Tackling Health Disparities in Radiology: A Practical Conceptual Framework

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INTRODUCTION
To better highlight and address health equity, radiology as a field must explicitly address disparities in imaging-related patient care [1]. However, imaging as an intermediate step in a patient’s care often precludes identification of the imaging-related drivers of disparities. A conceptual framework for identifying disparities and modifiable factors that drive them would facilitate a more effective approach to related research efforts. Thus, we present a practical and generalizable framework for understanding the factors that influence imaging-related health disparities and that can inform future interventions aimed at more equitable care. We provide examples from the breast cancer imaging continuum to illustrate key framework principles. By outlining this framework, we hope to inspire and encourage the radiology community to leverage its unique, central position in the patient care continuum to address ongoing health care disparities and improve health equity.

CONCEPTUAL FRAMEWORK OVERVIEW
According to the National Institute of Minority Health and Health Disparities (NIMHD), a health disparity is a health difference that adversely affects disadvantaged populations, based on one or more specific health outcomes [2]. The NIMHD highlights that many factors and levels of influence (eg, individual, community, societal) impact the risk of an individual experiencing health disparities. In conceptualizing the complexity of health disparities, we build upon established frameworks and models through the unique lens of radiology. Specifically, we build upon the following: (1) the Behavioral Model of Health Care Utilization, the most widely used framework for examining differences in access to and use of health care (Fig. 1) [3]; (2) the Foster-Fishman Framework for Systems Change that proposes that improving care pathway connections and removing structural barriers can improve health disparities [4]; and (3) a recent health disparities research framework put forward by the NIMHD after a 2-year science visioning process [5].

Our conceptual framework suggests that an individual’s access to and use of diagnostic imaging technologies are directed by multilevel factors that exist both inside and outside the health system (ie, individual-level, neighborhood-level, and health care-level factors). Equitable care occurs when imaging technology access and use are aligned with predisposing characteristics and needs, and inequitable care occurs when access and use are limited by a lack of delivery-level resources.

IMPORTANCE OF A MULTILEVEL APPROACH
Much of what has been published in the radiology literature pertaining to health disparities has been limited to evaluating the access and use of specific imaging technologies based on individual-level characteristics, such as race or ethnicity. However, disparities in imaging care are likely due to a combination of individual-, neighborhood-, health care–, and policy-level factors. For instance, in breast imaging, disparities in access, use, and outcomes of different screening and diagnostic technologies—ranging from tomosynthesis screening to image-guided breast biopsy services—are influenced by a multitude of individual-level (eg, race or ethnicity, education, insurance), neighborhood-level (eg, geocoded median household income at the neighborhood or census tract level, rural or urban residence), examination-level (eg, advanced imaging modalities including ultrasound and MRI), provider-level (eg, radiologist expertise), and practice-level (eg, multispecialty breast center, transfers in care, reporting systems) factors. Moreover, many of these factors interact with one another so they must be examined collectively to avoid...
misleading results due to confounding or mediating factors.

To this end, the NIMHD strongly recommends that health disparities research take a multilevel approach [5]. In our model (Fig. 1), we suggest that whenever possible, radiology disparities research should include data parameters associated not only with commonly examined individual-level factors (eg, race or ethnicity, insurance status) but also neighborhood-, practice-, and policy-level factors. Neighborhood-level factors can be accessed through freely available zip code–geocoded measures based on US Census data, including the University of Wisconsin’s Neighborhood Atlas (https://www.neighborhoodatlas.medicine.wisc.edu/) and the National Institutes of Health–funded PhenX toolkit (https://www.phenxtoolkit.org). Both data sources provide shared geocoded sociodemographic measures that can be applied to disparities-related data analyses. Practice-level factors are readily available to radiology practices and radiology health services researchers and include items such as availability of on-site technologies, characteristics of their interpreting radiologists, integration of imaging with other clinical services (eg, coordinated care for high-risk breast cancer screening), practice ownership type, safety net hospital affiliation, and imaging capacity. Finally, when examining disparities in access and use, policy-level factors such as regional or national reimbursement policies and imaging guidelines should be accounted for in data analyses.

