Pharmacogenomics Education in U.S. Doctor of Pharmacy Programs: A Cross-Sectional Study

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Introduction

- The CYP2D6 first polymorphism was discovered in the 1970s leading to over 200 prescription medications with genetic recommendations.[1]
- Pharmacists are uniquely situated to interpret and apply the findings of pharmacogenomic testing to optimize medication therapy.
- ACPE guidelines identify pharmacogenomics/genetics as a competency area for students.[2]
- Studies over the last 10 years have demonstrated varying degrees of implementation of pharmacogenomics in pharmacy education.[1,3]

Research Objective

- To describe the extent to which pharmacogenomics content is integrated into Pharm.D. curricula in the United States (U.S.).

Study Design

- **Study Design and Timeline:** Cross-sectional online survey conducted in March 2022 – June 2022.
- **Study Population:** All accredited Pharm.D. programs in the U.S..
- **Survey Development:**
  - Hybrid survey consisting of 30 published pharmacogenomics competencies mapped to Entrustable Professional Activity domains and additional survey items about timing, course type, and educational background of faculty.[4]
- **Data Collection**
  - A total of three e-mail invitations were sent to faculty with pharmacogenomics expertise or the dean of each program.
- **Data Analysis:**
  - Quantitative data was analyzed descriptively and reported out as frequency counts and percents.
  - Open-ended data was coded and categorized.

Response Rate and Demographics

- **Response Rate**
  - 44 responses (31% response rate) with varying response rates to individual questions.
- **Respondent Characteristics**
  - Majority were private institutions (n=25, 56.8%) and not affiliated with an academic medical center (n=24, 55%).

Results

Competency	Programs addressing competency (%)
Foundational Genetics Concepts	
Explain basic genetics concepts using appropriate vocabulary	41 (97.6)
Identify how genetic variations associated with drugs and diseases facilitate development of prevention, diagnostic, and treatment strategies that are unique to the patient	41 (97.6)
Explain the impacts that disease and drug responses have on genetic, behavioral, social and environmental factors	35 (83.3)
Assess the differences between various genetic testing technologies (including sequencing and genotyping)	32 (82.1)
Recognize what the legal protections are against using the results of genetic tests for any type of discrimination against the patient	26 (66.7)
Identify the difference between genetic-based clinical diagnosis, and predisposition to disease based on genetics	26 (61.9)
Patient Care Provider	
Teach students how to determine the impact of genetic variants on the pharmacokinetics/pharmacodynamics involved in a drug therapy recommendation	37 (94.9)
Identify which test results from a genetic test that are relevant to a patient's care and specific disease states	33 (84.6)
Teach students how interpret genetic test results including how to translate genotypes to phenotypes and then making a drug therapy recommendation based on this information	32 (82.1)
Inform students how to utilize the results of pharmacogenomic tests in conjunction with other clinical variables when deciding on drug therapy	31 (79.5)
Give pharmacy students the tools to recommend pharmacogenomic testing when deemed necessary	28 (71.8)
Use the tools necessary to determine the quality and source of existing pharmacogenomic test results, distinguish whether the results are actionable or non-actionable	27 (69.2)
Identify if a medication-related problem is linked to genetic variability without a pharmacogenetic test being performed	24 (61.5)
Give students the tools to determine the quality and source of existing pharmacogenomic test results	23 (59.0)
Teach students how to use family history to assess a patient's predisposition to a disease and/or a drug response	22 (56.4)
Recognize the implications of genetic results on a disease state, and if necessary, refer to a genetics-trained healthcare provider	21 (53.8)
Give students the skills to properly follow-up and monitor a pharmacogenomics care plan	16 (41.0)
Teach students how to involve the patient, caregivers, and other healthcare professionals in creating and implementing pharmacogenomic-guided care plans	15 (38.5)
Teach students about cost and reimbursement for pharmacogenomic tests, and to incorporate this in the decision for pharmacogenomic tests	14 (35.9)
Demonstrate how and where to document pharmacogenomic test results in the electronic health record	11 (28.2)

Competency Cont.	Programs addressing competency n (%)
Interprofessional Team Member	
Provide students appropriate knowledge to collaborate as the pharmacogenomics expert in an interprofessional team	28 (71.8)
Population Health Promoter	
Teach students how to use genetic variations to identify patients that may be predisposed to adverse drug reactions and what steps to take to modify therapy accordingly	36 (92.3)
Demonstrate how to identify patient populations that may be more likely to benefit from pharmacogenomic testing	29 (74.4)
Teach students to recognize differences in pharmacogenomic allele frequencies among ancestry groups and use that to guide appropriate test selections and maximize medication use	26 (66.7)
Information Master	
Demonstrate where to access and how to use evidence-based resources and pharmacogenomics information to improve patient care	31 (79.5)
Teach students to use a culturally-sensitive approach, such as considering potential ethical concerns, when counseling patients about pharmacogenomic results	20 (51.3)
Provide training on how to educate patients and professional colleagues on the benefits and limitations of pharmacogenomics to optimize drug therapy	18 (46.2)
Practice Manager	
Provide opportunities for students to practice overseeing pharmacy operations that integrate pharmacogenomics in a work shift	4 (10.3)
Provide opportunities for students to fulfill medication orders while considering the clinical implications of pharmacogenomics	4 (10.3)
Self-Developer	
Teach students how to create a written plan for continuous professional development in clinical pharmacogenomics	5 (12.8)

Plans for Pharmacogenomics Education
- Plan to increase the level of pharmacogenomics education (n=20, 51.3%)
- Plan to maintain the current level of pharmacogenomics education (n=13, 33.3%)
- Unsure of plans (n=6, 15.4%)

Perceived Adequacy of Pharmacogenomics Education Within Program
- There is an appropriate amount of pharmacogenomics education (n=21, 53.8%)
- There is not enough pharmacogenomics education (n=18, 46.2%)

Open-Ended Comments Regarding Perceived Adequacy
- *"While we try to incorporate as many aspects as possible in our didactic curriculum, there are some applied skills that need more practice in experiential courses. We are piloting an APPE this year related to this."*
- *"The way our curriculum is set up, there isn't enough time to complete more. I'm hoping with the curricular changes we are making I can include things like interpreting tests, more patient cases and creating treatment plans."*

Discussion

- **Barriers**
  - Curricular content may already be "full" and opportunities to incorporate more content are limited.
  - Variable levels of training for faculty who are teaching pharmacogenomics content.
- **Suggested Solutions**
  - More integration into existing courses that provide hands-on experiences.
  - More formal educational training opportunities for faculty (e.g. ASHP Pharmacogenomics Certificate).
- **Study Limitations**
  - Low response rate and variable responses to individual survey items.
- **Future Research**
  - More thorough assessment of the various ways that PGx education is provided, including innovative mechanisms to support application of content to practice with hands-on learning opportunities.
  - Better understanding of how practicing pharmacists are incorporating pharmacogenomics into their daily practice and/or within the context of an interprofessional team.
- **Conclusion**
  - Although improvements have been made, greater consistency and time given to pharmacogenomics education is required to best meet the needs of the evolving field.

References

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