



Thinking Ahead to the Next Generation of Cardiometabolic Investigators: What It Takes to Successfully Engage Underrepresented Minorities in Biomedical and Public Health Careers

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Abstract

Purpose of Review The purpose of this review is to examine the existing information regarding cardiometabolic syndrome (CMS) manifestations among underrepresented minority populations, underrepresented minorities' representation in the cardiometabolic workforce, and the models that successfully recruit and retain underrepresented minorities in the field.

Recent Findings The scientific literature is replete with information on methods to recruit and train URM in research careers. However, there are few programs that are specifically designed to train URM to become diabetes researchers, or more specifically cardiometabolic researchers.

Summary The CMS scientific community leaders do not have to design a new learning program to engage URM in research. They only have to follow the prototypes by other organizations and make applicable to cardiometabolic research.

Keywords Cardiometabolic disease · Diversity · Mentor · Underrepresented minority (URM) · Train · Investigator

Cardiometabolic syndrome (CMS), first described in 1988, is a cluster of metabolic and cardiovascular risk factors that include abdominal obesity, insulin resistance, hypertension, and hyperlipidemia. CMS risk factors are more evident in minority populations, particularly African Americans, Hispanics, and American Indians [1–3]. The burden of cardiometabolic disease among underrepresented minorities (URMs) means that college/universities and the scientific community must prepare a cadre of investigators to research all aspects of this syndrome. Thinking ahead to the next generation of cardiometabolic investigators, the research workforce should reflect the diversity of the population most afflicted by CMS. The purpose of this review is to explore the available information on CMS manifestations among underrepresented minority populations, the representation of URMs in the biomedical and public health workforce,

and models that successfully engage URMs in biomedical and public health careers.

Evidence Acquisition

Data on the CMS among URMs were reviewed from *Current Diabetes Reports*, Centers for Disease Control and Prevention (CDC), the National Institute of Diabetes, Digestive Disorders, and Kidney Disease (NIDDK), American Diabetes Association (ADA), American Heart Association (AHA), and related articles retrieved from a PubMed search. The National Diabetes Statistics Report (2020) estimated that 13% of all adults in the US suffered from type 2 diabetes mellitus (T2DM) in 2018. There were over 5500 children and adolescents between the ages of 10 and 19 who were diagnosed with T2DM in 2014–2015. T2DM prevalence is highest in diverse communities. Complications from T2DM such as cardiovascular disease (CVD) are more prevalent in minority populations. Research to date indicates that major insights into the interrelatedness of genetics, lifestyle, behavioral, and biological factors with CMS require more interdisciplinary research in URM populations not only to discover the reasons for this disproportionate burden but

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also to discover prevention, and short-term and long-term management [4–7].

In addition to adversely affecting the health of historically disadvantaged populations, URMs lack representation in medical, dental, and biomedical professions. In 2003, the Institute of Medicine documented in their publication entitled “Unequal Treatment” the potential benefits to health and healing when the patient and health care provider share the same ethnic/racial identity. Documentation of the need to increase the diversity of America’s public health, health professional, and biomedical research workforce has increased steadily since the publishing of the Report on Black and Minority Health in 1980. Among the recommendations for health professions’ development was: “The development of innovative mechanisms to attract minorities into the health care field and into health research with direct and continuing input from leaders in the minority professions [8–10].”

Some critical barriers to increasing the number of African Americans in public health, biomedical research, and health careers are the following: lack of knowledge about health sciences career options; lack of role models; limited financial support; lack of guidance in completing the application process; lack of knowledge in the basic sciences; lack of survival skills once admitted to graduate and professional schools and in many cases dropping out or not progressing toward graduation for academic, personal, and/or financial reasons.

Biomedical scientists are in short supply in the USA. The shortage is most acutely felt among diverse populations, where young adults rarely enter science, technology, engineering, and mathematics (STEM) fields. Approximately one million STEM professionals will be needed in the USA within the next 5 years. Because the country’s population is constantly diversifying, URMs will have greater opportunities to pursue careers in STEM fields. A diverse biomedical workforce benefits both minority and majority populations. It is critical that the research workforce of the future investigating CMS and related conditions reflect the diversity of the population most often affected. Despite efforts to expand the number of minority researchers in the biomedical field by the National Institutes of Health (NIH) and other organizations, there continues to be a shortage [11–13].

