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BRIEF REPORT

Implementing comprehensive pharmacogenomics in a community hospital–associated primary care setting

Jennifer A. Wick, Tara Schmidlen, Kendra Grande, Chad Moretz, Kristine Ashcraft, Julia Green, Nicolas Moyer, Burns C. Blaxall*

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ABSTRACT

Background: Pharmacogenomics (PGx) is an emerging field. Many drug-gene interactions are known but not yet routinely addressed in clinical practice. Therefore, there is a significant gap in care, necessitating development of implementation strategies.

Objective: The objective of the study was to assess the impact of implementing a PGx practice model which incorporates comprehensive pharmacogenomic risk evaluation, testing and medication optimization administered by 7 PGx-certified ambulatory care pharmacists embedded across 30 primary care clinic sites.

Methods: Pharmacogenomic services were implemented in 30 primary care clinics within the Cincinnati, Ohio area. Patients are identified for pharmacogenomic testing using a clinical decision support tool (CDST) that is fully integrated in the electronic medical record (EMR) or by provider designation (e.g., psychotropic drug failure). Pharmacogenomic testing is performed via buccal swab using standardized clinic processes. Discrete data results are returned directly into the EMR/CDST for review by PGx-certified ambulatory care pharmacists. Recommendations and prescriptive changes are then discussed and implemented as a collaborative effort between pharmacist, primary care provider, specialists, and patient.

Results: A total of 422 unique interactions were assessed by the embedded ambulatory care PGx pharmacists (N = 7) during this interim analysis. About half (213) were pharmacogenomic interactions, and of these, 124 were actionable. When an intervention was actionable, 82% of the time a change in medication was recommended. The underlying reasons for recommending therapy alterations were most commonly ineffective therapy (43%), adverse drug reaction prevented (34%), or adverse drug reaction observed (13%).

Conclusion: Variations in drug metabolism, response, and tolerability can negatively impact patient outcomes across many disease states and treatment specialties. Incorporation of pharmacogenomic testing with accessible clinical decision support into the team-based care model allows for a truly comprehensive review and optimization of medications. Our initial analysis suggests that comprehensive PGx testing should be considered to enhance medication safety and efficacy in at-risk patients.

Background

Pharmacogenomics (PGx) is the study of how genetic variations affect the metabolism, action, and tolerability of medications. Such interactions are detailed on prescription labeling; over 100 medications listed in the Food and Drug Administration (FDA) Table of Pharmacogenetic Associations have labeling guidance for PGx.[1] Given the therapeutic impact of these interactions, multiple organizations have developed evidence-based guidelines and recommendations for integrating PGx into clinical practice. The Clinical Pharmacogenetics Implementation Consortium (CPIC) and Dutch Pharmacogenetics Working Group (DPWG) are among the most cited.

The CPIC is an international consortium group with guidelines endorsed by The Association for Molecular

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* **Correspondence:** Burns C. Blaxall, PhD, FACC, FAHA, FISHR, FAPS, 2139 Auburn Ave, Cincinnati, OH 45219.
E-mail address: burns.blaxall@thechristhospital.com (B.C. Blaxall).

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Pathology, The American Society for Clinical Pharmacology and Therapeutics Board of Directors, and The American Society of Health-System Pharmacists. The CPIC has developed evidence-based guidelines for a variety of genes and medications. Their guidelines span the traditional pharmacogenomic interactions of psychiatric medications and extend to genes and indications implicated in cardiology, oncology, human immunodeficiency virus, epilepsy, gastroenterology, and more. More than 70 medications currently have level A or B PGx guidance from the CPIC, meaning there is both evidence and actionability.[2]

The DPWG, an interdisciplinary group funded by the Royal Dutch Pharmacists' Association, provides pharmacogenomic therapeutic recommendations and assists providers by integrating recommendations into electronic systems for prescription surveillance.[3] While CPIC, DPWG, and FDA guidance often aligns, there are many differences.[4,5]

Integration of guidelines and recommendations into clinical practice is a relatively new endeavor. While psychiatric pharmacogenomic testing has gained interest, comprehensive integration of FDA, CPIC, and DPWG guidance is less prevalent and largely limited to academic medical centers.[6-8] At The Christ Hospital Health Network, a community hospital health system, precision medicine has been a focus since 2019. The precision medicine service offers disease risk evaluation (e.g., hereditary cancer evaluation, genetic counseling, and testing); however, the program also focuses on pharmacogenomic services. This brief report details the implementation of comprehensive PGx within the network as a novel practice model.

