (PGx) testing encompass pharmacoeconomics regarding a patient medication cost savings?

Answered: 19 Skipped: 0

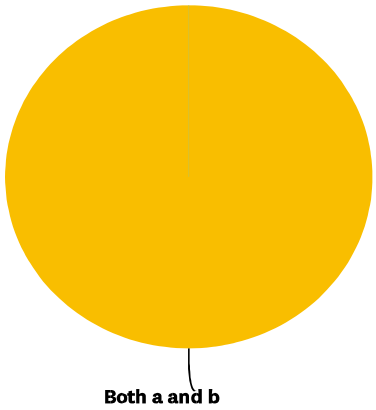


ANSWER CHOICES	RESPONSES

True	57.89%	11
False	42.11%	8
TOTAL		19

Q7. Pharmacogenetic (PGx) testing can help improve pharmacotherapy by identifying patients:

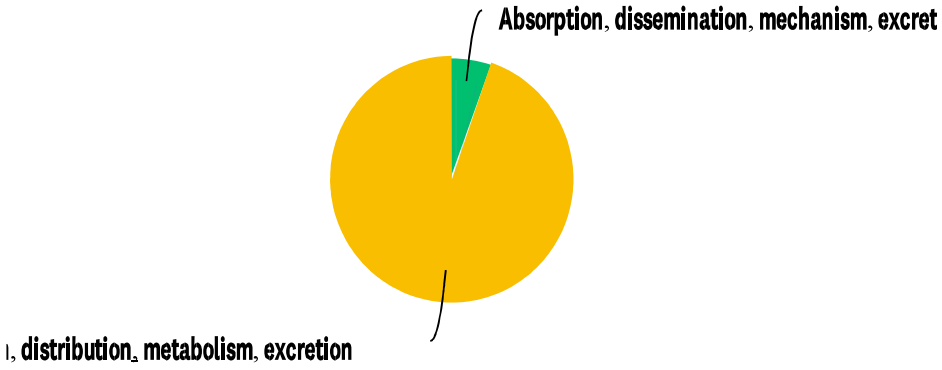
Answered: 19 Skipped: 0



ANSWER CHOICES	RESPONSES	
At an increased risk of having no response when prescribed conventional drug therapy	0.00%	0
At an increased risk of experiencing drug-induced toxicities when prescribed conventional drug therapy	0.00%	0
Both a and b	100.00%	19
None of the above	0.00%	0
TOTAL		19

Q8. What are the four main Pharmacokenetic process steps?

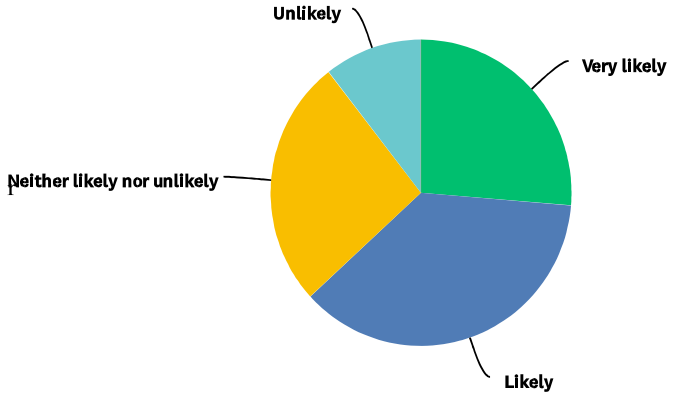
Answered: 19 Skipped: 0



ANSWER CHOICES	RESPONSES	
Absorption, dissemination, mechanism, excretion	5.26%	1
Adaptation, distribution, medical, exclusion	0.00%	0
Absorption, distribution, metabolism, excretion	94.74%	18
Alignment, digestion, muscle, execution	0.00%	0
TOTAL		19

Q9. After learning the benefits of pharmacogenetic (PGx) testing as an individualized approach towards treating chronic pain patient, would you use this tool in your patient care?