Models That Successfully Engage Underrepresented Minorities in Biomedical Careers

Examples of models that successfully engage URMs in biomedical careers include programs for undergraduate students, a program to address CVD disparities, and programs specifically designed for high school and middle school students. Imhotep, housed at Morehouse College, an 11-week

summer research program, began in 1981 by the steering committee of the Atlanta University Center to address the lack of diversity in the racial/ethnic workforce. Undergraduate and recent baccalaureate graduates who are accepted into the program begin with 2 weeks of intensive course work in bioethics, health disparities, biostatistics, and epidemiology. Participants are then placed in partnering agencies and organizations to begin a research project which provides experience in data analysis and scientific writing [14]. Investigators at Johns Hopkins University created an educational enhancement and career development initiative to address CVD disparities in the biomedical workforce. The multilevel program is limited to students and early career professionals who are associated with the university. This transdisciplinary program offers participants community-based participatory research (CBPR) training, mentoring, and didactic courses which can result in a certificate. Participants may also apply for research funding through the consortium [15].

The High School Short-Term Research Experience for Underrepresented Persons (HS-STEP-UP), an 8–10-week mentored summer research opportunity, was designed by NIDDK to provide research opportunities to exceptional high school students who are traditionally underrepresented in biomedical/bio-behavioral sciences. Candidates must be 16 years old and in the 11th or 12th grade at the time of their application. Once accepted, participants begin an online module for training in the responsible conduct of research and must complete research certification through the Collaborative Institutional Training Initiative (CITI) Program. Students then begin to work with a mentor on a research project. At the conclusion of the program, participants travel to the Bethesda, Maryland campus of the NIH to present their findings [16].

The Case Comprehensive Cancer Center (Case CCC) at Case Western Reserve University (CWRU) in Cleveland, Ohio, initiated a training program, Youth Enjoy Science (YES) that recruits students from middle school to undergraduate and local teachers. YES aims to increase the number of URMs in biomedical research and health professions. YES contains three parts; Learn to Beat Cancer, Research to Beat Cancer, and Teach to Beat Cancer, for middle school students and their parents, high school to undergraduate students, and STEM teachers, respectively [17].

Models that successfully engage URMs in biomedical careers have been implemented collaboratively by Predominately White Institutions (PWIs), Historically Black Colleges and Universities (HBCUs), and a variety of consortia inclusive of diverse institutions working together toward a common goal. One example is The Leadership Alliance composed of 32 institutions which has been led by Brown University for almost 30 years. The Leadership Alliance provides an academic research experience of 8 to 10 weeks, with a variety of academic disciplines. The Leadership

Alliance has tracked its students since its inception and has provided long-term professional development opportunities, mentoring, and networking [18, 19].

The AHA has been intentional in its commitment to diversify the biomedical workforce. In 2020, the AHA released a Call to Action Statement on Health Disparities that concluded structural racism was a major risk factor leading to health disparities and was exacerbated in 2020 by the COVID-19 pandemic and the police killings of African-Americans. Prior to 2020, the AHA had been an advocate of diversity and had released multiple statements and developed initiatives in support of its mission to promote diversity and inclusion. Included in their most recent strategy to address structural racism was to support diversity and inclusion of AHA-funded investigators and other marginalized groups earlier in their careers. AHA-funded Strategically Focused Research Networks (SFRN) have also been used as a mechanism to increase diversity in the biomedical workforce pipeline. SFRN fellows range from MD and PhD post-doctoral researchers to junior faculty. Undergraduate fellows from the HBCU Tougaloo College have also participated in this training. On a wider level, the AHA has created a mentored summer research program, Supporting Undergraduate Research Experiences, which partners with current AHA awardees at 5 academic institutions. Students from regional HBCUs and Hispanic serving institutions are recruited for the program [20•].

The AHA Office of Health Equity sponsors three programs to advance diversity in the biomedical workforce, the EmPOWERED in Science™ Program, the HBCU Scholars Program, and the Hispanic Serving Institutions (HSI) Scholars Program. These programs provide URM students with the opportunity to pursue research in biomedical fields during the academic year [21•, 22].

