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Genomic Medicine in Cardiovascular Fellowship Training

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As genomic testing becomes more accessible for both clinical indications as well as for patients' personal curiosity, cardiologists are increasingly asked to interpret the results in terms of future risk of disease. In many cases, patients hope that such testing will yield detailed, personalized recommendations regarding not only their own but also their family's medical care. However, given the lack of formal instruction in genomic analysis during cardiovascular training, there exists a gap between some patients' desires and our own abilities to incorporate genomic information into practice.

There is little doubt that patient care and biomedical research will be increasingly influenced by genomic medicine efforts in the coming years. In his 2016 budget proposal, President Obama allocated $215 million to fund the Precision Medicine Initiative.[1] The goal of this program is to develop data lakes compiling vast arrays of patient data, including genomic information as well as detailed phenotypic, epigenomic, proteomic, transcriptomic, and metabolomic data. By using the computational power of such an effort, clinicians will hopefully be able to better predict disease and tailor therapies at both the population and individual level. Given this enormous investment of resources as well as the global burden of cardiovascular disease, the cardiovascular community will likely play a key role in this movement. Therefore, it is critical that we begin to incorporate training modules on genomic medicine into our formal fellowship programs.

Because the use of genetic information in clinical practice is a relatively new phenomenon, many practitioners have not been exposed to genetic testing during clinical training. A recent survey of internists in an academic setting found that 73.7% of respondents felt their knowledge of genetics was very or somewhat poor, and 82% felt they needed more training on counseling patients.[2] In 2014, the Inter-Society Coordinating Committee for Physician Education in Genomics acknowledged these limitations and published a set of key competencies in genomic medicine.[3] This set of basic genomic skills included familiarity with the significance of a detailed family history, genomic testing, therapy based on genomic results, somatic genomics, and microbial genomics. The group acknowledged that not all specialties or practitioners would require expertise in all competencies, but this could hopefully serve as a framework for programs in graduate medical education.

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Conflict of Interest Disclosures

None.

Some groups have already taken steps to develop and implement genomics training into various medical education paths. At a national pathology meeting on personalized medicine in 2010, various professional societies and governmental agencies met to discuss the role of the field in the precision medicine era. The group concluded that the most critical step moving forward was to ensure all pathology residencies incorporate mandatory training in genomics and personalized medicine.[4] Along those lines, the Training Residents in Genomics Working Group has designed and held workshops at the major annual pathology meetings, and it has also developed a free curriculum for residencies to implement at home.

In order to help formalize the role of genomic analysis in clinical care, translational research, and education, leaders at our own institution have formed the Brigham Genomic Medicine (BGM) program to bring together clinicians and researchers from a variety of backgrounds. During weekly meetings, participants discuss cases of rare, unexplained diseases and formulate detailed strategies for genomic analysis. Candidate gene variants from these analyses are presented at subsequent meetings with a goal of prioritizing likely causal variants, arranging confirmatory functional testing, and ultimately influencing patient care. Trainees in multiple fields, including cardiology, medical genetics, and internal medicine, are invited to attend these sessions. Although these meetings are illuminating, we can further the educational value by asking residents and fellows to take on more active roles and incorporating these exposures into their core curriculum.

While cardiovascular medicine is in many ways at the forefront of the precision medicine movement, our field lags behind others in terms of formal training pathways. Part of this is due to the multitude of competencies required for successful completion of a cardiovascular medicine fellowship within 36 months, which requires proficiency in no fewer than nine distinct subspecialties in addition to research and scholarly activities. Notably, the most recent Core Cardiology Training Symposium (COCATS) statements acknowledge that trainees should “know principles of genetics, genomics, proteomics, metabolomics, and pharmacogenomics” by the end of the fellowship to satisfy Level I training requirements.[5] However, there are no details specifying the criteria for proficiency, and there are no sample curricula to help fellowship programs ensure trainees can fulfill this requirement.

Just as it would be unfathomable for any cardiologist to exclude electrocardiogram interpretation from their practice, it may soon be unfathomable for cardiologists to claim ignorance in understanding genetic risk scores or in using pharmacogenomic data to choose a medication. Therefore, it is time for professional societies to develop clear guidelines and curricula integrating principles of precision medicine that will be required for all trainees during fellowship. To help spearhead this movement, we propose using our own BGM program as a laboratory for education in clinical genomics. Under the guidance of a senior mentor, we will ask our current general cardiology fellows to present a clinical case and detailed pedigree to the BGM group. Following the case discussion, they will be paired with individual researchers to learn firsthand the processes entailed in sequence alignment, variant identification, and variant annotation. Finally, they will work with the research team to prioritize a list of candidate gene variants, and fellows will participate in the subsequent discussion of these variants as well as additional confirmatory testing. As part of this exposure, we will also have trainees meet with genetics counselors to better understand the

ethical consideration of genomic testing and sharing of results. Ultimately, our goal will be to not only turn this pilot program into a key component of our own fellowship, but also to create detailed case studies to be used by other fellowships across the country.

Given the lengthy training period necessary in cardiology, there will certainly be difficult decisions in terms of how best to allocate time among the various disciplines. Nonetheless, by incorporating instruction in clinical genomics into our formal training pathways, we can ensure that cardiovascular medicine remains at the forefront of both precision medicine research efforts as well as the clinical implementation of research findings.

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