Improving Genomic Literacy Among Cardiovascular Practitioners via a Flipped-Classroom Workshop at a National Meeting

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The enormous progress in the field of human genetics since the completion of the Human Genome Project—most notably the identification of both rare and common variants associated with a plethora of clinical traits and diseases through novel methodologies, such as the genome-wide association study and next-generation DNA sequencing—has revolutionized our understanding of human health. At the same time, this progress threatens to outstrip the ability to apply these discoveries to clinical care for the benefit of patients. One significant barrier is a lack of genomic literacy among clinical practitioners,[1–4] not surprising given that many advances in genetics and genomics have emerged recently, well after the completion of formal training by most practitioners.

Published examples of attempts to enhance the teaching of clinical genomics to medical learners have largely been lecture based. For example, the Stanford University's Department of Pathology created a Genomic Medicine course for their residents and fellows that comprised a series of 10 lectures that were also made available online.[5] In another example, the Tufts University School of Medicine's medical school curriculum added a lecture on the science and technology of genomic testing and incorporated a homework assignment in which students analyzed the results of genome testing of anonymous patients.[6] Neither of these educational innovations address the considerable need to educate active practitioners about genetics and genomics in a way that does not rely on traditional lecture-based classroom learning—an impracticality for busy professionals—but rather draws from best practices in adult education, including the growing recognition of the superiority of active-learning approaches in science, technology, engineering, and mathematics education, such as the so-called flipped classroom.[7]

In 2010, through the Program Directors Section of the Association of Pathology Chairs, the Training Residents in Genomics (TRIG) working group (WG) was formed to create teaching tools about clinical genomics for pathology residents.[8] With funding from the National Cancer Institute, the TRIG WG, with membership that included experts in molecular pathology, medical genetics, medical education, and genetic counseling, developed a team-based, active-learning curriculum that has been implemented as workshops at many national pathology conferences.[9,10] Although the flipped-classroom concept is not novel in medical education, having been used in longitudinal settings, such as medical school courses or residency training programs,[11] there are limited examples of this teaching strategy being used successfully at a national meeting when the participants are not known to each other or the instructors. The application of the TRIG curriculum was, to our knowledge, the first such use of the flipped classroom and team-based learning in workshops at national meetings.[9]

In light of the success of the TRIG workshops, in 2013, the National Human Genome Research Institute's Inter-Society Coordinating Committee for Practitioner Education in Genomics[12] recognized the need to embrace new teaching methods and formed an Innovative Approaches to Education (IAE) WG. The IAE WG has been working to adapt the oncology-centric TRIG WG curriculum into a flexible core curriculum that can be generally applied to a variety of medical specialties by substituting genes and diseases relevant to each specialty. As a pilot project, we partnered with the American Heart Association (AHA) to adapt the IAE WG core curriculum to cardiovascular medicine and implement it at the AHA's annual national meeting, the AHA Scientific Sessions. As described below, this effort culminated in a successful flipped-classroom workshop at the 2015 meeting.

Preparation

The AHA recently published a Scientific Statement on Basic Concepts and Potential Applications of Genetics and Genomics for Cardiovascular and Stroke Clinicians that summarizes the key concepts needed for cardiovascular practitioners to be literate with respect to clinical genomics.[13] In tandem with this statement, a series of 16 Basic Concepts of Genetics and Genomics videos, each 10 to 20 minutes in length and totaling 4 hours, was produced and made available on the AHA's Professional Education Center website (https://learn.heart.org/activity/3517565/detail.aspx). Physicians, nurses, and

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pharmacists are all able to obtain continuing education credit by watching the videos and completing 50 self-assessment questions.