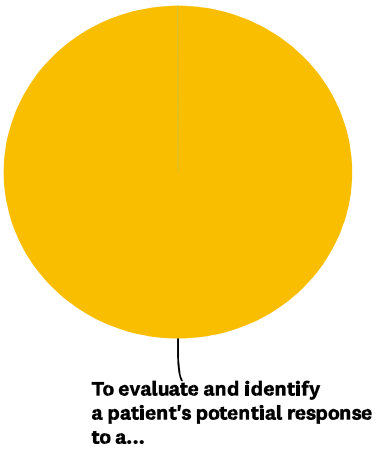
Answered: 19 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very likely	26.32%	5
Likely	36.84%	7
Neither nor unlikely	26.32%	5
Unlikely	10.53%	2
Very unlikely	0.00%	0
TOTAL		19

Q10. What is the purpose of using Pharmacogenetic (PGx) testing?

Answered: 19 Skipped: 0

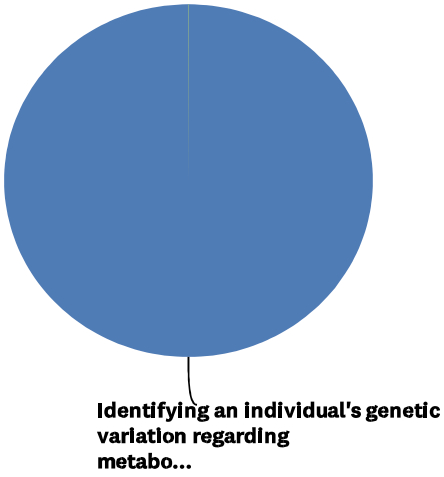


ANSWER CHOICES	RESPONSES	
To evaluate and identify a patient's sex, race, and age	0.00%	0
To find additional uses of a medication regarding off-label uses	0.00%	0
To evaluate and identify a patient's potential response to a medication's therapy	100.00%	19
To evaluate the heritage of where the patient originated from	0.00%	0
TOTAL		19

Post-test Questionnaire

Q.1 How can Pharmacogenetic (PGx) testing be helpful in the primary care setting?

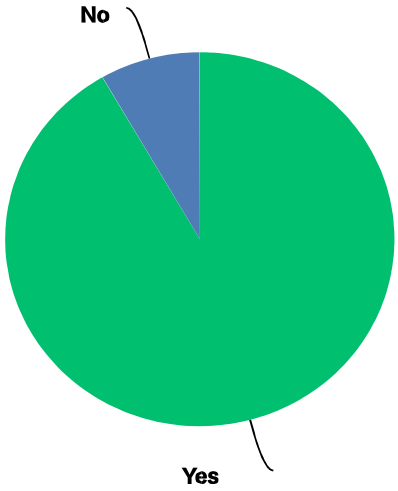
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
The drug variation of a person regarding medication changes	0.00%	0
Identifying an individual's genetic variation regarding metabolic response to medications	100.00%	12
Finding the drug response from the foods eaten	0.00%	0
Teaching how medications help treat different disease processes	0.00%	0
TOTAL		12

Q2. Does a patient's metabolic rate (slow metabolizer, normal metabolizer, or ultra-metabolizer) affect medication prescribing choices, duration, or dosage when deciding prescriptions in current prescribing practice?

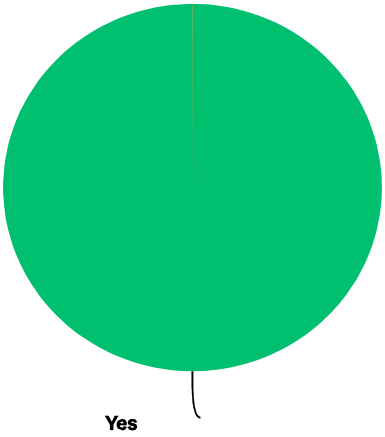
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	91.67%	11
No	8.33%	1
Not sure	0.00%	0
TOTAL		12

Q3. Does PGx testing help identify a person's genotype (AA, AG, and GG) and metabolic profile pathways playing an essential role in medications' ability to work effectively or drug's bioavailability in the chronic pain patient?