**IMPORTANCE OF THE ENTIRE CARE CONTINUUM**

Future radiology health disparities research should also examine entire episodes of care whenever possible. In many instances, patients undergo imaging at multiple time points over the course of an episode of care. In breast imaging, for example, an abnormal screening mammogram may lead to diagnostic mammography and ultrasound, imaging-guided breast biopsy, preoperative MRI, and presurgical localization before a breast cancer imaging episode of care is completed. Differential access to and use of imaging technologies at any one or more of these points can lead to disparities in imaging care-related patient outcomes. Moreover, disparities in access and use of care at earlier times could lead to cascading disparities at later times. In breast imaging, disparities in timely care at multiple imaging-related steps between abnormal screening and treatment can accumulate to cause delays leading to worse outcomes, with many of these delays associated with facility-level resources [6]. There is a dearth of imaging-related analyses that have examined cumulative disparities at multiple imaging points for other disease entities. Because of their multiple touch points in the patient care continuum, radiologists are well positioned to examine potential cascading of worse outcomes for disparities populations and help identify specific times in disease episodes of care when interventions can alleviate these disparities.

**IMPORTANCE OF LINKING HEALTH CARE PROCESSES TO OUTCOMES**

According to the NIMHD, a major barrier in achieving health equity is
that previous efforts in disparities research have not incorporated more health care delivery factors [5]. Health care delivery—specifically processes within care delivery—is now considered an integral social determinant that contributes to creating and perpetuating disparities [7]. Radiologists and radiology staff are increasingly being asked to help direct patient management, including patient navigation efforts for the next recommended step in imaging care. By implementing processes to ensure proper imaging follow-up and management, radiologists are central to ensuring timely care. However, radiology health services researchers need to associate these processes in imaging care with measurable patient outcomes.

The tendency of many well-meaning publications related to imaging disparities is to identify differences in imaging access across diverse populations without specific testable recommendations for practice change. The value of these types of analyses is limited unless they lead to actionable interventions that can improve outcomes for the target population. Future radiology disparities research needs to step beyond just questions of access and demonstrate that increased access to specific imaging technologies leads to improved intermediate process metrics within the imaging pathway, such as timely delivery of additional imaging (diagnostic imaging after an abnormal screening examination) or interventions (eg, image-guided procedures). These in turn need to be associated with better clinical outcomes. For instance, in breast cancer, diagnostic workup delays as few as 30 days between image-guided breast biopsy and definitive breast surgery have been shown to lead to lower overall survival and disease-specific survival [8]. Thus, timely intervention after image-guided biopsy is a worthwhile intermediate process metric to examine across diverse populations served. Future radiology health disparities research addressing the delivery of care, including imaging access, should focus on imaging processes that lead directly to improved patient outcomes.

BUILDING THE INFRASTRUCTURE NEEDED TO ADDRESS RADIOLOGY DISPARITIES

Although this conceptual framework encourages multilevel, longitudinal radiology disparities research, the reality is that existing data silos are barriers to immediately conducting such work. For example, although many institutions have rich data within their individual electronic medical records system, there are policy and logistical challenges in creating a centralized data set from electronic medical records across multiple institutions. One key strategy for advancing health disparities science is to leverage and foster linkages between “big data” sources to increase analytic capacity and more swiftly translate findings into disparities reductions [4]. Multiple-team science groups and imaging societies working together can facilitate development of a data infrastructure to make these important analyses possible. For example, both the Breast Cancer Surveillance Consortium and the ACR’s National Mammography Database are collecting rich longitudinal breast imaging-related data sets involving multilevel data elements linked to long-term outcomes that are conducive to robust disparities analyses.

The radiology community should leverage medical informatics platforms for imaging-related disparities research. This includes structured reporting and the development and use of a common radiology lexicon in which discrete data fields can be searched and exported for future analyses. Radiology health disparities research will also benefit from radiology reporting systems incorporated into institutional electronic medical records (eg, Epic Radiant). Moreover, radiology health services researchers should begin exploring direct, patient-reported data collection of key individual- and neighborhood-level data elements. Breast imaging has led in this regard with the collection of relatively sensitive information at the time of imaging, such as questions about safety and violence at home in patient checklists [9].

SUMMARY

Ultimately, the field of radiology stands to make a considerable impact in improving health equity across populations by identifying and intervening upon the factors that influence imaging-related patient outcomes, such as severity of disease at diagnosis and disease-specific morbidity and mortality. Radiologists occupy a unique place in the care continuum, with multiple patient touch points in episodes of care, and are thus well positioned to identify, intervene upon, and close disparities in patient care and outcomes. Our conceptual framework presents what we need to do: take a truly multilevel approach to disparities research, examine the entire care continuum, link imaging processes to meaningful intermediate patient outcomes, and take an active role in data collection and curation to create the infrastructure necessary to make a meaningful impact in health equity.

REFERENCES

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