Nurses' communication of pharmacogenetic test results as part of discharge care

As pharmacogenetic (PGx) testing is becoming integrated into routine clinical procedures for admitted hospital patients, consideration is needed as to when test results will be communicated to patients and by whom. Given the implications of PGx test results for current and future care, we propose that if results are not promptly discussed with patients when testing is completed, results should be discussed with patients during discharge care when possible, included in the printed or electronic discharge summary and a copy of the results sent to their primary provider. Nurses play an important role in discharge planning and care by providing patients with the necessary information and support to transfer from the hospital setting to an outpatient setting or to return to home and work. To promote nurses' ability to fulfill the role of communicating PGx test results, revised curricula and interprofessional and clinical decision support are needed.

Keywords: education • nursing • patient communication • pharmacogenetic testing

Pharmacogenetic (PGx) testing is one of the pillars of the personalized medicine movement. As the use of PGx testing continues to increase and testing for more drugs becomes standard of care, new delivery models need to be considered [1–3]. Delivery of PGx services may occur at the time when a drug is prescribed (point of care) or preemptively to inform future medication needs [4,5]. Some groups are including PGx testing as part of the suite of tests ordered upon hospital admission, anticipating that most patients will warrant some pharmacological treatment before being discharged [6–8]. Given the potential lifetime benefits of PGx testing, it is critical to communicate these test results to patients. If it is not feasible to immediately communicate the results when testing is completed, the results should be provided during the discharge care as part of the overview of diagnostic procedures performed during the hospital stay. Nurses play a vital role in discharge planning and patient education [9], with several studies reporting improved health outcomes with

nurse education and discharge instructions during this often stressful time for patients [10–12]. Nurses will need to increase their knowledge about PGx testing to provide comprehensive discharge care and effectively respond to patient needs. In particular, nurses may benefit from interprofessional and clinical decision support systems to effectively communicate to patients about PGx testing during the discharge period.

Importance of patient-provider discussion of PGx testing

Ideally, PGx testing would be discussed with the patient prior to ordering the test. Specifically for genetic testing, informed consent is often warranted given the unique risks such as the potential for incidental information and genetic discrimination. However, in the hospital setting, this may not always be possible depending on the patient's condition and the time when testing is ordered (e.g., immediately upon admission). Many clinical procedures and tests considering standard of care are covered by a general 'consent for

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treatment.' However, if circumstances permit discussion with a patient about PGx testing at the time testing is ordered or require consent, nurses may play a key role with patient education to help patients understand the purpose of PGx testing, risks and benefits of testing, the genetic basis of the test and potential benefits of testing for future treatment [13].

At the time that testing is completed, the results should be reviewed with the patient if the patient is in an alert state and able to comprehend the results. When describing the test outcomes, providers should repeat or describe (if not mentioned previously) the purpose of the test, the results and their interpretation, the limitations of testing, how the results will impact current treatment and how PGx results may impact future drug treatments [13]. While a 'normal' result may not typically be reported for some clinical tests, for PGx testing, communicating a normal result is just as important as an abnormal result as it will help avoid duplicate testing and reassure patients of the safety of the drug and its likelihood to work for them, thereby potentially promoting adherence [14]. Patients should be encouraged to share their results with every treating provider to reduce the potential for duplicate testing and ensure optimal prescribing for future medications. Given the challenges of transfer of hospital health records to the general practitioner or other provider [15,16], the patient will benefit from having a good understanding about testing to enable sharing with other providers.

Nurse communication of PGx test results at discharge

In the event that communication of PGx test results is overlooked or not feasible during the hospital stay, it should be reviewed with the patient at discharge and a copy of the report included in their discharge records. The US Joint Commission on the Accreditation of Healthcare Organizations requires that discharge summaries include six elements: reason for hospitalization; significant findings (primary diagnosis); procedures and treatment provided during hospital stay; patient's condition at time of discharge; instructions for the patient/family (including medication, physical activity and therapy); and signature of attending physician (Standard IM.6.10, EP 7). For the few hospitals that are currently integrating PGx testing, a highly regimented clinical support system of review and interpretation of results for treating providers is in place [6]. Without this infrastructure, PGx results may be overlooked by nonordering providers due to lack of general knowledge about how to interpret and apply them to treatment decisions. To our knowledge, there are no data available about the communication of PGx results

to patients in a hospital (or any other clinical) setting, but it will be important for patients to understand the results and share them with providers since test results will likely be significant to a range of medications [17].