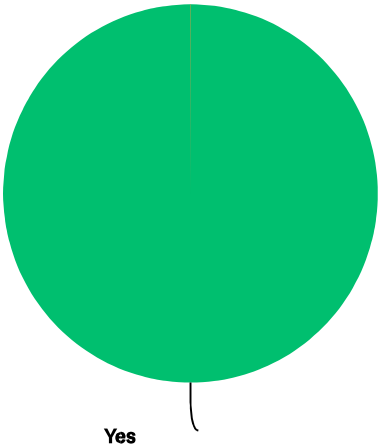
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	100.00%	12
No	0.00%	0
Not sure	0.00%	0
TOTAL		12

Q4. Will PGx testing identify potential risks of adverse drug events or potential drugs competing for binding sites?

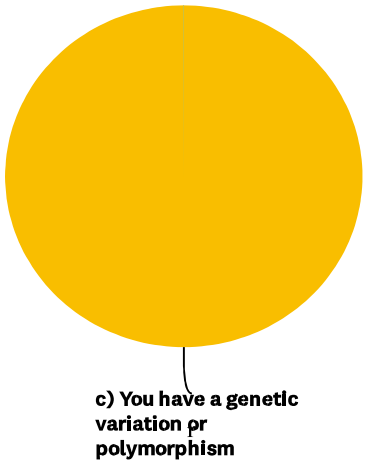
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	100.00%	12
No	0.00%	0
Not sure	0.00%	0
TOTAL		12

Q5. When counseling a patient about their pharmacogenetic (PGx) test results the following statement is most acceptable to use:

Answered: 12 Skipped: 0

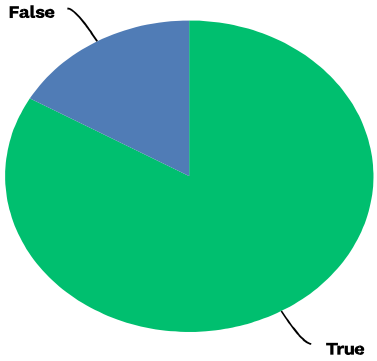


ANSWER CHOICES	RESPONSES	
a) Your DNA is mutated	0.00%	0
b) Your DNA is abnormal	0.00%	0
c) You have a genetic variation or polymorphism	100.00%	12
d) Both a and c	0.00%	0

TOTAL	12

Q6. Does pharmacogenetic (PGx) testing encompass pharmacoeconomics regarding a patient medication cost savings?

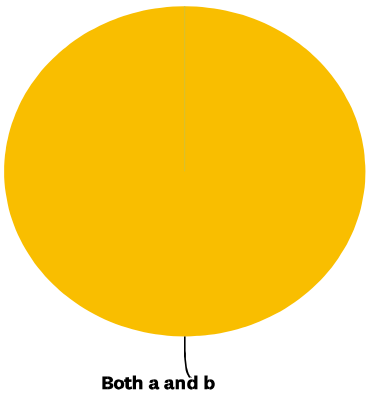
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
True	83.33%	10
False	16.67%	2
TOTAL		12

Q7. Pharmacogenetic (PGx) testing can help improve pharmacotherapy by identifying patients:

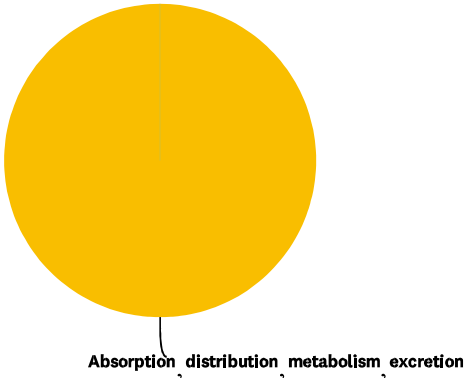
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
At an increased risk of having no response when prescribed conventional drug therapy	0.00%	0
At an increased risk of experiencing drug-induced toxicities when prescribed conventional drug therapy	0.00%	0
Both a and b	100.00%	12
None of the above	0.00%	0
TOTAL		12

Q8. What are the four main Pharmacokenetic process steps?

