

STEM researchers are needed to advance multi-level interventions for health disparities.

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Editorial

Healthcare in the United States and across the world continues to face unique challenges. While these challenges and even methods/technology for meeting these challenges change, the central goal remains the same, to improve the health and well-being of people, all people. One unique aspect of health care delivery is the prevalence of health disparities. Multiple definitions exist for a health disparity, a working description was stated by Warnecke et al. [1], "A difference may become a disparity when some subgroups and not others are given access to resources to manage their differential risk from biological or other factors and the groups without access have poorer outcomes." As efforts continue to address the complex issues associated with health disparities, several notable conferences are dedicated to discussing problems and potential solutions. The corresponding author enjoys these conferences and learning about the tremendous work being done in the field. His attendance also raises questions about the makeup of the attendees—more specifically, where were the STEM researchers? What is the theory behind why these proposed interventions were designed the way they were? Can these interventions be further optimized? Yes, perhaps as engineering, the author's mind frequently frames problems in terms of the engineering design or scientific methods. Such viewpoints may be helpful. To accelerate the development of solutions for complex health disparities, multiple disciplinary approaches that leverage STEM expertise must be included in the discussion. In short, STEM researchers must engage more in the area of health disparities research.

Sufficient multilevel interventions are necessary in order for health disparities to be eradicated. Meaning patients, healthcare systems, healthcare providers, the community, as well as lawmakers need to be on the same page in order for a long-lasting, impactful intervention to be successful. Health disparities begin when a patient sees a physician. The patient and physician have an interaction on what is problematic for the patient. Often a prescription is given or a treatment plan is made. This process is not the same for a patients who are racial/ethnic minorities due to an implicit bias a physician may have about them. Implicit bias refers to the stereotypes or attitudes affecting our understanding, actions, and decisions in an unconscious manner. Such a bias is the leading cause of health disparities. The implicit bias the providers have is due to their culture and how they were taught to view certain people. Physicians may allow implicit bias to sway their decisions on how to medically and morally treat their minority patients. This type of bias delays the patient's treatment and deepens the bias the physician has for them. Multiple interactions in biased

environments worsen the patient's disease state. The physician then may note the patient is not compliant and less cooperative. The patient's age, gender, income and education level do not matter; due to their racial/ethnic minority status, their provider has an implicit bias against them. Changing this narrative begins with the provider's medical education. One way to intervene on these implicit biases providers have, culturally responsive healthcare is necessary [2]. Future physicians should undergo cultural competency training prior to becoming licensed. This training can decrease the implicit bias an individual may have. A few states already have this law in place as a requirement for licensure and a few medical schools are working on adding cultural competency to their curriculums.

Multilevel interventions exist beyond patient-provider interactions. This can be seen in two interventions outlined by Paskett: one dealt with cervical cancer disparities and the other with cardiovascular disease disparities [3]. With the cervical cancer disparities in Appalachian Ohio, the intervention to increase the rate of Human Papilloma Virus (HPV) vaccinations and decrease the rate of cervical cancer was on three levels: the health system encouragement (1), regular staff meetings with HPV presentations (2), educating parents with daughters (3). In the end, the intervention was considered successful because number of girls receiving the first vaccination of the series increased; however, the total number of girls receiving the vaccination was low. A cardiovascular disease intervention introduced healthy food choices in the front of four neighborhood corner stores in East Los Angeles and Boyle Heights. The intervention involved the entire community, minus policy makers. Within a two-year span, there was no significant change in healthy food consumption; however perceptions of fresh food availability improved. Both interventions proved the beneficial, however, the impact of multilevel interventions is still an underdeveloped area.

Researchers in STEM fields need to become more involved in the intervention process as well. Health fairs are commonplace in underserved communities, however, very few providers or researchers speak with community members about new treatments or clinical trials they may be eligible for. Clinical trials are beneficial to both the researcher as well as the patient: the researcher is able to have data and the patient has access to free healthcare (depending on the extent of the research) and they are usually compensated for their time. Insurance companies could be present to provide information and answer questions for community members as well.

Patients and their families want consideration of the whole person as opposed to an isolated focus on the disease.

Interventions must provide information on resources available in their community [4]. The Delaware Cancer Treatment Program provides an excellent example of multidisciplinary mechanisms working together to create a successful multilevel intervention. This program was created in 2004 through legislation to give Delaware-residents access to universal treatment and screening of colorectal cancer. This program gives patient's assistance during the entire process. Care-coordination and case-management is available to everyone within the state even if the patient does not have insurance. Since its inception, the Cancer Treatment Program has eliminated disparities in screening and rates of incidence.

The literature has shown a sincere appreciation for the multifactorial and multi level nature of health disparity problems. Much of the success found in these interventions stems from the interdisciplinary of the teams that developed these interventions. Various disciplines within Engineering focus on systems (e.g. systems engineering), this expertise should be applied towards the development of system wide interventions. Similar to scientists, technologists, and mathematicians, engineers have experience with complex, multifaceted problems and want unique opportunities to contribute beyond medical in laboratories. We believe one of the barrier towards greater involvement of engineers in health disparities research, is their lack of knowledge about health disparities, and a lack of understanding within the health disparities community regarding engineering. Interdisciplinary workshops, conferences, and collaborations involving people from multiple disciplines can meet, discuss, learn, and eventually solve challenging problems, would address the gap between research teams. Another challenge is the lack of translation of many key concepts in STEM research. A significant portion of STEM research is rightfully theoretical, in order to generate the new knowledge that leads to new solutions. Medical research and innovation has a history of application-based solutions that grew from theoretical research. Therefore, STEM researchers are well equipped to translate new knowledge into solutions. While time to generate a solution is a concern, I believe greater involvement of STEM research would not add significant time to the current process. Current interventions involve extensive research and development. STEM research can work in parallel with existing intervention designs, shortening the time until launch.

Many may argue that enough STEM based interventions exist, why should STEM researchers invest more into this area? Examples of innovative solutions are found in recent developments related to mobile health (mHealth). mHealth technologies have created new and accessible platforms providing vast amounts of healthcare information to users, regarding one's own health status as well as general information about healthcare related questions. mHealth has also presented opportunities for unprecedented access to healthcare providers. Even with the promise of mHealth technology, disparities still exist. Sarkar et al. [5,6] looked at the impact of internet portals on improving patient literacy. Patients used a new resource (i.e. a portal with information about patient health). The intervention had limited impact, as

many individuals with perceived lower health literacy levels, never accessed the resource. A follow-up study suggested the lack of use of new resources stems from the digital divide, as well as other significant issues extending beyond access to technology. Therefore, solving technical issues alone *via* the mantra "If you build it they will come" does not address the complexities of health disparities. STEM alone cannot solve Health disparity issues. Socioeconomic and political issues must also be addressed.

Even with the tremendous strides in healthcare and medical technology, society recognizes the increased complexities, facing human health. Significant levels of effort translated into innovative approaches for addressing health disparities as seen in many multilevel interventions. Many interventions were launched *via* interdisciplinary partnerships including STEM researchers. To continue such innovation, we as STEM researchers must increase our involvement in health disparities research and the development of future interventions. In doing so, we will directly support the missions of the NSF "...to advance the national health..." and the NIH "...to uncover new knowledge that will lead to better health for everyone..."

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