A Clinical Genomics Bootcamp workshop was planned for the AHA Scientific Sessions 2015 meeting and broadly advertised to the AHA community. Interested individuals were asked to preregister for the Bootcamp by checking an option during the online registration process for the scientific sessions; ≈50 people preregistered in this fashion. We made preregistrants aware ≈1 month before the scientific sessions that the basic concepts videos were freely available, provided them with instructions on how to access the videos and obtain continuing education credit if so desired and strongly encouraged them to look at the topics covered by the videos and watch any videos they felt were needed to refresh themselves on certain topics or to acquaint themselves with the topics for the first time. We chose not to make completion of the videos a requirement for attending the Bootcamp, reasoning that for some individuals with extensive familiarity with basic concepts of genetics and genomics, watching the videos was unnecessary and redundant. We advised all preregistrants to bring Web-enabled laptops or devices to the Bootcamp as these would be necessary to access the three Bootcamp exercises.

Bootcamp Format

The Clinical Genomics Bootcamp took place during the AHA Scientific Sessions on November 8, 2015, as a Sunday Morning Session, which offered the flexibility of scheduling an uninterrupted 4-hour session (in contrast to the standard 75-minute session). Most of the preregistered session attendees did participate in the Bootcamp session although many nonregistered attendees asked to attend the Bootcamp session on the spot, with no previous preparation for the Bootcamp. Because of the length of the Bootcamp and the explicit division of the Bootcamp into 3 parts (see below), some participants stayed for only some of the Bootcamp, with ≈60 people remaining through the entire session and ≈90 people attending at least some of the Bootcamp. The room was arranged with round tables that could seat 8 people each to facilitate small-group interactions. Because of the desire to accommodate any walk-in attendees, it was not feasible to preassign teams. Instead, participants were free to sit wherever desired although they were encouraged to sit at tables with other people to facilitate team-based learning. In general, participants spontaneously formed and worked as teams of 3 to 4 people throughout the Bootcamp session.

A panel of 9 instructors had been recruited to lead the Bootcamp session. Along with 5 physicians with formal or informal specialization in clinical genetics, there were instructors with backgrounds in genetic counseling, pharmacy, and nursing. This ensured that content experts were available for all of the topics covered in the Bootcamp, and it allowed for a diversity of perspectives and viewpoints. This also ensured that there were enough instructors available to circulate around the room and answer questions from attendees during the team-based learning activities. We note that a traditional 4-hour lecture-based session (with invited speakers or oral abstract presentations) at the AHA Scientific Sessions would involve ≈10 speakers and 2 moderators, similar to the number of instructors involved in the Bootcamp.

The Bootcamp was divided into 3 parts (see below). After a 15-minute introduction to acquaint attendees with the innovative format of the session, each part ran for ≈75 minutes. This allowed for 45 to 60 minutes for the team-based learning exercise, followed by 15 to 30 minutes in which the exercise was reviewed in a general room-wide discussion moderated by the instructors. During the team-based activity, the instructors circulated around the room to monitor the progress of the various teams, answer any questions from participants, and provide guidance to any team that seemed to be having difficulty with any aspect of the exercise. For the general discussion, the instructors took their seats as a panel at the front of the room, and the lead instructor went through each part of the exercise, calling on various teams to offer their opinions. One or 2 of the instructors carried microphones around to the tables to facilitate the discussion. Contrasting opinions from different teams were encouraged, and various instructors added their own expert commentary when appropriate.

Content

The content of the Bootcamp was directly adapted from a preliminary version of the IEA WG core curriculum. The first exercise covered single-gene testing (http://goo.gl/forms/KCSlM57OAE); the second exercise, gene panels and whole-genome sequencing (http://goo.gl/forms/4HzMjdVktg); the third exercise, risk prediction and pharmacogenomics (http://goo.gl/forms/IETQ90QQli) (Web-based documents with complete, up-to-date exercises along with suggested solutions are available by contacting the corresponding author). For each of the 3 parts of the Bootcamp, the attendees were provided with a Web link that accessed a Google Forms document that contained the exercise in multiple pages/parts (the same links listed above). Each page contained multiple questions for the teams to answer. Each team discussed the questions with the intent of reaching a consensus although each individual was free to enter her or his preferred answers into the Google Forms document and, at the completion of the exercise, submit the document and thereby generate a saved record of the submitted answers that could be sent to the individual after the Bootcamp.