Objectives

The objective was to determine the impact of implementing pharmacogenomic services within primary care offices associated with a community health network, utilizing embedded, PGx-certified ambulatory care pharmacists, a PGx risk evaluation tool, a comprehensive PGx gene panel, and a clinical decision support tool (CDST) integrated in the electronic medical record (EMR) with a discrete order/result interface.

Methods

Pharmacogenomic services within The Christ Hospital Health Network are largely driven by outpatient offices. Outpatient utilization of PGx is expected to be higher than other settings due to less pressure for rapid result return. The first pharmacist was embedded in primary care offices in 2019. Expansion of this model to 7 PGx-certified ambulatory care pharmacists has been integral to the implementation of pharmacogenomic care.

Each of our ambulatory pharmacists is embedded directly into the primary care clinics. The pharmacists are physically located in the offices and assist with chronic disease management, medication therapy management, and PGx. They are each board certified in a related practice area and PGx certified. Board certification is administered through the Board of Pharmacy Specialties, the only board certifying body for pharmacists in the United States. PGx certification was administered through the American College of Clinical Pharmacy, one of several bodies offering such certification. The pharmacists serve as medication and pharmacogenomic experts, interpreting results and providing subsequent therapy recommendations to prescribers within and beyond primary care.

The service has also capitalized on recent technology advancements, both patient and provider facing. Prior to their visit, patients receive basic education on PGx and next steps for testing via a chatbot. Providers universally experience PGx via the EMR-integrated CDST that analyzes potential drug-gene interactions to determine if testing is recommended based on current evidence. This is presented to the pharmacist and provider as both a pharmacogenomic interaction probability[9-11] (PIP, percentage) score and as a testing recommendation (recommended, optional, etc.). The PIP score, developed by the PGx company Invitae, calculates the probability of finding a pharmacogenomic interaction given known gene prevalence and current medications, while the testing recommendation reflects the highest level of evidence supporting testing for each drug-gene pair by either FDA labeling or CPIC guidance. Test ordering and discrete data result returns both occur directly within the EMR. Coupled with the integrated CDST, all results are evaluated by a PGx-certified pharmacist. The CDST also evaluates drug-drug interactions and phenoconversion, where medications can alter the genetic phenotype, such as an inhibitor making an intermediate metabolizer a poor metabolizer. The pharmacogenomic panel utilized by The Christ Hospital Health Network is a 25-gene panel performed on a buccal swab specimen. This eliminates needle-phobia barriers and facilitates easy collection in the office or lab. Orders can be placed by any provider within The Christ Hospital Health Network. Results are returned within 7-14 days.

PGx results are sent to the clinic's embedded ambulatory care pharmacist via electronic EMR inbox. The pharmacists analyze patient pharmacogenetic results in combination with their current medications, disease states, and reported tolerability to develop individualized recommendations. The EMR-integrated PGx CDST facilitates identifying relevant literature, FDA labeling, and CPIC/DPWG guidance when developing actionable recommendations. When interactions are detected, the CDST provides interaction information on alternates by class or indication. Together, the prescriber(s), patient, and pharmacist review recommendations and determine a personalized and optimized medication regimen.

Pharmacist interventions are also captured in the CDST. A quality assurance (QA) analysis was conducted to assess the impact of a PGx practice model, which incorporates embedded ambulatory pharmacists and an EMR-integrated CDST. A detailed outcome analysis, encompassing quality and financial impacts is forthcoming.

The QA analysis includes data on patients currently enrolled in an institutional review board—approved, large-scale, prospective, randomized, controlled PGx clinical trial in progress at The Christ Hospital Health Network. The analysis provided data on the total number of interactions assessed, the total number of actionable interventions, interaction type, recommended action, and recommended action rationale. Data were extracted via the CDST in April 2022.

