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Identifying and Addressing Healthcare Disparities in the Pediatric Acute Care Setting

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Doctor of Philosophy

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M.S., Arizona State University, 2006

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An abstract of
A dissertation submitted to the Faculty of the
James T. Laney School of Graduate Studies of Emory University
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy in Nursing
in
2023

Abstract

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By Amy R. Kolwaite

Healthcare disparities refer to differences between groups in access to and use of healthcare, health insurance coverage, and quality of care that cannot be explained by differences in health needs, patient preferences, or treatment regimens. In the pediatric acute care setting, healthcare disparities have been linked to social and structural determinants of health such as economic stability, neighborhood and built environment, and healthcare access. Addressing healthcare disparities related to social and structural determinants of health is complex due to barriers such as multifactorial root causes, challenges with identifying disparities in a systematic and standardized manner and implementing effective interventions.

Manuscript I was a qualitative study which describes processes that children's hospital leadership are taking to identify and address healthcare disparities, as well as perceived facilitators and barriers within their institution. Manuscript II was a quantitative study that evaluates whether the Childhood Opportunity Index is associated with patient-level morbidity and mortality following surgery for congenital heart defects in Atlanta, Georgia. Lower-level childhood opportunity levels were associated with a greater risk of poor outcomes and longer postoperative hospital length of stay. Manuscript III was a post-hoc analysis of a clinical decision support (CDS) intervention to determine the impact of CDS on differences in influenza uptake by demographic factors and other social determinants of health. There were significant differences in influenza vaccination rates between sex and racial groups that resolved post-CDS implementation, highlighting the ability of CDS to address differences in adoption of evidence-based practices.

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CHAPTER 1: INTRODUCTION

Introduction

The Institute of Medicine (IOM) report (2003), “Unequal Treatment: Confronting Racial and Ethnic Disparities in Healthcare” brought national attention to the widening gap in care among vulnerable populations.[1] But while efforts have increased to address disparities, the differences in life expectancy have been widening, with the wealthiest 1% of Americans now living 10-15 years longer than the poorest 1%.[1] A nationwide population-based study found that the mortality rate of Black infants in the United States has increased from 1.6 to 2.4 times that of Whites from the 1950s to 2005, while another study found that childhood mortality is higher among Black children than among Whites, Asians, or Pacific Islanders.[2,3] The disparities in mortality for Black children result from both injury-related and medical causes such as heart disease and respiratory diseases.[3]

Healthcare disparities and Health disparities

It is important to distinguish between healthcare disparities and health disparities because they are not the same.

Healthcare disparities refer to differences between groups in access to and use of healthcare, health insurance coverage, and quality of care that cannot be explained by differences in health needs, patient preferences, or treatment regimens.[4]

Health disparities may be defined as “differences in the quality of health across different populations and may include differences in the presence of disease, health outcomes, or access to healthcare across racial, ethnic, sexual orientation and socioeconomic groups”.[5]

There are over 250 children’s hospitals in the United States, providing multidisciplinary, specialized care to meet the unique needs of children and their families.[6] Children’s hospitals are typically located in urban centers and are affiliated with academic institutions.[6] While only one in 20 hospitals are children's hospitals, they serve larger geographical regions compared to general hospitals and provide over 95% of pediatric transplantations, cancer programs, and tertiary care.

Children's hospitals are essential, serving America's most vulnerable children. Half of the care provided at children's hospitals is provided to disadvantaged children, and 6% of those children requiring ongoing care for medically complex diagnoses.[6] Given the population served, it is essential that children's hospitals are implementing processes to identify and address healthcare disparities. This dissertation focused on how economic stability, health care access and quality, and neighborhood and built environment impact patient care and healthcare outcomes in the pediatric hospitalized population, as well as ways to monitor and address disparities outcomes in hospitalized children.

Conceptual Framework

Social determinants of health (SDOH) are the conditions in the environments where people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality of life outcomes. Healthy People 2030's Framework for Social Determinants of Health groups SDOH into 5 domains: economic stability, education access and quality, healthcare access and quality, neighborhood and built environment, and social and community context (figure 1).[7] More recently, the concept of structural determinants of health has been introduced as it represents the governing processes, economic and social policies that can affect everything from housing policies to minimum wage scales which are ethe intermediary step to unequal distribution of power, prestige and resources which then creates social determinants of health.[8]

