

## 10 Simple Rules in Biomedical Research Design to Ensure Health and Healthcare Equity

Olivia L. Lanier, Mykel Green, Elizabeth Cosgriff-Hernandez  
University of Texas at Austin

In an address at the Convention of the Medical Committee for Human Rights in 1966, Dr. Martin Luther King Jr. stated “Of all the forms of inequality, injustice in healthcare is the most shocking and inhumane.” It is disappointing to report that today, in 2021, health and healthcare inequity is still a prevalent issue affecting individuals from socially disadvantaged groups. As biomedical researchers, we are poised to either improve the health disparity landscape or further widen the gap. Here, we have created 10 simple rules for researchers to follow in order to establish equitable healthcare and healthcare technology in new developed products. These rules encompass how to identify research disparities for underserved communities, how to design technology that can be implemented for all populations of people, considerations for experimental testing to ensure equity, and future perspectives of how to shift the research culture surrounding these issues. With this presentation, we aim to educate engineers and researchers on how to better approach and solve these issues.

**Background.** Health inequities, which are also referred to as health disparities, are understood as preventable population-specific differences in the burden of disease, health outcomes, or access to healthcare. Health inequities are not just based on race, ethnic, and cultural groups, but also encompass age, gender, sexual orientation, lifestyle choices, socio-economic, and environmental differences. Statistics on health disparities are staggering and unjust, and racial and ethnic minority patients are 1.5 to 2 times more likely than white patients to have chronic diseases[1].

It is important to distinguish the difference between health inequities and healthcare inequities. Healthcare inequities refer to the differential access to and use of medical care and said quality of that care. The role of how social determinants of health and implicit bias serve as drivers of health disparities is well documented in the literature, however the impact of biomedical engineers who develop healthcare technologies that further propagate these inequities has only been implicitly stated. Researchers have the propensity to optimize new technologies and therapies, be it unknowingly or not, in a way that excludes minority populations and renders the technology either ineffective or potentially hazardous.

In the context of hospitals exceeding capacity in the height of the COVID-19 pandemic, healthcare providers used pulse oximeters to remotely monitor a patient’s supplemental oxygen levels. While a standard procedure, the oximeters are three times less likely to detect occult hypoxemia in Black patients than in white patients[2]. As a result, a Black patient may be less likely to be triaged for urgent care. The pandemic also highlighted the shortcomings of parenterally delivered therapies being unfit for third world countries who were ill equipped to maintain necessary storage conditions for equitable vaccine distribution.

To help biomedical engineers and researchers ensure more equitable designs and improve healthcare equity we have created the following 10 guidelines:

1. **Use systematic tracking to evaluate equity in healthcare technology.** By first establishing baselines and measurable outcomes, improvements can be made.
2. **Increase research on underserved diseases and conditions.** Many groups of people or conditions that affect them are often neglected in research including: infants and children, elderly, disabled, and women’s health. Funding in these areas must be increased.
3. **Ensure diversity in research teams.** Diversity in teams broadens the range of perspectives, approaches and information to solve a program. In addition, it is more likely to include diseases that affect diverse groups if diverse groups are leading the charge.
4. **Consider health care access, cost of production and storage.** The cost of the product should be considered as passed to the customer and to the government.
5. **Make designs that promote diverse community adoption.** Input from diverse groups should be collected to ensure user friendly designs and broad patient compliance. Designs should respect traditional practices.
6. **Consider sex determinants of health.** Sex determinants of health are not considered when taking into account new devices/ technologies although they are prevalent and been shown to have effect on presentation of many diseases/ conditions.
7. **Examine ancestral biological determinants.** Differences in patients can be identified on a genetic basis and therapies evaluated in various groups.
8. **Examine geographical determinants.** Likewise, demographic differences in patients can be considered.
9. **Evaluate diverse populations in clinical trials and data collection.** Clinical demographics should include all groups of people.
10. **Teach and expose the next generation to health inequities and bias in medical research.** Perhaps most importantly, spreading awareness about health disparities can inspire new ideas in new groups of people.

**Concluding Impact.** By addressing these issues with our colleagues in biomaterials research, we hope to bring awareness to these issues and mitigate health disparities in future designs. Education and inspiration are the keys to real change.

### **References:**

- [1] J. H. Price, J. Khubchandani, M. McKinney, and R. Braun, “Racial/ethnic disparities in chronic diseases of youths and access to health care in the United States,” *Biomed Res. Int.*, vol. 2013, 2013
- [2] M. W. Sjoding, R. P. Dickson, T. J. Iwashyna, S. E. Gay, and T. S. Valley, “Racial Bias in Pulse Oximetry Measurement,” *N. Engl. J. Med.*, vol. 383, no. 25, pp. 2477–2478, Dec. 2020.