To illustrate a nurse's role with PGx testing, consider the following hospital-based clinical scenario. A patient is admitted for an emergency surgery following a car accident. Upon admission, a blood sample was collected for blood typing and PGx testing. Following surgery, standard hospital practice is to administer Vicodin® or Percocet® (typically an acetaminophen combination with hydrocodone or oxycodone) and provide a prescription for a few days of pain medication. However, while her husband is in surgery, the patient's wife informed the nurse that he is allergic to acetaminophen. The provider decides that the best pain relieving options may be oxycodone or codeine due to the acetaminophen allergy. In addition, testing results are available the next day and the patient is found to be an ultrarapid metabolizer of *CYP2D6*. Therefore, he will metabolize a standard dose of codeine more rapidly than normal and would not have sufficient pain relief [18]. Thus, the provider informs the patient of these findings, prescribes a noncodeine-based medication and a note is made in the patient's chart for future prescribing. At discharge, the nurse reviews the PGx test results again with the husband and wife to promote understanding of how the results impacted the choice of pain medication and may potentially impact selection and dosing of other medications.

Overcoming challenges to communicating PGx test results

In general, several challenges related to discharge planning and care have been reported including limited knowledge, unclear provider roles and responsibilities, and time [19]. Several studies have noted that laboratory results (current and especially pending results) are less frequently included in discharge summaries [16,20–22]. Additional challenges associated with limited provider knowledge of and communication of PGx results [23] may also affect how well patients comprehend the test results. The nursing community has already recognized the need to revise curricula and training to provide nurses with the knowledge and skills to deliver genetics care in general [24–26]. Genetics and genomics nursing competencies developed in part by the American Nurses Association also include PGx as a specific area of knowledge and describes several clinical performance indicators including the ability to describe genetic and genomic factors that contribute to pharmacologic variability to patients and the ability to safely administer medications after considering PGx testing results [27]. Similarly, the American

Nursing Association (ANA) and International Society of Nurses in Genetics recommend incorporation of PGx information for genetically targeted drugs [28]. The UK Task and Finish Group Report to the Nursing and Midwifery Professional Advisory Board also recommended that nurses should be educated about PGx [29], particularly for nurses working with cancer patients [30].

Though some groups have begun to incorporate genetics and genomics into care [31] and nursing curricula [32], evidence suggests that programs have not been substantially revised to provide nurses with the knowledge and skills defined by these competencies [33,34] suggesting the need for targeted continuing education programs [23,35,36]. In addition to the recommendations to implement the genetic competencies recommended by the ANA [27], programs are needed to 'train the trainer' to help increase PGx content in coursework and training and ensure that leaders in nursing education are able to effectively share this knowledge with students. Consideration should also be given to developing opportunities to cross-train with other professional trainees at institutions with multiple health professional schools and programs. Interprofessional continuing education programs can further engage nurses and encourage learning from and with other trainees [37,38]. For example, nursing students can acquire fundamental understanding of PGx by working alongside pharmacy students. Learning opportunities with genetic counselors or genetic nurses would enable nursing students to gain communication and counseling skills needed to effectively discuss PGx testing with patients. Continuing education programs can also serve to update nurses about specific PGx tests relevant to certain specialties or introduce new applications.

Utilization of interprofessional care could also greatly benefit patients and alleviate some of the challenges experienced by nurses [37,38], particularly regarding providing information about the impact of PGx testing on medication. Effective interprofessional care includes well-defined roles of each provider [39]. The ordering physician would have the primary responsibility of interpreting PGx results and making the necessary changes to the patient's medication while the nurse would assist the physician in executing the medicine changes, educate the patient about testing and results and address any questions the patient may have (the latter two roles may be in addition to the physician in order to promote patient comprehension). Interprofessional PGx services can include additional providers as well. For example, pharmacists can provide support to help physicians interpret results and assist nurses with understanding the interpretation of

results and the implications of test results on medication decisions so that they can share that information with their patients. A pharmacist or a multidisciplinary panel established to review medication regimen for patients pending discharge demonstrated significant reduction in medication errors [40,41]. Although pharmacists do not routinely provide medication counseling at discharge [42], the delivery of medication counseling by a pharmacist has been reported to be more effective than the standard discharge care [43–45]. Some nurses have recognized the challenges of providing medication counseling [46], although the extent, feasibility and interest in collaborating with pharmacists are uncertain.

Effective communication of PGx information may be further complicated by the already extensive amount of information typically provided during discharge, the emotional distress of the transition and the additional time required to discuss testing. Some patients do not understand some of the information conveyed during discharge, including information about their medications [47], particularly for older patients [48,49]. For hospitals that are or will soon begin to implement preemptive PGx testing, providers and patients may benefit from a section on PGx testing in the discharge summary or a separate handout of the results. For instance, dissemination of a card or patient-friendly version of the lab report may be extremely helpful to patient understanding, recall and sharing of results with future providers. In addition, providing a list of accurate online resources or tools such as the Medicine Safety Code initiative [50] may help patients better understand the results. Alternatively, use of electronic summaries may enable patients to review the test results at a later time and facilitate sharing with other providers via a downloadable version of the results [51]. Both options can help nurses to optimize limited time with patients.