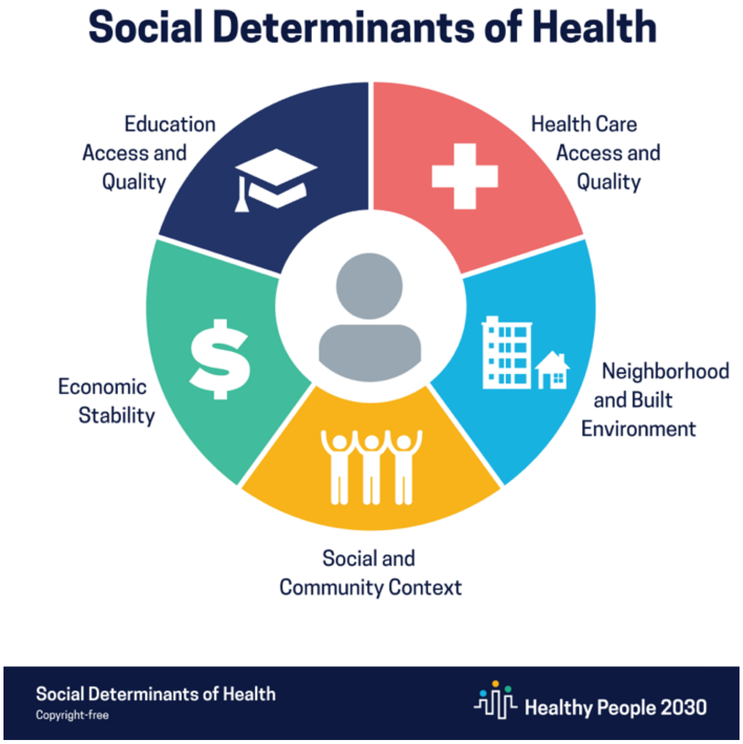

Figure 1: https://health.gov/healthypeople/objectives-and-data/social-determinants-health

Economic Stability

Poverty

Extreme poverty in the United States has more than doubled since the 1990's with more than 1.6 million households, including 3.5 million children, surviving on incomes of less than $2 per person per day which is World Health Organization's (WHO) definition of extreme poverty.[1] The stressors of a hospitalization on a family are substantial and financial costs of a hospitalization may be catastrophic for an already financially distressed family.[9] Additionally, lower-income families may have jobs with less flexibility, forcing parents to choose between earning income or being with their hospitalized child.[9]

Healthcare Access and Quality

Insurance

Access to insurance helps offset the financial impact on a family, reduces unmet healthcare needs, and improves access and utilization of healthcare. Yet, in 2017, 27 million Americans were uninsured with most uninsured individuals reporting annual incomes near or below the official poverty line ($11,770 for an individual in 2016).[1] The number of uninsured children in the United States has increased by more than 400,000 between 2016 and 2018, bringing the total to over 4 million uninsured children in the nation.[10]

Lack of insurance and access to a primary care provider often forces uninsured patients to seek care from their local emergency department (ED).[11] The Center for Disease Control and Prevention's National Health Interview Survey reported that in 2019, 5.2% of children 0-17 ages were uninsured, however children without insurance comprised 16-18% of ED mortality, suggesting that uninsured children are at disproportionate risk.[12] Once they arrive in the ED, uninsured children have a nearly 5-fold increase in the incidence of ED mortality.[12] ED mortality did not vary significantly across most diagnoses, indicating that cause of death may not explain the evident disparities in the incidence of ED mortality, rather mortality is dependent on upstream factors such as regular access to primary care, and delays in seeking care, potentially caused by lack of insurance.[12]

Significant increased all-cause mortality for hospitalized uninsured children transfers over to inpatient wards. Abdullah et al. performed a descriptive analysis of data from a collection of administrative databases in the United States from 1988 to 2005 to characterize the impact of insurance status on inpatient mortality and costs of care in the pediatric population.[11] The researchers found that uninsured pediatric patients compared with insured were more likely to present through the ED (22.92 versus 18.21%, $p<0.0001$) and that uninsured children had significantly increased all-cause mortality compared with insured children with an adjusted mortality rate 60% higher for uninsured children.[11] Additionally, while overall length of stay of insured and uninsured children was the same, insured children who died were likely to be hospitalized longer by one day compared to uninsured children who died. The authors speculate that this may be an indirect indicator of disease severity of the uninsured at presentation resulting in them to expire sooner than insured children.[11]

Although Medicaid, the public insurance program that covers low-income Americans, including children, improves access to care, healthcare disparities are still seen in public-insured children compared to children with commercial insurance. For example, specialist care may be difficult to obtain because of the low fees that Medicaid pays to specialists who are free to turn away Medicaid patients.[1] In a nationwide audit study, 76% of orthopedists' offices refused to provide care to a Medicaid-insured child with a fracture, whereas only 18% refused a child with commercial insurance.[1]

Similar to uninsured children, hospitalized Medicaid patients are also at risk for increased morbidity and mortality compared to children with commercial insurance. Stone et al. examined the effect of primary payer status on mortality, morbidity, and resource utilization in children within the United States following pediatric surgical operations.[13] Patient data from the Kids' Inpatient Database of the Healthcare Cost and Utilization Project were analyzed; a weighted total of 153,333 pediatric surgical patients from 2003 and 2006 were included. Following risk factor adjustments for patient and hospital-related factors, primary payer status remained a significant predictor of mortality ($p<0.0001$). In comparison to children with commercial insurance, uninsured children had a greater than three-fold increased risk of mortality.[13] In the risk-adjusted model, Medicaid payer status had the highest adjusted odds ratio for postoperative complications

(OR: 1.14, CI: 1.05-1.24); risk-adjusted hospital resource utilization was also significantly associated with payer status, with Medicaid patients having increased length of hospital stay and total charges in comparison to commercial insurance ($p<0.0001$).[13]

According to the researchers, the finding that payer status is associated with postoperative outcomes has multi-factorial origins and is reflective of similar studies done in the adult population. Firstly, uninsured children underwent more non-elective or urgent operations which means the child might have gone into the operation in comparatively poorer health. In addition, commercial insurance allows the opportunity for referral to specialty centers while Medicaid and uninsured children may have less flexibility when selecting a surgeon or healthcare facility.