The Jackson Heart Study Undergraduate Training and Education Center (JHSUTEC) at Tougaloo College is another unique success model. The NIH/National Heart Lung and Blood Institute (NHLBI) has funded JHS for over 20 years. Attributes of these models include a comprehensive selection process, and a meticulous training structure inclusive of didactic courses in public health, epidemiology, biostatistics, research methodology, and ethics along with an introduction to biomedical research career opportunities and hands-on research experiences. Additionally, role models, mentoring, and partnerships with multiple institutions and agencies are critical components of what it takes to successfully engage URMs in biomedical and public health careers [23].

Undergraduate students at Tougaloo College are selected as JHSUTEC scholars during their freshman year. While all majors are considered and accepted, students are heavily recruited from the STEM majors. High school students who participated in the JHS Science, Language Arts, and

Mathematics (SLAM) program and enroll at Tougaloo College after graduation are also recruited to become JHSUTEC scholars. The SLAM program is an on-campus pre-college learning experience that is an extension of the JHSUTEC scholar program that provides 9th – 11th grade students with peer mentorship and rigorous STEM coursework during the summer. A total of 987 new students have been enrolled in the SLAM from 2001 to 2018. During this same period, 50 SLAM participants have enrolled in Tougaloo College and were selected to participate in the JHSUTEC scholar program [24].

Selected students are informed of program expectations and must sign a contract to continue. Scholars begin their training immediately and participate in colloquia focused on the history of the JHS, public health, and health disparities. Scholars begin math and reading enhancement sessions.

The didactic training includes four required JHS sponsored courses: “Introduction to Public Health and Epidemiology,” “Biostatistics,” “Research Methods in Public Health,” and “Ethics, Medicine and Technology.” These courses are based in large part on health disparities and data compiled by the JHS. Scholars must enroll in the “Introduction to Public Health and Epidemiology” course in the fall semester of their sophomore year and the “Biostatistics” course in the spring of their sophomore year. Since 2018, these courses have been taught by former JHSUTEC scholars who have completed Master’s Degrees in Public Health and Epidemiology. Scholars may enroll in the other two courses at any time during their junior or senior year. One of the novel exercises that scholars learn in the classroom is how to write a lay summary. Examples of non-classroom-based trainings have included PubMed training through the National Library of Medicine (NLM) and research certification through the CITI Program [25].

JHS scholars are required to participate in research during the academic year and summer months. Several of these opportunities would not be possible without the support of partnerships and the team of mentors who interact with the students. More than 60 informal documented non-contractual collaborators (DNC) have partnered with the program since 2002. The JHSUTEC has three formal partnerships, Documented Contractual Collaborators (DCC), that are bound by a contract and/or a memorandum of understanding (MOU). These collaborations are essential to the program. Many of the mentors have experience in working with undergraduate students, more specifically URMs. They are usually repeat mentors who are very sensitive to the needs of URM students and are able to relate to them on various levels [26].

Moreover, the JHSUTEC program has been in operation for over 20 years, making it old enough to have several former scholars who serve as research mentors. These mentors have completed the JHSUTEC training program and have completed graduate or professional school, and are now

working in biomedical careers. Because of their familiarity with the program, they have a distinctive perspective and are eager to serve as mentors and give back. The benefit of arranging placements for current JHSUTEC scholars with former scholars is symbiotic. The former scholars are adding to the mentoring dynamic and the current scholars are reassured that they too can successfully contribute to biomedical research and health disparities. JHSUTEC provides mentor training sessions to update mentors on program changes and to respond to any concerns of the mentors. These sessions also offer an opportunity for feedback and allow for program adjustments as needed.

JHS scholars receive mentoring from every member of the JHS community, which exemplifies that the JHS program has mentoring built in for each level of student engagement. JHS investigators who give lectures in the JHSUTEC-sponsored classes have invited scholars to work with them on their research projects. Each JHS Overall Principal Investigator/Director has mentored scholars, which emphasizes the importance of mentorship to the organization.

More than 20 former JHSUTEC scholars have received NHLBI Research Supplements to Promote Diversity in Health Related Research, which is another federally funded opportunity available to support and develop the biomedical workforce. The student's educational levels for these Diversity Supplements have ranged from high school to terminal degree students. Many of the scholars worked on the Diversity Supplement projects with mentors with whom they were paired during their JHSUTEC training.