Results

A total of 228 patients who underwent recommended PGx testing had 422 unique interactions assessed by one of 7

Table 1
Study inteventions by pharmacists either overall or specifically based on PGx testing results

Pharmacist PGx study interventions	Totals	PGx only
Unique patients with an intervention	228	163
Avg interventions per pharmacist	60	30
Intervention types	**Totals**	**PGx only**
Total interventions	422	213
Actionable interventions	181	124
Discontinue medication	36	16
Change medication	126	102
Dose increase	4	3
Dose decrease	10	3
Separate dosing	5	NA
No change	237	89
Not taking (reported by patients after analysis)	4	0
Intervention reasons (actionable, multi-selection allowed)		
ADR prevented	84	49
ADR observed	26	18
Ineffective therapy	75	62
Other	9	7
No longer necessary	10	7
Therapeutic duplication	4	0
Nonadherence	2	0

Abbreviations used: ADR, adverse drug reaction; PGx, pharmacogenomics.

embedded ambulatory care pharmacists. Patients who had interactions assessed were female (65%), had an average age of 66 years, and were taking an average of 10.5 medications. The average PIP score—the probability that at least one actionable PGx interaction would be identified with testing—for the 228 patients was 62%. These data are summarized in Table 1.

Of 422 unique interactions, 213 (50.5%) were pharmacogenomic and 124 were actionable, with a change to therapy recommended. Of the actionable interventions, in 82% (102 interventions) the pharmacist recommended changing the medication to an alternate. Other intervention recommendations are summarized in Figure 1A. The underlying reasons for intervention were ineffective therapy (62 interventions, 43%) and prevention of adverse drug reactions (49 interventions, 34%). These data are summarized in Figure 1B.

Discussion

Emerging evidence continues to support the importance of integrating PGx into clinical practice.[12] However, optimizing implementation remains a challenge. Our preliminary results indicate that implementation of a pharmacist-guided PGx service embedded in primary care offices supported by EMR-integrated ordering, return of results, and CDST may provide an optimized method to integrate benefits of PGx into clinical practice. Of the patients who were assessed for PGx risk in this model, 41% had several medication interactions, both pharmacogenomic and otherwise. Of those with pharmacogenomic interactions, >80% had alternate therapies recommended per guidelines. This percentage is substantial and indicates that a large proportion of our clinic patients stand to benefit from PGx testing.

Qualitative reports from staff and providers have indicated high satisfaction and very limited recommendation refusal. We believe this is in large part due to our innovative practice model utilizing PGx pharmacists embedded in primary care. Provider recommendation acceptance can be a lagging measure, and data collection is ongoing.

Embedding residency-trained ambulatory care pharmacists who are certified in PGx has been vital to our success. Our practice model capitalizes on their expert drug knowledge as well as their existing relationships with patients and providers. The providers trust and empower their clinic-based PGx pharmacists, which may improve recommendation acceptance. The use of the pharmacists for PGx result analysis and initial interpretation via the EMR has also increased implementation uniformity and speed. A single group of certified individuals is able to make recommendations without pulling current staff away from their busy clinic workflow.

In addition to avoiding resource siphoning, our pharmacogenomic service model can be a resource optimizer. The pharmacists we utilize for this process routinely conduct comprehensive medication reviews and chronic disease state management. PGx can be incorporated into these services as an extension of drug interaction analysis. Additionally, the pharmacist can collaborate with providers across service lines for medication optimization. This is a substantial enhancement to value-based care, increasing value and improving care within the traditional clinic service model.

While these data reflect our successful implementation in the primary care sector, we also believe that improvement and expansion are possible. In the coming years, cardiology, oncology, and musculoskeletal specialty practices are likely to be included. Expanding the use of CDST and EHR integration is also on the horizon. Proactive gene-drug interaction alerts may allow our providers to begin intervention prior to medication initiation. Long-term, pre-emptive PGx testing on all patients will inform lifelong prescribing. While outside the scope of this brief description, there are also emerging positive economic advantages from PGx testing.[12] Studies have validated health care savings and outcome improvements such as reductions in hospitalizations, and direct testing reimbursement is expanding rapidly.[13,14]