Neighborhood and Built Environment

Neighborhood

Neighborhood of residence has been identified in the literature as a social determinant contributing to healthcare disparities in the pediatric population. Lower-income neighborhoods may lack the healthcare infrastructure found in higher-income neighborhoods. In addition, physical living conditions and distressed social environments such as substandard or overcrowded housing; environmental hazards, including increased air pollution levels; less green spaces and parks; and higher levels of crime also contribute to poor health outcomes.[9] The association between neighborhood characteristics and health are well documented in the literature with patients from lower-income neighborhoods demonstrating worse outcomes for conditions such as obesity, asthma, and low birth weight.[9] Similarly, living in a lower-income neighborhood and the effect on pediatric hospital outcomes has been described in a few studies, but much more research is needed.[9,14,15]

In an effort to determine if disparities exist in patients based on neighborhood of residence, one study linked data from the Pediatric Health Information System database and the US Census Bureau to examine associations, over and above the effects of race and payer, between median annual household income by zip code and mortality, length of stay, inpatient standardized costs, and costs per day for children undergoing cardiac surgery.[14] In this national, retrospective study, the researchers found that children from lower-income neighborhoods had higher mortality, longer lengths of stay, and use more inpatient resources than children from higher-income neighborhoods and that these differences are only partially explained by differences in race, insurance, or hospital.[14] They also found that these effects persisted across ages, races, insurance type, and geographic regions, and are similar for children undergoing high-risk procedures and low-risk procedures.[14]

It is often difficult to differentiate the impact of one factor over the combined effect of multiple factors. This is especially true when considering the social determinants of economic stability and the neighborhood/built environment. Some might argue that these could be considered one in the same since income level may influence neighborhood of residence and subsequently health outcomes. This was the hypothesis in a population-level, retrospective analysis of admissions to the Cincinnati Children’s Hospital Medical Center PICU between 2011 and 2016. The researchers geocoded residential addresses of patients and spatially linked them to census tracts.[9] PICU admission and bed-day rates were calculated by using numerators of admissions and bed days, respectively, over a denominator of tract-level child residents. They found significant correlations between neighborhood child poverty rates and neighborhood rates of PICU use, providing evidence of income-based disparities in the need for intensive care services. Since the study looked specifically at PICU admission and PICU bed-day rates, measured at the level of the census tract, they did not gather underlying patient-level data on diagnosis or severity of disease.[9] Previous studies suggested that lower-income children were more ill when they arrive to the PICU and may be more likely to die before PICU or hospital discharge; however more research is needed to understand the relationships between poverty, neighborhood and pediatric intensive care needs.[9]

An external database, the Childhood Opportunity Index (COI), is a national database that provides neighborhood characteristics at the level of census tract. The COI, developed by diversitydatakids.org, defines "opportunity" as "neighborhood-based conditions and resources conducive to healthy child development."[16,17] The COI is publicly available and includes a variety of measures enumerating relative opportunity for 29 variables across 3 domains (i.e., educational, health and environmental, social and economic opportunities).[17]

To illustrate the use of COI, Cincinnati Children's Hospital manages approximately 95% of all pediatric hospitalizations for Hamilton county, Ohio.[18] Their healthcare team felt that a neighborhood-level view of poverty-related health disparities may support public health and system-based approaches to pattern recognition and preventive strategies aimed at disparity reduction.[18] They used geocoding to identify multiple hospitalization hotspots for intervention with the goal to reduce the rate at which children from high-morbidity, high-poverty neighborhoods spend days in hospital by 10%.[18] Through the use of quality improvement methods and interventions which included the optimization of chronic disease management; transitions in care; mitigation of social risk; and use of real-time data, the inpatient bed-day rate for the two target neighborhoods decreased by 18% from baseline to the improvement phase.[18] Hospitalizations decreased by 20%. There was no similar decrease in the control neighborhoods.[18] This study highlights the value of identifying high-risk neighborhoods or "hot spots" to inform future community-hospital partnership interventions.

Research Question and Study Aims

There is no paucity of literature describing the impact of social determinants of health on healthcare disparities. However, more information is needed on how pediatric healthcare institutions are identifying and addressing healthcare disparities in the acute care setting (e.g., hospitals, emergency departments), which data sources may be used to identify and monitor disparities, and examples of successful interventions to reduce disparities in this population. Therefore, three specific aims were formulated for this dissertation:

1. Describe processes that pediatric hospitals are implementing to identify and address healthcare disparities in patient care and healthcare outcomes.
    a. Sub-aim: Explore system-level hospital leaderships' perceived facilitators and barriers in identifying and addressing healthcare disparities in patient care and healthcare outcomes at pediatric hospitals in the United States.
2. Determine whether the Child Opportunity Index (COI), a nationally available measure of relative educational, health/environmental, and social/economic opportunity across census tracts within metropolitan areas, is associated with population- and patient-level morbidity and mortality following surgery for congenital heart defects in Atlanta, Georgia.
3. Determine the extent to which social determinants of health (i.e., race/ethnicity, insurance status, gender) impact pediatric influenza vaccination administration.
    a. Sub-aim: Evaluate the impact of a clinical decision support tool in reducing identified disparities.