Since peer mentoring is vital to a successful biomedical training program, the summer following their freshman year, the newly selected scholars serve as teacher assistants and mentors for the SLAM summer enrichment program. At the conclusion of the first year, the scholars take two trips, one to the CDC and the second trip to the NIH. These excursions are not typical "field trips" because scholars are introduced to biomedical research, career opportunities, and graduate and professional schools.

Results

The models described that successfully engage URMs in biomedical careers are examples of programs nationwide designed to address the widening gap in the representation of URMs in biomedical careers devoted to addressing disparities in CVD, CMS, and other disease that disproportionately affect minority populations. While the programs described are geographically diverse, they are premised on the same foundation—to attract URM students to careers in biomedical research. Additionally, the programs cited share four common components (Fig. 1): (1) recruit students in STEM; (2) provide a didactic program in math and science

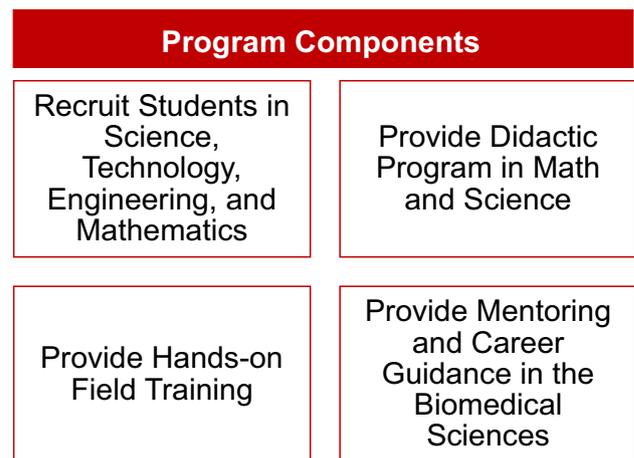


Fig. 1 Components of programs that engage underrepresented minorities in biomedical and public health research. Created with Microsoft Word

that focuses on biostatistics, epidemiology, and health disparities; (3) provide hands-on field training and problem-solving activities; and (4) provide mentoring and career guidance in the biomedical sciences.

In-common components of the programs cited include a variety of recruitment strategies such as beginning as early as middle school to introduce students to STEM careers. High school programs attract students who demonstrate an interest in the biomedical sciences while guest speakers and excursions to NIH and CDC broaden the scope of possibilities.

All of the models include didactic courses in public health, biostatistics, health disparities, and related topics. Additionally, they all offer fieldwork experiences that promote critical thinking and problem-solving skills to enhance students' scientific and academic growth.

Mentoring, which has been defined as a way to help "mentees to feel fortified and empowered to navigate their way through sometimes complex career pathways," is a crucial element of a successful training program that yields abundant examples of student success. Mentoring in the biomedical field may direct the mentees toward developing their research skills and cultivating scientific writing and presentation skills. While on the surface it seems that the mentee reaps all of the benefits, the relationship is also beneficial to the mentor who may feel empowered by the giving process [27••].

The National Institute of General Medical Sciences partnered with the NIH-sponsored Diversity Program Consortium (DPC) and five academic institutions to create the National Research Mentoring Network (NRMN) that provides mentorship and professional development to trainees in biomedical research and other disciplines to increase diversity in research careers. NRMN offers in-person training at

collaborating institutions and national/regional meetings, and web-based trainings. Another challenge is the shortage of professionals who understand how to mentor URMs. With this in mind, NRMN offers training for mentors that may result in certification from the network [28, 29].

Conclusions

Thinking ahead to the next generation of cardiometabolic investigators, and what it will take to successfully engage URMs in biomedical and health careers will require a twenty-first-century assessment of the critical barriers and successes previously experienced. It will require an evaluation of what is effective and what is not. Adjustments would have to be made to improve outcomes. Undoubtedly, strengthening the infrastructure will continue to require funding support for students who demonstrate an interest in biomedical and public health careers and for cardiometabolic investigators to continue and advance their research. It will take health education of the population at large about CMS, CVD, and the related modifiable risk factors. Often, personal experiences with chronic illnesses inspire students to pursue careers in related fields. Finally, it will take collaborations and partnerships among agencies, organizations, and institutions.

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Declarations

Conflict of Interest The authors declare no competing interests.

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