The 3 exercises were framed as a series of related patient cases intended to illuminate various concepts of clinical genomics. Since the Bootcamp was geared toward cardiovascular medicine, the cases were centered on patients with hypertrophic cardiomyopathy and myocardial infarction. Data relevant to the cases were incorporated directly into the Google Forms surveys as figures and tables. Answering the questions required the use of a variety of Web-based resources, with links provided directly within the Google Forms surveys. These resources included ClinVar, PubMed, PolyPhen-2, OMIM, and clinical practice guidelines.

Some parts of the exercises were designed to be ambiguous and foster debate among the teams and, later, in the general discussions. Thus, for some questions, there was no correct answer, just as there may not be in clinical practice. This resulted in some vigorous back-and-forth during the discussions, on the part of both attendees and instructors.

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Feedback

The attendees present at the end of the Bootcamp were asked to provide instantaneous feedback using a separate Google Forms survey (with the link included at the end of the third exercise). About half of the attendees completed the survey (results are shown in the Table).

All of the respondents felt that the Bootcamp was a worthwhile use of their time at the AHA Scientific Sessions, and all indicated an interest in attending Bootcamp-style workshops in the future. The vast majority felt that they learned more from the Bootcamp format than the traditional lecture-based format prevalent at national meetings, with only a few preferring the traditional format. Almost all respondents felt that they were much better or somewhat better equipped to incorporate clinical genomics into their practice, with the majority opting for the former. Indeed, it is striking that 57% of respondents felt that they were much better equipped after the 4-hour Bootcamp although it is worth noting that most respondents also reported using the 16 basic concepts videos before the Bootcamp—among this subset of respondents, 69% felt that they were much better equipped. We also note that the feeling of being much better equipped does not mean that they are fully qualified to incorporate clinical genomics into their practice but rather reflects a relative improvement compared with their previous knowledge about clinical genomics. Although we did not specifically solicit the information from respondents, it seems likely that many of the respondents had no or little previous knowledge.

Generalizability

Having successfully adapted the IEA WG core curriculum to the specialty of cardiovascular medicine and used it as the basis of a workshop at a national conference, we think that the IEA WG core curriculum and its team-based learning format can be implemented widely in a wide variety of medical specialties and for a wide variety of audiences. The original TRIG workshops were all aimed at pathology residents but were subsequently expanded to a broader audience, including practicing pathologists. The Clinical Genomics Bootcamp at AHA Scientific Sessions 2015 also attracted a more diverse adult learner audience. In addition to national meetings, TRIG workshops have also been held at individual residency programs. In similar fashion, the cardiovascular workshop could be implemented in a variety of settings, including regional and local cardiology meetings, continuing education activities in cardiology divisions of individual hospitals, and teaching sessions for cardiology fellowship programs, with local content experts serving as instructors. Future goals include further refinement of the IEA WG and Bootcamp curricula and, through the Inter-Society Coordinating Committee for Practitioner Education in Genomics, adapting the material to other medical specialties.

Our feedback also suggested that Bootcamp participants perceived more value in the active-learning, flipped-classroom format than the traditional lecture-based format—concordant with the literature on active learning—although for this pilot Bootcamp, we did not seek to rigorously gauge the amount of learning experienced by the participants. In future iterations of the Bootcamp and other workshops using the IEA WG curriculum, we plan to incorporate objective assessments of learning outcomes, both immediate learning gains and long-term learning retention.

Table. Survey Results for Clinical Genomics Bootcamp at AHA Scientific Sessions 2015

Did you feel that the Bootcamp was a worthwhile use of your time at AHA Scientific Sessions 2015?
Yes=100%
No=0%
Was the preassigned homework (ie, basic concepts videos) about genetics and genomics helpful for the Bootcamp?
Yes=76%
No=0%
N/A=24%
After the Bootcamp, do you feel you are better equipped to incorporate clinical genomics into your practice?
Much better=57%
Somewhat better=36%
About the same=7%
Less equipped=0%
How do you feel about the Bootcamp format compared with the standard lecture-based session format at AHA Scientific Sessions?
Learned more from the Bootcamp format=76%
Learned about the same=19%
Learned more from the standard format=5%
Would the ability to participate in a Bootcamp (covering a topic of interest to you) at a future AHA conference make you more likely to attend that conference?
Yes=74%
No=26%
How would you categorize yourself? (check all that apply)
Physician=54%
Nurse=10%
Pharmacist=2%
Clinical geneticist=2%
Clinical scientist=24%
Basic scientist=12%
Epidemiologist=2%
Trainee=10%
Where are you from?
United States=66%
Non-US North America=7%
Asia=7%
Europe=20%

AHA indicates American Heart Association.