Outline of the Dissertation

The research team anticipates publishing at least three papers that report the research priorities of this study. The proposed publications include the following chapters: **Chapter 2)** is a qualitative study, characterized by qualitative data collection using interviews and thematic analysis, which describes processes that children's hospital leadership are taking to identify and address healthcare disparities within their institution, as well as describing perceived facilitators and barriers to implementing these processes. (Specific Aim 1); **Chapter 3)** is a quantitative study that evaluates whether the Childhood Opportunity Index, a nationally available measure of relative educational, health/environmental, and social/economic opportunity across census tracts within metropolitan areas, is associated with patient-level morbidity and mortality following surgery for congenital heart defects in Atlanta, Georgia (Specific Aim 2); and **Chapter 4)** is a quantitative study describing the extent to which social determinants of health impact pediatric influenza vaccination administration, as well as the impact of a clinical decision support tool in addressing any identified disparities (specific Aim 3). In **Chapter 5** an integrative summary and synthesis of this study, implications for future research, practice, and policy are presented.

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CHAPTER 2: Hospital Leaderships' Perceptions and Experiences in Identifying and Addressing Healthcare Disparities in Patient Care and Healthcare Outcomes at Free-Standing Acute Care Children's Hospitals Nationally

Abstract

Background: Children’s hospitals play a crucial role in providing high-quality healthcare to children. However, healthcare disparities persist, disproportionately affecting children from minority and low-income backgrounds. This study aims to understand the perceptions of healthcare disparities and the facilitators and barriers to identifying and addressing them among hospital leaders at free-standing acute care Children’s hospitals across the United States.

Methods: In this descriptive qualitative study, semi-structured interviews were conducted with 12 system-level hospital leaders from 10 free-standing Children’s hospitals. Data were collected through online interviews and analyzed using an inductive approach, supported by MAXQDA 2022 software for thematic analysis.

Results: Participants discussed social and structural determinants of health, with disparities encompassing patients, their families, and healthcare employees. Various approaches for identifying disparities included external databases, health equity dashboards, and health equity teams were described. Interventions included raising awareness, addressing language barriers, utilizing ‘navigators’, and community engagement. Ideal systems involved family and community involvement, data systems utilization, diverse healthcare staffing, external pressure, and peer learning. Influencing factors comprised data systems understanding, staff capacity, buy-in and training, time, public disclosure, leadership support, and partner collaboration.

Discussion: Our findings indicate that identifying and addressing healthcare disparities is a complex and multifaceted process. Participants expressed optimism that with proper commitment, healthcare systems can effectively address disparities. Through this in-depth exploration, we strive to make progress towards guaranteeing equitable access to high-quality healthcare for all children, irrespective of their background or medical condition.

Background

Pediatric acute care settings within the context of Children's hospitals play a critical role in providing high-quality healthcare services to children with acute and chronic medical conditions. However, healthcare disparities, defined as differences in healthcare access, quality, and outcomes, remain a significant challenge in the pediatric acute care setting.[1] These disparities disproportionally affect children from minority and low-income backgrounds, leading to worse health outcomes and increased healthcare costs.[2–5] Social and structural determinants of health are non-medical factors determined by social and economic systems that influence health outcomes.[6] They are the conditions in which people are born, grow, work, live, and age, as well as a wider set of forces and systems which shape conditions of daily life, including economic policies, development agendas, social norms, social policies, racism, climate change, and political systems that determine policies.[6] While healthcare systems are starting to both acknowledge the existence of healthcare disparities and a willingness to address them, there remains an abundance of literature describing the continued impact of social and structural determinants of health on healthcare disparities.[2–4,7–12]

Health systems have a crucial responsibility to prioritize healthcare equity by implementing effective policies and programs that address healthcare disparities. However, creating meaningful change within complex health systems can be a daunting task, requiring careful consideration of social and structural determinants of health that impact specific patient populations. Unfortunately, the lack of consistent measures or metrics to quantify healthcare disparities and document changes over time has hindered efforts to identify and address these disparities.[13] Without consistent metrics, it is challenging to disaggregate multiple clinical, social, and individual factors that affect disparities which can impede efforts to identify and address these disparities and assess the effectiveness of interventions at a healthcare level. Fortunately, recent advancements in health information technology offer promising solutions. By leveraging detailed patient data, health systems can implement precise, targeted treatment regimens, and foster greater patient participation in shared decision-making.[13]

In the United States (U.S.), over 250 specialized Children's hospitals provide multidisciplinary care tailored to the unique needs of children and their families.[14] A staggering 50% of patients at these institutions hail from disadvantaged backgrounds with 6% requiring ongoing care for medically complex diagnoses.[14] Given the diverse patient population served, Children's hospitals must implement robust processes to identify and address healthcare inequities. The purpose of this study is to better understand the perceptions of healthcare disparities and the facilitators and barriers to identifying and addressing them in patient care and outcomes among hospital leaders at free-standing acute care Children's hospitals across the United States.