Conclusion

Not much literature exists regarding provider roles and skills needed to appropriately deliver PGx testing and what specific information should be communicated to patients. We believe that nurses will be a key resource of health information for the patient. Due to the increase in PGx testing in hospitals and various outpatient settings, it is imperative for nurses to be aware of testing and its impact on patient care. If testing is performed in the hospital setting, nurses may be responsible for reviewing PGx information with patients at the time testing is ordered or during discharge. Thus, a need exists to promote nurses' knowledge of PGx testing nurses through education and training and interprofessional collaboration to

enable nurses to effectively and efficiently communicate information about PGx testing to the patient and optimize patient comprehension.

Future perspective

The use of PGx testing is expected to continue to increase in the coming years and potentially become part of regular clinical care in hospital and office-based settings. Patient education will be a key component of maximizing utility of PGx testing for the patient's lifetime and patients may benefit from clinical support that would promote greater recall of the gene(s) they have had testing for, the result of the test and greater understanding overall of the potential impact of a genetic variation on drug response. Patient health portals can facilitate access of laboratory reports and

enable sharing of the test report between providers. Thus, if patients have a fundamental understanding about PGx testing, such online tools for patients can further promote integration of the results each time a new medication is prescribed.

Financial & competing interests disclosure

SB Haga is a paid consultant to the nonprofit Inova Translational Medicine Institute. This work was supported by NIH grant R01-GM081416. The authors have no other relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript apart from those disclosed.

No writing assistance was utilized in the production of this manuscript.

Executive summary

- The utility of pharmacogenetic (PGx) testing will be optimized if patients understand their PGx test results and the potential impact of the results on both currently prescribed and future medications.
- Nurses will likely play a key role in the provision of genomic and personalized medicine, including patient education about testing and communication of test results.
- In the hospital setting, circumstances or policies may not enable discussion of PGx testing with the patient at the time testing is ordered or when testing is completed. Thus, review of PGx testing results should be included in discharge care, a responsibility primarily of nurses.
- Revisions to nursing curricula, development of interprofessional care and clinical decision support can help nurses fulfill this role.

References

- Callard A, Newman W, Payne K. Delivering a pharmacogenetic service: is there a role for genetic counselors? *J. Genet. Couns.* 21(4), 527–535 (2012).
- Mills R, Haga SB. Clinical delivery of pharmacogenetic testing services: a proposed partnership between genetic counselors and pharmacists. *Pharmacogenomics* 14(8), 957–968 (2013).
- Haga SB, Moaddeb J. Comparison of delivery strategies for pharmacogenetic testing services. *Pharmacogenet. Genomics* 24(3), 139–145 (2014).
- Adelung MR, Fitzsimons VM. Pharmacogenomics: the path to individualised patient care. *Br. J. Nurs.* 23(13), 738–739 (2014).
- Wei CY, Lee MT, Chen YT. Pharmacogenomics of adverse drug reactions: implementing personalized medicine. *Hum. Mol. Genet.* 21(R1), R58–R65 (2012).
- Hoffman JM, Haidar CE, Wilkinson MR *et al.* PG4KDS: a model for the clinical implementation of pre-emptive pharmacogenetics. *Am. J. Med. Genet. C* 166(1), 45–55 (2014).
- Pulley JM, Denny JC, Peterson JF *et al.* Operational implementation of prospective genotyping for personalized medicine: the design of the Vanderbilt PREDICT project. *Clin. Pharmacol. Ther.* 92(1), 87–95 (2012).
- Van Driest SL, Shi Y, Bowton EA *et al.* Clinically actionable genotypes among 10,000 patients with preemptive pharmacogenomic testing. *Clin. Pharmacol. Ther.* 95(4), 423–431 (2014).
- Glaholt S, Hayes GL, Wisniewski CS. Evaluation of discharge medication orders following automatic therapeutic substitution of commonly exchanged drug classes. *PT* 39(4), 267–277 (2014).
- Ho SM, Heh SS, Jevitt CM, Huang LH, Fu YY, Wang LL. Effectiveness of a discharge education program in reducing the severity of postpartum depression: a randomized controlled evaluation study. *Patient Educ. Couns.* 77(1), 68–71 (2009).
- Lambrinou E, Kalogirou F, Lamnisos D, Sourtzi P. Effectiveness of heart failure management programmes with nurse-led discharge planning in reducing re-admissions: a systematic review and meta-analysis. *Int. J. Nurs. Stud.* 49(5), 610–624 (2012).
- Shepperd S, Lannin NA, Clemson LM, Mccluskey A, Cameron ID, Barras SL. Discharge planning from hospital to home. *Cochrane Database Syst. Rev.* 1, CD000313 (2013).
- Mills R, Voora D, Peyser B, Haga SB. Delivering pharmacogenetic testing in a primary care setting. *Pharmacogenomics Pers. Med.* 6, 105–112 (2013).
- Haga SB, Lapointe NM. The potential impact of pharmacogenetic testing on medication adherence. *Pharmacogenomics J.* 13(6), 481–483 (2013).
- Kripalani S, Jackson AT, Schnipper JL, Coleman EA. Promoting effective transitions of care at hospital discharge:

- a review of key issues for hospitalists. *J. Hosp. Med.* 2(5), 314–323 (2007).
- 16 Kripalani S, Lefevre F, Phillips CO, Williams MV, Basaviah P, Baker DW. Deficits in communication and information transfer between hospital-based and primary care physicians: implications for patient safety and continuity of care. *JAMA* 297(8), 831–841 (2007).
 - 17 Wang B, Yang LP, Zhang XZ, Huang SQ, Bartlam M, Zhou SF. New insights into the structural characteristics and functional relevance of the human cytochrome P450 2D6 enzyme. *Drug Metab. Rev.* 41(4), 573–643 (2009).
 - 18 Crews KR, Gaedigk A, Dunnenberger HM *et al.* Clinical Pharmacogenetics Implementation Consortium guidelines for cytochrome P450 2D6 genotype and codeine therapy: 2014 update. *Clin. Pharmacol. Ther.* 95(4), 376–382 (2014).
 - 19 Nosbusch JM, Weiss ME, Bobay KL. An integrated review of the literature on challenges confronting the acute care staff nurse in discharge planning. *J. Clin. Nurs.* 20(5–6), 754–774 (2011).
 - 20 Roy CL, Poon EG, Karson AS *et al.* Patient safety concerns arising from test results that return after hospital discharge. *Ann. Intern. Med.* 143(2), 121–128 (2005).
 - 21 Walz SE, Smith M, Cox E, Sattin J, Kind AJ. Pending laboratory tests and the hospital discharge summary in patients discharged to sub-acute care. *J. Gen. Intern. Med.* 26(4), 393–398 (2011).
 - 22 Were MC, Li X, Kesterson J *et al.* Adequacy of hospital discharge summaries in documenting tests with pending results and outpatient follow-up providers. *J. Gen. Intern. Med.* 24(9), 1002–1006 (2009).
 - 23 Fairgrieve S, McDonnell S. Obtaining and communicating information about genetics and genomics. *Nurs. Stan.* 28(15), 37–41 (2013).
 - 24 Greco KE, Tinley S, Seibert D. Development of the essential genetic and genomic competencies for nurses with graduate degrees. *Annu. Rev. Nurs. Res.* 29, 173–190 (2011).
 - 25 Lewis JA, Calzone KM, Jenkins J. Essential nursing competencies and curricula guidelines for genetics and genomics. *MCN Am. J. Matern. Child Nurs.* 31(3), 146–153; quiz, 154–145 (2006).
 - 26 Umberger R, Holston EC, Hutson SP, Pierce M. Nursing genomics: practice implications every nurse should know. *Nurs. Clin. North Am.* 48(4), 499–522 (2013).
 - 27 Jenkins JF, Calzone K. *Essentials of Genetic and Genomic Nursing: Competencies, Curricula Guidelines, and Outcome Indicators (2nd Edition)*. American Nurses Association, Silver Spring, MD, USA (2008).
 - 28 Greco KE, Tinley S, Seibert D. *Essential Genetic and Genomic Competencies for Nurses with Graduate Degrees*. American Nurses Association and International Society of Nurses in Genetics, Silver Spring, MD, USA (2012).
 - 29 Kirk M, Campalani S, Doris F *et al.* Genetics/Genomics in Nursing and Midwifery: Task and Finish Group Report to the Nursing and Midwifery Professional Advisory Board. *Department of Health* (2011). www.gov.uk
 - 30 Genomics Policy Unit, Medical Genetics Service. Fit for Practice in the Genetics Era: a competence based education framework for nurses, midwives and health visitors. NHS Department of Health, University of Glamorgan (2004). www.geneticseducation.nhs.uk
 - 31 Junglen L, Pestka EL, Clawson M, Fisher S. Incorporating genetics and genomics into nursing practice: a demonstration. *Online J. Issues Nurs.* 13(3), 7 (2008).
 - 32 Daack-Hirsch S, Jackson B, Belchez CA *et al.* Integrating genetics and genomics into nursing curricula: you can do it too! *Nurs. Clin. North Am.* 48(4), 661–669 (2013).
 - 33 Kirk M, Calzone K, Arimori N, Tonkin E. Genetics-genomics competencies and nursing regulation. *J. Nurs. Scholarsh.* 43(2), 107–116 (2011).
 - 34 Thompson HJ, Brooks MV. Genetics and genomics in nursing: evaluating Essentials implementation. *Nurse Educ. Today* 31(6), 623–627 (2011).
 - 35 Coleman B, Calzone KA, Jenkins J *et al.* Multi-ethnic minority nurses' knowledge and practice of genetics and genomics. *J. Nurs. Scholarsh.* 46(4), 235–44 (2014).
 - 36 Kelly P. Understanding genomics: no longer optional for gastroenterology nurses. *Gastroenterol. Nurs.* 31(1), 45–54 (2008).
 - 37 Careau E, Briere N, Houle N, Dumont S, Vincent C, Swaine B. Interprofessional collaboration: development of a tool to enhance knowledge translation. *Disabil. Rehabil.* 14 1–7 (2014).
 - 38 Reeves S, Perrier L, Goldman J, Freeth D, Zwarenstein M. Interprofessional education: effects on professional practice and healthcare outcomes (update). *Cochrane Database Syst. Rev.* 3, CD002213 (2013).
 - 39 Interprofessional Education Collaborative Expert Panel: Core competencies for interprofessional collaborative practice: Report of an expert panel. Interprofessional Education Collaborative, Washington, DC, USA (2011).
 - 40 Beardsley JR, Schomberg RH, Heatherly SJ, Williams BS. Implementation of a standardized discharge time-out process to reduce prescribing errors at discharge. *Hosp. Pharm.* 48(1), 39–47 (2013).
 - 41 Christiansen SR, Morgan JA, Hilmas E, Shepardson A. Impact of a prescription review program on the accuracy and safety of discharge prescriptions in a pediatric hospital setting. *J. Pediatr. Pharmacol. Ther.* 13(4), 226–232 (2008).
 - 42 Pedersen CA, Schneider PJ, Scheckelhoff DJ. ASHP national survey of pharmacy practice in hospital settings: monitoring and patient education – 2012. *Am. J. Health Syst. Pharm.* 70(9), 787–803 (2013).
 - 43 Pal A, Babbott S, Wilkinson ST. Can the targeted use of a discharge pharmacist significantly decrease 30-day readmissions? *Hosp. Pharm.* 48(5), 380–388 (2013).
 - 44 Warden BA, Freels JP, Furuno JP, Mackay J. Pharmacy-managed program for providing education and discharge instructions for patients with heart failure. *Am. J. Health Syst. Pharm.* 71(2), 134–139 (2014).
 - 45 Sarangarm P, London MS, Snowden SS *et al.* Impact of pharmacist discharge medication therapy counseling and disease state education: pharmacist assisting at routine