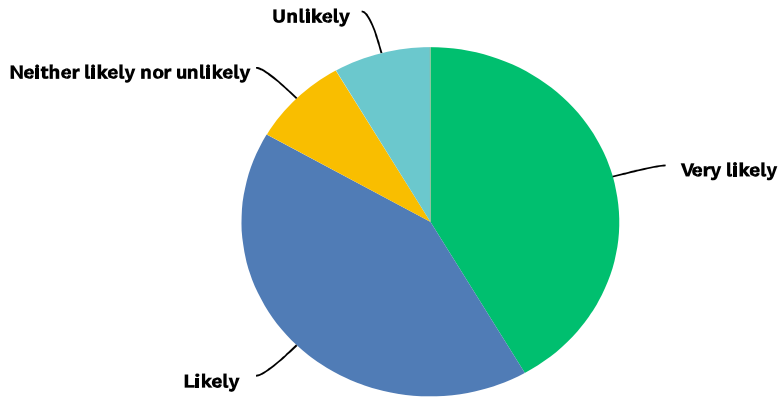
Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
Absorption, dissemination, mechanism, excretion	0.00%	0
Adaptation, distribution, medical, exclusion	0.00%	0
Absorption, distribution, metabolism, excretion	100.00%	12
Alignment, digestion, muscle, execution	0.00%	0
TOTAL		12

Q9. After learning the benefits of pharmacogenetic (PGx) testing as an individualized approach towards treating chronic pain patient, would you use this tool in your patient care?

Answered: 12 Skipped: 0

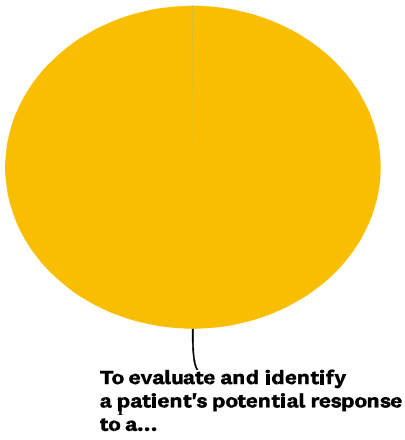


ANSWER CHOICES	RESPONSES	
Very likely	41.67%	5
Likely	41.67%	5
Neither likely nor unlikely	8.33%	1
Unlikely	8.33%	1
Very unlikely	0.00%	0

TOTAL	12

Q10. What is the purpose of using Pharmacogeneting (PGx) testing?

Answered: 12 Skipped: 0



ANSWER CHOICES	RESPONSES	
To evaluate and identify a patient's sex, race, and age	0.00%	0
To find additional uses of a medication regarding off-label uses	0.00%	0
To evaluate and identify a patient's potential response to a medication's therapy	100.00%	12
To evaluate the heritage of where the patient originated from	0.00%	0
TOTAL		12

Q11. Additional comments or questions

Nice job!

10/22/2021 6:13 PM

great presentation

10/21/2021 12:35 PM

Great job Laura, Thank you!

10/20/2021 9:25 AM

CURRENT

good info! I will utilize it!

10/20/2021 9:00 AM

nothing to add

10/20/2021 9:00 AM

Thank you! I have often wondered about this!

10/20/2021 8:59 AM

Appendix K: PowerPoint Presentation

Understanding Pharmacogenetic (PGx) Testing as a Tool in the Chronic Pain Patient

- "Trial and failure" in treatment choices has been a concern in treatment in the chronic pain patient. Often it will take multiple trials in medications and dosages before the patient finds acceptable pain relief.
- As providers there is the concern of adverse drug related events, overdose is a major concern while trying to treat the chronic pain to achieve a manageable level of pain control
- Pharmacogenetic (PGx) testing is a tool to help aid in understanding a patient and their individual genetic profile and drug metabolism

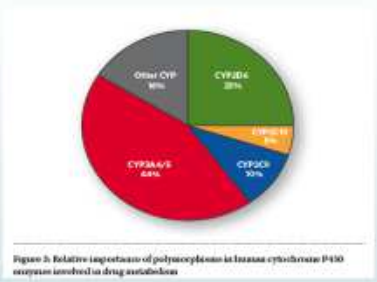
Personalized Medicine

- **Drug Metabolism factors to take into consideration:**
- Physiological: Gender, Age, and Pre-existing Health Conditions
- Environmental: ETOH use, Smoking, Diet, and Drug Co-administration
- 80% of patients who had an adverse drug event had poor CYP2D6 metabolizing ability
- Personalized medicine can improve a person's daily life by decreasing their chronic pain to a manageable level and decreasing the risk of adverse drug-related events through PGx test results tailored to an individual's DNA profile
- Identifying pharmacokinetic drug-drug interactions within individual patients