Methods

Study design

This study followed a descriptive qualitative design using semi-structured interviews to explore the perceptions and experiences of system-level hospital leaders in identifying and addressing healthcare disparities in their pediatric acute care setting. The chosen study design allows for a better understanding of the varied perceptions and experiences of individuals and the opportunity to solicit new information on current activities, facilitators, and barriers, thus providing a summary of events in the language of the people experiencing the event and requires minimal data interpretation by the researcher.[15] A semi-structured interview approach with open-ended questions allowed for unanticipated responses and the opportunity to elicit further information of responses.[16]

Sample

The sample included systems-level leaders working in free-standing Children's hospitals with greater than 100 beds across the U.S. Purposive sampling on the regional level was used to include at least one hospital in each of the five geographic regions (i.e., Northeast, Southwest, West, Southeast, and Midwest). Twelve participants were interviewed representing ten free-standing Children's hospitals. We relied heavily on snowball sampling, that is "who knows who", when recruiting participants within these hospitals. We started with participants known for their interest or involvement in identifying and reducing disparities within their healthcare system then sought recommendations for additional potential participants from them. Once identified, participants were contacted via email. In introductory emails, prospective participants were sent background information asked if they would like to participate in the study. Participants included physicians (e.g., intensivists, cardiologists, pediatricians), nurses, social workers, pediatric researchers, and hospital administrators.

Data collection and analysis

Institutional review board (IRB) approvals were obtained. All interviews were conducted online using the HIPAA-compliant video conferencing Zoom platform and lasted approximately 45-60 minutes. Before beginning the interviews, the consent document was read with the participant, time was given for questions, and the participant was asked to provide a verbal consent. Participants had the option to have their video on or keep the video off and use audio only. An IRB-approved semi-structured interview guide consisting of 8 open-ended questions was used to guide interviews (Figure 1). Probing questions were used to solicit additional information to responses. Interviews were video- and audio-recorded and transcribed verbatim by an independent transcription service. Transcriptions were cleaned of any identifying information prior to analysis. An initial codebook was developed using the interview guide as a foundation. Two coders (AK and LO) independently coded two initial transcripts, compared codes, and then collaboratively refined the codebook and code definitions. The final codebook was applied to the remaining transcripts. A third coder (SB) was available to resolve any differences in opinion between the two primary coders. The final codes and themes were discussed and approved in a peer debriefing session (SB and AK). The qualitative software MAXQDA 2022 (VERBI Software, 2021) was used to conduct thematic analysis and organize codes using an inductive approach which allowed the analysis to be guided by specific study objectives.[16] Peer debriefing was completed to enhance rigor and achieve trustworthiness. During the peer debriefing sessions, themes and codes were compared with the themes and codes identified from independent analysis.

1. Tell me about your position within your institution?
2. Describe a time when you noticed or felt there may have been a disparity in patient care or outcomes at your institution?
3. How are healthcare disparities identified at your institution?
4. How are healthcare disparities being monitored within your institution?
5. How are healthcare disparities being addressed within your institution?
6. What would you consider as an ideal system for identifying and addressing healthcare disparities?
7. What are some factors that would influence whether this ideal system can be achieved?
8. Is there anything else you would like to return to or add to our discussion?

Figure 1: Interview Questions

Results

Identified Themes.

Five overarching themes were identified during data analysis: 1) perceived healthcare disparities, 2) identification of healthcare disparities, 3) addressing healthcare disparities, 4) ideal systems for identifying and addressing healthcare disparities, and 5) influencing factors. Below, each theme is described individually. Prior to discussing these five themes, the following quote from a participant sets the stage for the unfolding themes and their implications for enhancing healthcare equity among children in pediatric acute care settings.

> *"I think the one thing that we just have to realize is that our healthcare system, and the more we admit that our healthcare system, was built on the basis of white supremacy, and sexism, and the patriarchy, then the more we can just embrace that this isn't what we built. We're a part of it and we can absolutely rebuild. We can absolutely rebuild it where we don't have a healthcare system that if a woman goes into an emergency department complaining of chest pain that she's going to be told she's hysterical and probably is mentally unstable, but in fact is having a heart attack. Where a black woman is not at higher risk of mortality simply by getting pregnant. That our symptoms will be believed and that we will be treated equitably."*

Perceived Healthcare Disparities

> *"If this patient's parents spoke English or if these parents were white, or if they weren't from a different country, would they have had the same outcome?"*

Participants were asked to share a time when they noticed or felt there may have been a disparity in patient care or outcomes at their institution. Social and structural determinants of health were shared broadly by participants including discussions about race, ethnicity, transportation, access to care, language, health literacy, implicit bias, treatment differences, sex, mental health, and experiences of perceived discrimination. Identified disparities were not limited to the patient, but additionally included patients' families and healthcare employees.

