Educating Future Providers of Personalized Medicine

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No longer isolated specialties, genetics and genomics now span all fields of medicine. However, efforts to improve the genomic literacy of health care providers have struggled to keep pace with this change [1]. Canonical approaches to teaching genetics are not necessarily appropriate for the next generation of providers, who will be expected to implement genomic approaches in the clinic [2]. At the same time, patients increasingly have access to personal genomic information that has the potential to empower them to engage with clinicians and to collaborate on improving their health. Given this situation, how can we equip the provider workforce to meaningfully respond to patients' needs?

A cross-disciplinary team of faculty and staff members of the Duke University School of Nursing and the Duke Center for Personalized and Precision Medicine developed a formal genomics and personalized medicine curriculum for providers, which consists of 2 specialty electives designed for entry-level and advanced students in nursing and other health professionals. These interdisciplinary courses foster professional development and applied learning in key content areas. The focus of the courses is on clinical applications of genomics for the prevention, prognosis, and treatment of complex disease states; optional personal genome testing is made available through an online provider as an experiential learning tool. Overarching themes include ethical and social considerations relating to genome-based information and implications for personal health, public health, and public policy. The courses, which address all core competencies in genomics and genetics for nurses [3] and medical professionals [4] (eg, risk assessment, genetic testing and counseling, clinical management, and ethical implications), focus on underlying genomics concepts, communication with patients, and resources for evaluating technologies and calculating risk [1].

Rather than offering a traditional review of technologies within disease states (eg, cardiovascular risk, cancer, diabetes), the courses take a concept-based approach, discussing topics such as heterogeneity, oligogenicity, and gene-environment interactions. The courses also provide relevant examples from current literature. Classroom exercises build skills in evaluating the clinical validity and utility of genomic applications. Students emerge armed with real-world skills in using genomic applications and personalized medicine approaches, as well as an understanding of the implications of genomic technologies for society.

Students are given an opportunity to evaluate their own genomes and to gain personal experience with genomic testing through optional, subsidized personal genome testing integrated into the curriculum. Similar approaches have been used to educate graduate and medical students [5-9] and have led to improved learning outcomes [9]. Duke learners also are provided with mock genome profiles that they can substitute for, or use to supplement, their own profile. The personal genome platform serves as a touchstone throughout the courses as students explore different contexts of genomic information, from risk perception to ethical concerns.

To address concerns regarding the inclusion of students' personal genomes as an educational component [6, 10], the following measures were taken and reviewed with an external advisory board: confidentiality of participation; discussion of ethical, legal, and social considerations of direct-to-consumer genetic tests; a requirement that all instructors and students sign confidentiality statements; institutional review board assessment of social science research on the utility of personal genomes in the classroom; establishment of an external advisory board to handle unexpected stress or troubling outcomes; and provision of subsidized telephonic genetic counseling through a third party. The curriculum also establishes foundational principles before students receive their personal genome reports.

In the pilot offering, students unanimously reported that the experiential learning approach enhanced the lessons, noting the advantage of self-reflection within the classroom and acknowledging that both scientific and ethical concepts were reinforced with the personal

genome reports. From an educational perspective, the personal genome testing provided an avenue for applied learning about genomic concepts and allowed for multiple embedded constructs to bridge and spark discussions. The genome platform sets a framework for evaluation of clinical validity and discussion of the personal and clinical utility of genomic tests, which fosters critical thinking and synthesis of concepts in personalized medicine. This approach cultivates a broad adaptive understanding of genomics and personalized medicine, beyond rote review of current technologies or disease-specific genome algorithms for care.

The challenges of translating genomic technologies into health care practice require novel approaches to educate existing and future health care providers. The future provider workforce must be armed with core principles of genomics, the ability to critically evaluate applications, and familiarity with the implications of genomic information in social and personal contexts. Experiential learning via a personal genome analysis can reinforce these concepts. Pedagogical approaches using personal genome testing of health care providers are likely to be beneficial when the focus of the course is on critical evaluation of dynamic concepts in human genomics. NCMJ

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Acknowledgments

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The authors wish to thank members of the Duke Task Force and Advisory Committee (Isaac Lipkus, Donald Bailey, Jane Blood-Siegfried, Alex Cho, Susanne Haga, Constance Johnson, William Kraus, Anneka Landgraf, Jennifer Mangum, Lori Orlando, Jane Peace, Nancy Short, Walter Sinnott-Armstrong, Dori Sullivan, Barbara Turner, Allison Vorderstrasse, Keith Whitfield, and Aimee Zaas), who were charged with developing an educational program in genomics and personalized medicine within the Duke University School of Nursing. We thank 23andMe for providing an academic discount for personal genome tests and InformedDNA for providing an academic discount for genetic counseling services.

Potential conflicts of interest. All authors have no relevant conflicts of interest. The providers of personal genome testing and analysis had no role in the development of the courses or in the preparation of this manuscript.

References

1. Guttmacher AE, Porteous ME, McInerney JD. Educating health-care professionals about genetics and genomics. Nat Rev Genet. 2007;8(2):151-157.
2. Redfield RJ. "Why do we have to learn this stuff?"-a new genetics for 21st century students. PLoS Biol. 2012;10(7):e1001356.
3. Jenkins J, Calzone KA. Establishing the essential nursing competencies for genetics and genomics. J Nurs Scholarsh. 2007;39(1):10-16.
4. National Coalition for Health Professional Education in Genetics (NCHPEG). Core Competencies in Genetics for Health Professionals, 3rd ed. Lutherville, MD: NCHPEG; 2007. http://www.nchpeg.org/index.php?option=com_docman&task=cat_view&gid=58&limitstart=35. Accessed September 9, 2013.
5. Ormond KE, Hudgins L, Ladd JM, Magnus DM, Greely HT, Cho MK. Medical and graduate students' attitudes toward personal genomics. Genet Med. 2011;13(5):400-408.
6. Walt DR, Kuhlik A, Epstein SK, et al. Lessons learned from the introduction of personalized genotyping into a medical school curriculum. Genet Med. 2011;13(1):63-66.
7. Vernez SL, Salari K, Ormond KE, Lee SS. Personal genome testing in medical education: student experiences with genotyping in the classroom. Genome Med. 2013;5(3):24.
8. Daley LA, Wagner JK, Himmel TL, et al. Personal DNA testing in college classrooms: perspectives of students and professors. Genet Test Mol Biomarkers. 2013;17(6):446-452.
9. Salari K, Karczewski KJ, Hudgins L, Ormond KE. Evidence that personal genome testing enhances student learning in a course on genomics and personalized medicine. PLoS ONE. 2013;8(7):e68853.
10. Callier SL. Swabbing students: should universities be allowed to facilitate educational DNA testing? Am J Bioeth. 2012;12(4):32-40.

Electronically published November 19, 2013.

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N C Med J. 2013;74(6):491-492.
0029-2559/2013/74607