Cytochrome P450 (CYP450)

Cytochrome P450 has 5 Main Enzymes that Affect Drug Metabolism they include:

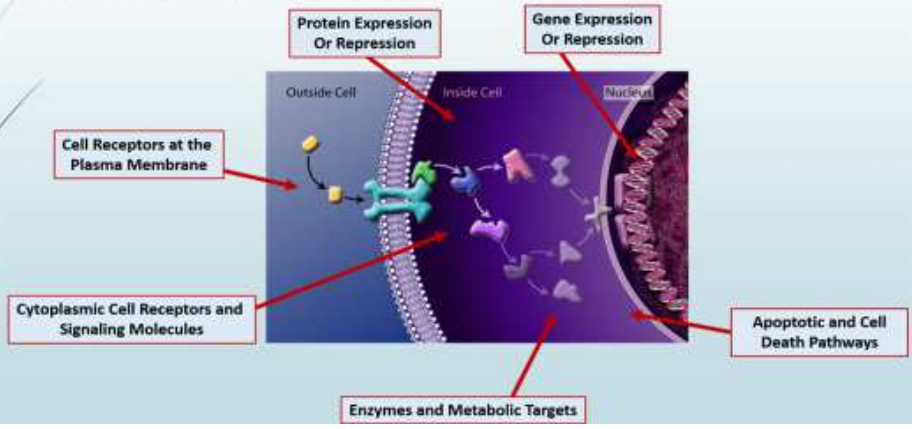
- CYP2D6
- CYP1A2
- CYP2B6
- CYP4F2
- CYP2C8
- CYP2C9
- CYP3A4
- CYP3A5



Within this CYP450 metabolism system, a person's drug metabolism can either cause an increase in the drug availability or a decrease in the drug's effect, placing the person at increased risk of an adverse drug-related event or ineffective pain control management

Drug Antagonists:

Drug antagonists interfere with agonist effectiveness by blocking the binding site, rendering the agonist unable to achieve the desired outcome. Removing the antagonist improves the effectiveness of treatment. Receptor sites have specific characteristics or duties. The chemical structure of the drug leads to an interaction with the receptor site, leading to a specific response. When an agonist interacts with the receptor, the expected response is blocked.



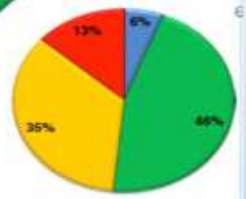
Individualized Patient Metabolism

Ultrarapid (UM) : Rapid rate of metabolism

Extensive (EM) : Normal metabolism

Intermediate (IM) : Reduced rate of metabolism

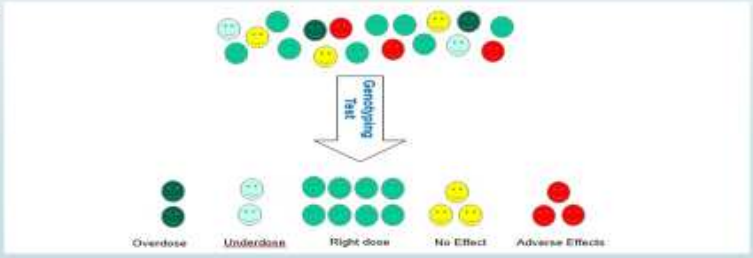
Poor (PM) : Slow rate of metabolism



CYP2D6 Phenotype Frequency

Individualized Patient Metabolism

- Current Prescribing Practice
- Ultra-rapid metabolizer, Normal metabolizer, Intermediate metabolizer, or Poor metabolizer
- Medication, Duration, or Dosage
- We need to keep in mind how a person's genetic profile affects Absorption, Distribution, Metabolism and Excretion (ADME)- affects drug effectiveness and availability
-