Transportation and access to the hospital, as a driver for healthcare disparities, were highlighted in multiple participant examples. One participant shared a story about a family that was late to an appointment due to transportation challenges and subsequently unable to be seen since “she had to take three buses. That's why she's three hours late. And it's a snowstorm and she's got two little people with her. And yet we're going to kick her out and say she can't be seen because she made it all the way here.” Another participant discussed the lack of bus stops near their Children’s hospital, “Even the buses didn't stop right there, and they had to switch buses in just a mile-long distance to get to the hospital. So, we learned, really understanding their perspective, how you could not have access, when we have a million plus visits on this campus, but you can't get there, I mean, what the heck?”

Disparities related to language barriers were reported frequently by participants. According to one participant,

> “anybody who has worked in a healthcare system, we know that we don't provide the same level of care to patients and families who use a language other than English....that can show up in the emergency department, like how you triage, that can show up in wait times, it can show up in our discharge planning, length of stay, admission and readmission.”

In addition to differences in treatment, limitations to family involvement in decision making due to language barriers were highlighted. As one participant experienced, “when it comes to English as a second language, I often see disparate care...I've seen that in terms of patients...when it's time for rounds, they're unable to advocate for their child because there's only one interpreter for the floor. So, if there's no one there that speaks Spanish, well then, they're just not going to be able to participate."

Race and implicit bias were intertwined in several participants' examples. One participant shared that "there's a clear difference between perhaps a nurse or a provider...who feels threatened by a black man yelling at them versus a white man yelling at them. They could do the same thing, posture the same way, have the same tone and cadence to their voice, and then it just feels different. One feels unsafe and one feels like there's no real fear here and I can handle this." While another participant stated that

> "it is very common for me to see patients described as difficult, or this is a challenging patient, and it is not uncommon then for me to go look and meet the patient and find that they're an African American patient. That's very, very common. And so, the context of why they are difficult or perceived as difficult is often not discussed, what might have happened before, what might have been...What laid the groundwork for them to have either some level of distrust or why are people perceiving them that way, when someone else who is just as vocal is viewed as a "VIP", or they know a lot, or whatever other adjective you want to use that is then not used for these other populations, specifically African Americans."

Finally, one participant highlighted the need to address health literacy and the ability of healthcare providers to effectively communicate information to families, particularly in relation to race/ethnicity and language barriers. The participant explained:

> "There's also very little focus on health literacy, and that makes me crazy...We had a recent case...where...a family withdrew [their child's] care shortly after they [the child] had cardiac surgery. When we were discussing why was that, why did they [the family] go forward with the surgery? Everyone's like, well, the family, when they...realized that the kid may not walk, talk, and needed a trach…they decided that this is not a life that they could handle. So, there was a lot of discussion about why didn't we have this conversation beforehand? Maybe the conversation was had beforehand, just not in very succinct terms, or maybe it wasn't as black and white, or maybe people used different language that was softer. So, the family did not grasp the severity of the situation. And it really brings back home to me how bad we are at bringing it down six notches to be able to have a conversation that a lay person can understand, let alone a lay person who's not educated."

Additional examples of identified disparities are presented in Table 1.

Identifying Healthcare Disparities

"We have a problem. We have taken the time to look at our safety data relative to race and ethnicity. And what we're finding is obscene."

Participants were asked to describe how healthcare disparities are identified within their healthcare system, including methods and metrics. Responses encompassed both standardized and non-standardized approaches, use of external databases, health equity dashboards, and involvement of health equity teams.

Examples of standardized approaches to identifying healthcare disparities were limited and primarily included screening of patients and their families for social determinants of health with the emphasis that this process was in the planning or early implementation phase. One participant shared an example of this type of screening and the processes in which they've learned to adapt the questions away from a more academic verbiage to language the families can more easily understand. They would ask the family if "there are any equity concerns that the team has or that the family has. Initially, when it rolled out, the team was reading the verbiage, and I think…does someone really understand what equity concerns are? …We're still evolving in terms of that question when we talk to families. I hear the residents say… "Is there anything that we can be doing to better support you or your family and/or your child?"

Non-standardized, or unofficial, methods for identifying healthcare disparities were the most common method described by participants. One participant highlighted that when it came to examining disparities data, "there were always a few people that did it in their own programs, but it wasn't in an organized fashion." And if inequities were found, one participant stated that "it's not clear that it's attached to any strategic goal or issue, it's not clear...And People say, 'Well, that's not fair or it's not right', then it's one more inequity measure that is entirely up to the individual and/or the division, whether they do something" about it.

Participants emphasized the need for "precise and measurable" equity metrics that capture root causes of healthcare disparities, beyond traditional healthcare quality metrics. Incorporating equity into existing metrics was highlighted by several participants with one sharing that "rather than new metrics and new ideas, let's add to…our quality measures…you have 25 of them…CLABSI's on there, missed appointments… hand hygiene, patient experience… our hope and expectation is that all 25 have an equity component… all 25 need to look at it by race, equity, and language."

Incorporating metrics that are outside of traditional healthcare quality metrics of patient safety and clinical outcomes and instead choosing metrics that more accurately capture root causes of healthcare disparities was a common theme. One participant highlighted metrics that had been chosen at their healthcare facility, "they are not typical healthcare measures…infant mortality, overall child mortality, teen pregnancy, obesity, things that are the wellbeing indicators, kindergarten readiness, high school graduation, things that many healthcare systems wouldn't think about, but actually mark very clearly the wellbeing of children in a community." The participant went on to explain that "all of these process measures…are not a true health equity measure, they will never achieve what you want. You get so good at your process…But if you don't have them as subservient metrics to help equity, I believe we fail the children again…And so it's hard work and it takes... making a stand on it and not to go back to just healthcare quality metrics."