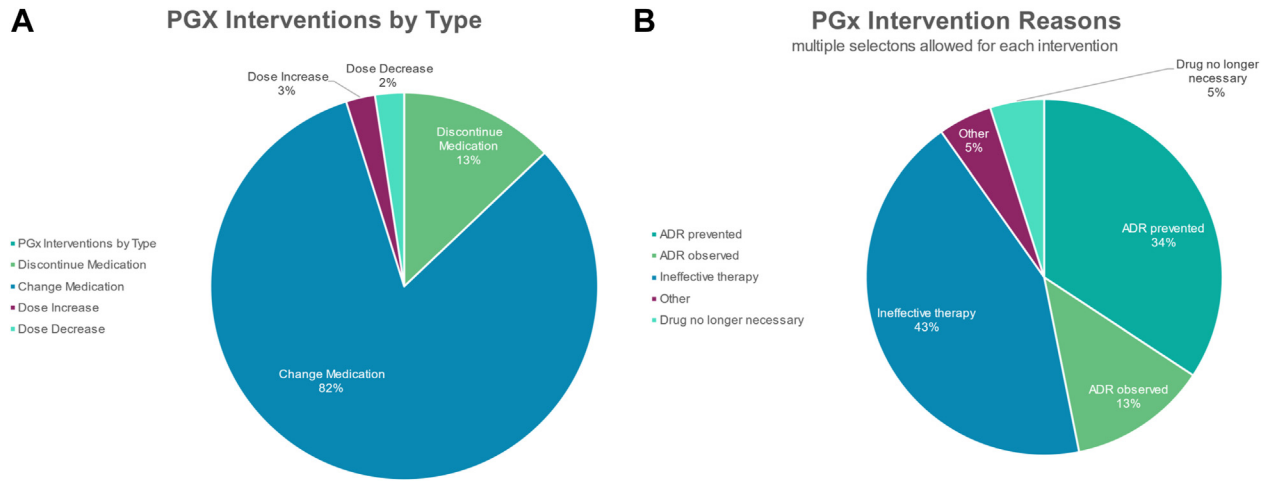

Figure 1. Type and reasons for PGx interventions implemented by pharmacists following PGx testing.

There are other examples of implementing PGx in the primary care setting, as well as other varieties of PGx panel implementations. However, these have largely focused on either a low burden implementation in a disease-focused manner (e.g., psychiatry)[15,16] or a broader implementation of PGx testing that is supported by an academic institution (e.g., academic medical center).[17] Many of these studies also rely on an EMR-derived best practice alert that may not be heeded by the provider (often with <50% acceptance[18]). It is well documented that alert fatigue contributes to decreased acknowledgment across all types of alerts.[19] Our data reflect the impact of integrating these strategies: comprehensive gene inclusion and PGx testing interpreted by PGx pharmacists, all implemented beyond the walls of academia. This increases the clinical utility of PGx in a manner not previously seen. Our approach may be adaptable to other sites.

Of note, our health system is uniquely positioned in Ohio, where pharmacists are being recognized in both a provider and billing capacity. This has substantially aided our implementation. As other states such as Washington[20] and California[21] expand provider status and billing opportunities, the opportunity for similar implementations in other locales becomes possible. National advocacy and action on this issue will also be vital for expansion of many clinical pharmacy services, PGx included. Current national efforts, including the Right Drug, Dose, Now Act[22] as well as the Cures 2.0 act,[23] may aid the broader implementation of PGx into clinical practice.

Conclusion

Here, we demonstrate that PGx testing, evaluation, and recommendation within a primary care setting offer significant opportunities to improve patient care through evidence-based, collaborative decision making. Our innovative practice model and data show that full EMR integration and CDST guided by PGx pharmacists embedded within the primary care clinic is vital to success. This practice model also provides additional benefits, such as comprehensive and integrated medication therapy management. We believe continued expansion of both pharmacist and pharmacogenomic services is vital to the optimization of patient care, outcomes, and the expansion of value-based care.

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Jennifer A. Wick, PharmD, MPH, BCACP, Ambulatory Care Pharmacist Manager, Precision Medicine, The Christ Hospital Health Network, Cincinnati, OH

Tara Schmidlen, MS, CGC, Clinical Program Manager-Proactive Genetics, Invitae Corporation, San Francisco, CA

Kendra Grande, RPh, Software Success | Pharmacogenomics Pharmacist, Invitae Corporation, San Francisco, CA

Chad Moretz, ScD, Health Economics and Outcomes Research Lead, Invitae Corporation, San Francisco, CA

Kristine Ashcraft, BS, MBA, Medical Affairs Director, Pharmacogenomics, Invitae Corporation, San Francisco, CA

Julia Green, MPH, Population Health and Value Based Care Lead, Invitae Corporation, San Francisco, CA

Nicolas Moyer, BS, Data Engineer, Invitae Corporation, San Francisco, CA

Burns C. Blaxall, PhD, FACC, FAHA, FISHR, FAPS, Executive Director, Precision Medicine, The Christ Hospital Health Network, Cincinnati, OH