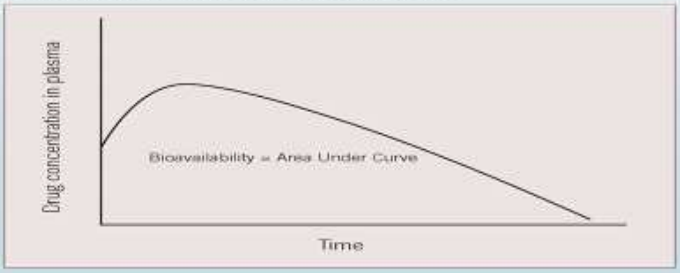


Theory of Pharmacogenetic (PGx) testing

- The theory in pharmacogenetic (PGx) testing prescribing medications genetically compatible with the patient's genetic profile could provide more effective pain control, reduce adverse effects, and decrease incidence of drug overdose.
- Real-time polymerase chain reaction (PCR) arrays increase detection of single nucleotide polymorphism (SNP), decreasing adverse drug events, increasing drug adherence, the outcome is improved patient care
- Identifying possible pharmacodynamic drug-drug interactions, a result when co-administration of two drugs respond by either causing drug toxicity or loss of efficacy of the intended goal

Drug Bioavailability

- The patient's genotype (AA, AG, and GG) and metabolic profile pathways will affect the prescribed drug bioavailability
- The goal of using PGx testing is to help the primary care practitioner prescribe medications that work effectively in pain management; more medication is not always the best practice, placing the patient at risk of an adverse event, with PGx testing as a prescribing tool can help identify drug compatiability to a person's genetic profile



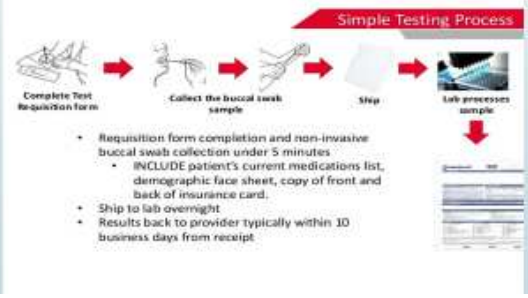
Chronic pain

- Pain is subjective making the goal of treating chronic pain a challenge in patient care
- Chronic pain management is complex, pharmacogenetic testing is a tool to help in the treatment of chronic pain improving the symptoms through DNA based information to decrease the level of pain safe and efficiently
- An article of *Pharmacogenetics of Chronic Pain Management*; has described a variety of different types of pain occurring in one out of three people in America
- 20% of patients seeking medical treatment due to the need to manage chronic pain symptoms

Pharmacogenetic (PGx) Testing process

The steps include:

- Order PGx test
- Instruct the patient that they should not eat, drink, or smoke for 30 minutes before the saliva test
- Identify patient
- Take Saliva swab sample
- Send biomaterial to corresponding laboratory preforming PGx testing
- Wait 2 – 3 days for lab analysis results
- Review PGx test result findings
- Follow up patient appointment to discuss PGx test findings and prescribe as needed for optimum pain control



Individualized Genetic Testing

Improves prescribing choices and improves the patient outcome through individualized genetic-based decisions

Pharmacogenetic (PGx) Testing

Using the PGx Testing tool could increase the patient's therapeutic response in chronic pain management, decreasing cost from failed drugs, and decreasing risk from Adverse Drug Events (ADE's)

- Angiotensin receptor blockers
- Anti-anginals
- Anti-arrhythmics
- Anticholinergics
- Anticholinesterases
- Anticoagulants
- Antidepressants (selective serotonin reuptake inhibitors, serotonin noradrenaline reuptake inhibitors, tricyclics, and others)
- Antidiabetics
- Anti-emetics
- Antiepileptics
- Antifungals
- Antihistamines
- Antiplatelets
- Antipsychotics
- Antitussives
- Benzodiazepines
- Betablockers
- Calcineurin inhibitors
- Hypnotics
- Non-steroidal anti-inflammatory drugs
- Opioid analgesics
- Proton pump inhibitors
- Psychostimulants
- Statins