Participants emphasized that the responsibility for creating and gathering metrics lies with hospital health equity teams. One participant explained that "The Center for Health Equity is still working on a standardized approach to evaluating disparities…. stratify by race, ethnicity, language, payer type, and…a proxy for social determinants of health or systemic racism", while another participant shared "our center for diversity and health equity pulls various pieces of information and outcomes that we've prioritized as areas of interest." Reporting of metrics is often done via health equity dashboards that include data from a “myriad of sources”, such as "patient safety reviews. It comes from electronic health record data. It comes from data from interpretive services. So there really are a myriad of data points coming not only from the native electronic health record, but also from other reporting systems that we use within the hospital.”

Linkage to external data was highlighted by several participants to fill in the data gaps, but this also comes with reported external data limitations. One participant highlighted the challenges by stating, “We are really stretching the use of publicly available data to use it at the individual level. But it's the best we have. We just don't capture individual-level social determinants of health or SES…we don't ask families their income.” One specific database mentioned by multiple participants was the childhood opportunity index (COI), which the participant describes as “a neighborhood level measure, which is a pretty strong correlate of individual-level social determinants.” This participant felt that instead of relying on a healthcare provider’s assumption, “it offers opportunities to intervene … although it does make assumptions based on where you live, rather than some health administrator's random perception of your skin color and which box you get put into, or if you've got an accent.” Another patient highlighted the challenges with the COI, “it’s not operational from a QI perspective. It's great to know roughly where you're at, and I think when we compare areas, we should control for baseline opportunity index, but you can't go to the infant mortality team and say, ‘Work on this index.’ So, it's a great starter place, it's a great control, baseline control measure, but when you're actually trying to do quality improvement work and change the number, you need to pick an equity metric that is precise and measurable on that topic.” Additional external data sources mentioned included Medicaid data and the Social Vulnerability Index.

Additional examples of participant quotes describing identification of healthcare disparities are presented in Table 1.

Addressing Healthcare Disparities

> *"We have to stop blaming our patients for systemic racism. We have to stop blaming them for it, it's not their fault. And we play a role in what we can control, and where we invest, and what commitments we make to the community and to our patients. And so I think just being able to start there as an organization is a really good place to align and kind of everybody get on the same page of ultimately let's control what we can try to control and remember that we don't have to take on the history of the past as ownership, but we can certainly be responsible for how we proceed and move forward."*

Participants were asked to describe interventions used by their healthcare facility to address healthcare disparities. Interventions described fall under 4 themes: awareness of equity issues, interventions to address language barrier, the use of 'navigators', and community engagement.

Several participants acknowledge that addressing healthcare disparities is a complex issue that requires a collaborative approach from multiple partners. One participant emphasized this by stating, "this is an area, that's a lot harder. And I think that one of the things that really contributes to this is that it's not one person" responsible for addressing disparities. Another participant raised questions about identifying which patients to intervene with, asking, "only your patients of color?... Is it your patients who have high financial need, patients who don't speak English, patients who might outwardly look like they might be white, but they are from a different culture?" They noted that there is still work to be done in determining when and how to intervene.

In order to address healthcare inequities, there must be increased awareness of healthcare disparities and buy-in by healthcare leadership and staff. This was mentioned by several participants as a critical first step towards addressing disparities. One participant shared, “I think we're at least at the awareness, raising the burning platform level of this is important and we need to do it. And we've got leaders on board who are aware of the importance and who are bought in. And I think then it just comes to the operationalizing or implementing.”

Interventions for addressing language barriers were highlighted by several participants with two participants describing it as “low hanging fruit” which doesn’t require much additional time or effort on the part of the clinical staff, stating it “doesn't actually require you to work on your own biases, it doesn't require you to go to DEI training, you just need to dial that 1-800 number and get an interpreter on the phone.” Another participant expressed it as “finally getting text messaging that is in different languages besides English…It's like bite the bullet, pay the bill, and increase texting capacity. Not everybody speaks English, it's not helpful to have directions and the appointment time in a language that somebody doesn't understand.”

Resource navigators play an important role in addressing healthcare disparities by connecting patients and their families to the resources they need. By providing individualized assistance and addressing the unique needs of each family, resource navigators, also referred to as community navigators, can help to reduce disparities and ensure that all patients have access to the care they need. As one participant explained, “The resource navigator, they are people who provide whatever is needed. So, if a family says they have food insecurity. Well, here's some resources.

You can go to this food shelter, or I can send you this link to this, or I can have food sent out to you. We can get you some food boxes, whatever. They determine what the need is and then they help the family work through that to make sure that need is met, whether it's financial, non-financial or whatever." These navigators can assist families with everything from transportation to finding affordable housing to accessing community resources.

