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VIEWPOINTS

Transforming Pharmaceutical Education to Accelerate the Acceptance and Implementation of Personalized Medicine

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The lack of appropriate health professional education is considered a major barrier to the implementation of pharmacogenomics in clinical practice. Pharmacogenomics is important for personalized medicines and for safer, more effective pharmacotherapy. In simple terms, pharmacogenomics can improve the clinical outcomes of pharmacotherapy by the use of genetic information. This will lead to better medical care due to the better chance of therapeutic success and the reduction of adverse effects. It also may reduce health care costs by restricting use of certain treatments to those who will get the most benefit.[1] Worldwide, only a limited number of pharmacists use pharmacogenomics in their practice and this is usually in highly specialized roles. Yet, it is acknowledged that pharmacists, as drug therapy experts, should have a greater role incorporating pharmacogenomic information into patient care. There is a wide range of opportunities for pharmacists in the field of pharmacogenomics.

Translational medicine is loosely defined as "the process of applying ideas, insights, and discoveries generated through basic scientific research to the treatment or prevention of human disease." The International Society of Pharmacogenomics has stated that pharmacogenomics knowledge is necessary for incorporating personalized medicine approaches into routine clinical practice. To facilitate translation, it is essential that pharmacists are fully prepared for the use of pharmacogenomic diagnostic tools; however, insufficient education and the resulting lack of knowledge and contextual awareness of these tools will pose severe barriers to the widespread implementation of personalized medicine into clinical practice. This commentary aims to highlight critical issues surrounding the development of pharmaceutical education in order to accelerate the acceptance of personalized medicine.

Two policy resolutions passed by the 2008 American Association of Colleges of Pharmacy (AACP) House of Delegates recommended an increased focus on the advancement of education in biotechnology.[2] The first resolution examined the curricular implications of biotechnology and personalized medicine. It focused on the need for pharmacy curricula to address up-to-date issues associated with biotechnology advances in tailored medicine. Specific competencies highlighted were cell and system biology, bioengineering, genetics/genomics, proteomics, nanotechnology, cellular and tissue engineering, bio-imaging, computational methods, and information technologies. The second resolution focused on faculty development in biotechnology. This policy stated that "faculty development programs and collaborative research and teaching strategies should be expanded such that faculty at colleges and schools of pharmacy are prepared to lead and contribute significantly to education and research. . ."

Murphy and colleagues[3] recently assessed the breadth and depth of pharmacogenomics content instruction, the importance of these topics as perceived by respondents, and whether faculty development was available relative to these areas in US colleges of pharmacy. The main finding of this study was that the majority of colleges of pharmacy in the US are now providing some pharmacogenomics within their curriculum, indicating an increased awareness of the need to do so, and thus demonstrating alignment with AACP recommendations about including this material within the PharmD curriculum. The secondary finding is the somewhat limited focus in faculty development for this subject matter.

Brock and colleagues stated how pharmacists in pharmacogenomics have 3 distinct roles: discovering pharmacogenomics-based therapies and evaluating them in clinical trial settings (researchers), teaching pharmacists and other clinicians to apply pharmacogenomics modalities to patient-specific situations(educators), and utilizing pharmacogenomics information to recommend and monitor patient-specific medication regimens (clinicians).[4]

Clemerson and colleagues proposed that advances in pharmacogenetic testing may provide an opportunity for pharmacists to take on new roles including providing community pharmacy-based services.[5] Pharmacists in the future, they stated, may have responsibility for supporting prescribing decisions through medicine selection and dosage adjustment using pharmacogenetic information and providing an easily accessible source of advice and information on the subject to the public. They proposed

that pharmacists would need greater access to patients' medical records and that increased collaboration with prescribers will be essential to enable pharmacists to take on roles in this area.

In the United Kingdom, Clemerson and Payne acknowledged that fundamental understanding of the technologies used in pharmacogenomics is required and therefore the education of the pharmacy profession needs to be enhanced in this area.[6] A report commissioned by the Pharmacy Practice Research Trust identified certain areas where pharmacy could participate.[7] These included translating scientific research findings into working technologies and new clinical practices, developing new services, creating technical and organizational infrastructures in areas such as genetic testing, increasing professional knowledge and training, and establishing new governance regimens.

McKinnon and colleagues identified that skill sets required for the optimal participation of pharmacists in pharmacogenomics and personalized medicine include genetics, health economics, pharmacoepidemiology, modelling and simulation, therapeutics and regulatory pathways.[1] In terms of educating pharmacists, their study found that there was a disconnect between the identified barriers thought to be limiting pharmacogenomics uptake and the current status of pharmacogenomics material in pharmacy curricula.

Through an Australian telephone survey, Plevin and colleagues found that pharmacists possess an ideal skill set for the optimal use of targeted therapies in cancer, but that increased education relevant to targeted therapy in cancer is required to harness this resource.[8] Three general ideas that emerged from the interviews regarding pharmacy education around targeted therapies were that education around targeted therapies is important, especially given the recent availability of targeted therapies in community pharmacy; only a limited quantity of material on this topic should be covered, at least at the undergraduate level; and only appropriately trained pharmacists, rather than pharmacists in general, should handle targeted therapies.

Corkindale, Ward and McKinnon studied the reasons for low acceptance of pharmacogenetic tests in Australia and found that accurate and rapid interpretation of test results was a barrier to adoption of pharmacogenetics.[9] They concluded that pharmacists could potentially fill this gap in the health care system in a similar manner to which therapeutic drug monitoring is conducted by pharmacists at present. Given the widespread concerns of pharmacists around the toxicities of many medicines, a greater pharmacist involvement in using these tests could potentially help to ameliorate toxicities where such tests exist. It was highlighted that pharmacists could provide appropriate pharmacogenomic information to clinicians and to patients, thus becoming a valuable resource for consumers and help to promote acceptance and use of pharmacogenomics.

Pharmacogenomics and its underpinning areas of genetics, diagnostics, ethics, and regulatory affairs are a compelling example of the need to teach pharmaceutical science and practice in an integrated manner. Equally important is the need to ensure that pharmacists are able to effectively communicate about pharmacogenomics to relevant groups, including with patients. We believe that the educational strategies most likely to deliver these outcomes involve the integration of pharmacogenomics education into existing therapeutics and clinical teaching rather than as a standalone topic.

As the International Pharmaceutical Federation (FIP) pharmacy education taskforce recently stated "because of their knowledge of medicines and clinical therapeutics, pharmacists are suitably placed for task shifting in health care and could be further trained to undertake functions such as clinical management and laboratory diagnostics. . . A coordinated and multifaceted effort to advance workforce planning, training and education is needed in order to prepare an adequate number of well-trained pharmacists for such roles."[10]

There is still much to be done before pharmacogenomics is routinely implemented into clinical practice and personalized medicine becomes a reality, which highlights the need for transformation of pharmacogenomics education. Further research and development is vital to be able to propose the most appropriate structure for education programs for pharmacy students and practicing pharmacists, this could then aim to provide a detailed analysis of the importance of education in facilitating increased clinical acceptance and implementation of personalized medicine.

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