Pharmacogenetic (PGx) testing Benefits

- A Simple Non-Evasive Test (cheek swab), send the sample to the laboratory to look at the genetic polymorphisms
- Individualized prescribing tool decreased Adverse Drug Events (ADE's)
- Improved pain management and depression through individualized patient DNA and metabolic profile
- To improve a person's daily functioning and improved quality of life through safer prescribing practices

Benefits when using PGx testing in the chronic pain patient

- Being able to identify when a drug is potentially changing another drug's absorption, distribution, metabolism, or elimination will decrease an adverse drug-related event or possible drug toxicity
- Identifying when a drug is potential to change another drug's absorption, distribution, metabolism, or elimination will allow the provider the informed ability to choose medications that are not negatively affected by the patient's genetic profile
- Pharmacogenetic testing helps identify the patients who are opioid-vulnerable, allowing the provider informed choices in pain management, improving the safety of the individual, averting a potential adverse drug event

An individual's genetic make-up affects a drug's metabolism, transportation, and action of each medication resulting in a varied metabolic rate of each person. Using PGx testing in the prescribing decision can improve the outcome in the patient's pain control

Poor Metabolizer

There are **two variants present**. Typically one is on the maternal-derived chromosome and a second variant on the paired paternal-derived chromosome. The alleles on both chromosomes produce "loss-of-function" enzymes.

Intermediate Metabolizer

There is only **one variant present**, located either on the maternal-derived chromosome, or on the paternal-derived paired chromosome.

The variant allele produces "loss-of-function" enzymes, while the ordinary allele on the paired chromosome generates normal enzymes.

Extensive Metabolizer

No variant alleles present on either of the patient's paired chromosomes.

All enzymes produced by these alleles have normal activity.

Ultra-Rapid Metabolizer

In **CYP2C19** the presence of a single *17 variant causes a slight increase in CYP2C19 enzyme activity.

In **CYP2D6** the presence of a *2 variant in some patients exists in multiple copies on the same DNA strand. This results in an increase in total CYP2D6 enzyme activity.

In table 2. The drugs are affected by the CYP2D6 metabolic pathway, whereas a different pathway activates the CYP3A4 activated drugs; this includes the same scenario under the CYP3A4/5, the role in PGx testing is identifying an individual's metabolic profile in drug

Table 2. Common Drugs Used in Pain and Their Metabolism Pathway

CYP2D6	CYP2C9	CYP3A4/5	CYP2B6
Amitriptyline	Celecoxib	Codeine	Methadone
Codeine	Flurbiprofen	Diazepam	
Desipramine	Ibuprofen	Fentanyl	
Diazepam	Meloxicam	Hydrocodone	
Hydrocodone	Piroxicam	Oxycodone	
Imipramine		Methadone	
Methadone			
Nortriptyline			
Oxycodone			
Tramadol			
Venlafaxine			

Knowledge Creates Power; Being able to have a tool to Effectively Treat a Patient's Pain and Improve their Level of Functioning is Motivating for the Patient and the Provider

- Genotype-based Treatment adds a Customized Approach to Pain Management while Decreasing the "Trial and Failure" Approach to Treating Chronic Pain
- As Pharmacogenetic (PGx) Testing is Relatively new to the Healthcare Field, the Benefit will Help Decrease Medication Waste, Improve Patient Satisfaction while Improving Chronic Pain Management
- Self-efficacy is derived from the insight gained from knowledge through education of new tools to help treat the patient and have a better understanding of why one medication over another will achieve the ultimate goal of adequate pain control
- Pain control management through DNA-based metabolic profile is a Tool that helps Reduce Cost, Reduce Adverse Drug Related Events, and Improve Patient Satisfaction through Improved Pain Control

Post-test

- **Please complete post test:**


References
Dunnoo, D. (2014). Understanding the Basics of Pharmacogenetic Testing. What exactly is personalized medicine and why is it important?
Kaye, A. D., Gracia, a. J., Hoit, G. M., Jens, G. M., Cornett, E. D., Orgnier, a. J., Kaye, a., Conett, E. M., & Urman, R. D. (2014). Update on the pharmacogenomics of pain management. Pharmacogenomics and personalized medicine, 15, 37–43.