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Disclosures

None.

References

1. Guttmacher AE, Porteous ME, McInerney JD. Educating health-care professionals about genetics and genomics. *Nat Rev Genet*. 2007;8:151–157. doi: 10.1038/nrg2007.
2. Feero WG, Green ED. Genomics education for health care professionals in the 21st century. *JAMA*. 2011;306:989–990. doi: 10.1001/jama.2011.1245.
3. Hurle B, Citrin T, Jenkins JF, Kaphingst KA, Lamb N, Roseman JE, et al. What does it mean to be genomically literate?: National Human Genome Research Institute Meeting Report. *Genet Med*. 2013;15:658–663. doi: 10.1038/gim.2013.14.
4. Haspel RL, Arnaout R, Briere L, Kantarci S, Marchand K, Tonellato P, et al. A call to action: training pathology residents in genomics and personalized medicine. *Am J Clin Pathol*. 2010;133:832–834. doi: 10.1309/AJCPN6Q1QKCLYKXM.
5. Schrijver I, Natkunam Y, Galli S, Boyd SD. Integration of genomic medicine into pathology residency training: the stanford open curriculum. *J Mol Diagn*. 2013;15:141–148. doi: 10.1016/j.jmoldx.2012.11.003.
6. Walt DR, Kuhlik A, Epstein SK, Demmer LA, Knight M, Chelmow D, et al. Lessons learned from the introduction of personalized genotyping into a medical school curriculum. *Genet Med*. 2011;13:63–66. doi: 10.1097/GIM.0b013e3181f872ac.
7. Freeman S, Eddy SL, McDonough M, Smith MK, Okoroafor N, Jordt H, et al. Active learning increases student performance in science, engineering, and mathematics. *Proc Natl Acad Sci U S A*. 2014;111:8410–8415. doi: 10.1073/pnas.1319030111.
8. Haspel RL, Saffitz JE. Genomic oncology education: an urgent need, a new approach. *Cancer J*. 2014;20:91–95. doi: 10.1097/PPO.0000000000000015.
9. Haspel RL, Ali AM, Huang GC. Using a team-based learning approach at National Meetings to Teach Residents Genomic Pathology. *J Grad Med Educ*. 2016;8:80–84. doi: 10.4300/JGME-D-15-00221.1.
10. TRIG Website. http://www.pathologylearning.org/trig. Accessed March 24, 2016.
11. Sisk RJ. Team-based learning: systematic research review. *J Nurs Educ*. 2011;50:665–669. doi: 10.3928/01484834-20111017-01.
12. Manolio TA, Murray MF; Inter-Society Coordinating Committee for Practitioner Education in Genomics. The growing role of professional societies in educating clinicians in genomics. *Genet Med*. 2014;16:571–572. doi: 10.1038/gim.2014.6.
13. Musunuru K, Hickey KT, Al-Khatib SM, Delles C, Fornage M, Fox CS, et al; American Heart Association Council on Functional Genomics and Translational Biology, Council on Clinical Cardiology, Council on Cardiovascular Disease in the Young, Council on Cardiovascular and Stroke Nursing, Council on Epidemiology and Prevention, Council on Hypertension, Council on Lifestyle and Cardiometabolic Health, Council on Quality of Care and Outcomes Research, and Stroke Council. Basic concepts and potential applications of genetics and genomics for cardiovascular and stroke clinicians: a scientific statement from the American Heart Association. *Circ Cardiovasc Genet*. 2015;8:216–242. doi: 10.1161/HCG.0000000000000020.

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