- medical discharge (project PhARMD). *Am. J. Med. Qual.* 28(4), 292–300 (2013).
- 46 Kendall S, Deacon-Crouch M, Raymond K. Nurses' attitudes toward their role in patient discharge medication education and toward collaboration with hospital pharmacists: a staff development issue. *J. Nurses Staff Dev.* 23(4), 173–179 (2007).
- 47 Horwitz LI, Moriarty JP, Chen C *et al.* Quality of discharge practices and patient understanding at an academic medical center. *JAMA Intern. Med.* 173(18), 1715–1722 (2013).
- 48 Maniaci MJ, Heckman MG, Dawson NL. Functional health literacy and understanding of medications at discharge. *Mayo Clin. Proc.* 83(5), 554–558 (2008).
- 49 Albrecht JS, Gruber-Baldini AL, Hirshon JM *et al.* Hospital discharge instructions: comprehension and compliance among older adults. *J. Gen. Intern. Med.* 29(11), 1491–1498 (2014).
- 50 Samwald M, Freimuth RR. Making data on essential pharmacogenes available for every patient everywhere: the Medicine Safety Code initiative. *Pharmacogenomics* 14(13), 1529–1531 (2013).
- 51 O'leary KJ, Liebovitz DM, Feinglass J *et al.* Creating a better discharge summary: improvement in quality and timeliness using an electronic discharge summary. *J. Hosp. Med.* 4(4), 219–225 (2009).