refuse patients because of their genetic composition (S. Bardal, personal communications, November 15, 2012).

According to Dr. Bardal, scientists in Canada, and more specifically British Columbia, are among the leaders in the field of pharmacogenomics. While the claims for the immediate impact of pharmacogenomics can be sensationalized in the media, its ultimate significance in medical practice is likely to be revolutionary. Although we have already seen much promise in the application of pharmacogenomics, especially in cancer therapy, it may be safe to say the best is yet to come.

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Direct-to-Consumer Genetic Testing: Profile of 23andMe

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Since the advent of genetic biotechnology, the race to decode the human genome has progressed at an unprecedented pace. From the development of the polymerase chain reaction in the 1980s to the completion of the Human Genome Project in 2003, scientists have made huge leaps in the quest to better understand the significance of our genetic code.[1,2] Indeed, the information in our genome is becoming increasingly applicable to clinical conditions, causing debate over whether individuals should be able to readily access their genetic information without guidance from physicians. Multiple personal genomics companies offering direct to consumer (DTC) genetic testing have cropped up to capitalize on rising public interest, one of the first and most well-known being the California-based company 23andMe.

Founded in 2006, 23andMe has now arguably become the most widely used DTC genetic testing service.[3] For a fee of $299 USD, a Personal Genome Service kit will be delivered to the consumer's door.[4] The consumer simply has to spit into the sample collection tube provided and send the saliva sample back to 23andMe for testing in a private lab.[4] Testing detects single nucleotide polymorphisms (SNPs) associated with various conditions, and test results are accessible online within three weeks.[4,5] Personal results indicate disease risk and carrier status for 244 conditions, and are also used in the company's own research into the relationship between SNPs and genetic conditions, which is communicated quite clearly on the 23andMe website.[6,7]

Controversy arises, however, when considering how the consumers will interpret their test results. 23andMe does not offer genetic counseling, and the task of distinguishing between significant risks and negligible risks is not always simple.[8] Questions have also been raised over how informative certain results will be. While there may be correlations between certain genetic presentations and clinical outcomes, the multifactorial nature of many diseases may cause genetic results to be misleading and ambiguous.[8,9] Without adequate counseling and informed consent, consumers may also be unaware of, or ill-prepared for, the potential psychological consequences of knowing one's genetic predispositions.[8,9] Consumers may openly share their results with family members who share genetic information without first appreciating that not everyone may want to know his or her own disease susceptibility, which could potentially impart negative psychological effects on others. Many of these issues can be addressed with proper physician involvement and input, which are largely absent from most DTC genetic testing services.

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Despite the opposition of many members of the medical community to DTC genetic testing, public interest in accessibility to one's own genetic information is propelling the industry forward. In 2008, the state of California initially ordered the company to cease operations, stating that physician involvement was required in all genetic tests.[10,11] Four months later, the

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state conceded to corporate and consumer interest, and granted 23andMe a license to operate.[12] Consumers may be justified in their interest in DTC genetic tests as there are substantial benefits to having access to one's genetic information. Knowing one's predisposition and genetic vulnerability to preventable conditions can allow patients to take pre-emptive measures to reduce risk. Family planning can be more informed. Medical treatments can become more personalized, and negative drug-gene interactions can be avoided. Favourable outcomes can be reached if test results are interpreted correctly.

The challenge then, should be for physicians to take a pro-active approach in counseling patients who desire DTC tests and assisting them in interpreting the results. DTC genetic tests are unlikely to leave the biotechnology landscape in the near future. The best approach may be for physicians to embrace the knowledge that DTC tests provide and work with their patients to circumvent the shortcomings in the DTC approach to genetic testing.

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Low Carb Diets – Sometimes Just as Sweet As They Sound

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The article published in the March 2012 issue praising the health benefits of low carbohydrate high protein diets[1] failed to stress the importance of protein sourcing on long-term outcomes.

True, it seems that going low–carb can have desirable effects on longevity and cancer rates, but not with a typical animal–based diet. Research from the Nurses' Health Study and Health Professionals Follow–up Study showed increases in all–cause, cardiovascular, and cancer mortality with low carbohydrate diets that were animal–based, while plant–based analogues had an inverse association.[2] The article by Ho and Krystal did make note that a high-protein diet should be "preferably not high in red meat"[1], but recommendations to source protein from non-animal sources should have been included.

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