One participant emphasized the importance of engaging the community to prioritize disparities and leverage their voice to drive service delivery, "One of the successes they've [hospital] had is in creating this community neighborhood council to actually give real input to what is needed by the community and what is desired by the community." To address access issues, alternative treatment sites within the community have been implemented. For instance, healthcare systems have leveraged community events to provide essential health services in more accessible venues to community members. A participant explained, "We've done events, neighborhood events where there was a street fair…Several different organizations came together and we had our mental health professionals out there, we had our gynecologist group out there, and they were handing out condoms and doing sexual education with the teenagers right there in the street."

Additional quotes from participants on interventions being used to address identified healthcare disparities are presented in Table 3.

Ideal System for Identifying and Addressing Healthcare Disparities

"I'm saying if you paid the hospital to get rid of racism and outcomes, it would happen."

All participants were asked to “dream big” when describing their vision for an ideal system to identify and address healthcare disparities. Participants’ ideas fall under six themes: family and community involvement, addressing underlying causes of disparities as they relate to structural and social determinants of health, utilization of data systems, healthcare staffing (i.e., dedicated health equity teams, workforce diversity) and external pressure through policy or reimbursement from national groups such as Centers for Medicare and Medicaid Services (CMS) and opportunities to learn from peers including other Children’s hospitals.

Participants emphasized the importance of partnering with communities. One participant explained, “another aspect that's important is to partner with communities to go beyond the four walls of an institution and say, ‘What's going on within our local community or communities, and how is that changing over time?" There were two distinct groups of people discussed: patients and their families and the larger community served by the healthcare facility. Participants had varying approaches to engaging with patients, families, and the community. Some emphasized the need for patient and family advocates who “can sit down with patients and families and try to understand what are the gaps that are barriers to the care that they are not receiving.” Others, like one participant, stressed the importance of addressing “whatever it is that the community wants to address. I think that by putting choice and preference, and power back into the community to say this, we get to say what matters in our lives and our kids' lives. And likely, it's going to be non-sexy things like food insecurity and housing and transportation, but they're really important things.” Having families participate as co-designers for the healthcare system was the dream of one participant:

> “I think in my ideal world, I would see a caregiver of a patient in a marginalized community… at the table with the head… with the chief informatics officer or in ongoing discussions at the board of trustees table … And to be able to say, none of that matters to me, all of the work that you just said, what I really care about is this for my kids… in my dream world, families and community members get to help to co-design what it is that the healthcare system actually is putting in place and to have a seat at the table in a real way.”

Participants called attention to the need to address the root causes of healthcare disparities, which are often linked to social and structural determinants of health. As one participant explained, “the disparities that we see in the medical system are just one small part of the greater overlying social disparities that we have in the US…And so, in an ideal situation or an ideal world, we would be able to figure out how we can address the underlying social disparities in our system. Which will, I think eventually address healthcare disparities.” Understanding why healthcare disparities exist by examining social and structural determinants of health was seen as crucial by participants. One participant emphasized the need to investigate the success rates [in patient outcomes] of White patients compared to Black patients and to identify any internal or external factors that might be contributing to disparities. These factors might include issues related to access, transportation, or health literacy, among others.

> “What is happening with our White patients that our Black patients aren't seeing that same success? And is there anything we can do as an organization internally to support our Black patients, but also is there anything we can do externally outside of our four walls to help those patients? Is it an access issue? Do they need help with transportation?

> Is it because the Mom and the Dad work all the time and they need a sitter? Is it because they don't have a high level of health literacy and we need to just do a better job of explaining to them what they're supposed to be doing, what to expect?"

Participants emphasized the importance of collecting and using SDOH data to guide clinical decision-making. One participant explained that hospitals need to be better equipped to collect SDOH data, and that the data should be used to frame what the hospital provides. They went on to explain that physicians should be comfortable asking about patients' housing situations and plans after leaving the hospital, and that this information should be used to adjust the care plan and provide necessary resources. The ultimate goal is to support the patient in a holistic manner, addressing both medical and social needs:

> "Would they [Physician] have comfort in saying, 'How's your housing situation? Where are you going after this?' And then they can say 'Okay, well since you're going to a shelter that has me rethinking what your care plan is going to be, because my care plan that I have established requires you to have this level of stability, all those things, and I'm hearing from you that you don't have that. So, I'm going to adjust and pivot, and we're going to come up with a way to support you. In the meantime, here are all the resources that (our hospital) is investing in the community to get you those needs."

Participants' ideal system also included better use of data and data systems for clinical decision making and research. One participant raised the issue of differences in treatment due to provider preference or potential implicit bias, stating that "there's no check boxes…It's really your own decision making, and my belief is that's probably where the small decisions that influence the larger outcome are made and also where your biases probably exert the greatest influence." Several participants discussed clinical decision support (CDS) as a means to standardize care, with one participant describing CDS as "a standardized approach to decision-making around offering…therapies to patients to find a way to ameliorate any implicit bias so, it's not just group think or an individual provider who may potentially be susceptible to bias." The use of EPIC or electronic health records (EHR) was also discussed as a way to reduce variation in care through automated responses, with one participant stating that "standardizing protocols...hopefully reduces variation in care, to some degree." Automation was also seen as a way to improve resource allocation, with one participant saying, "I'm all about automation because the less people have to remember, the more likely it is to get done."

Participants highlighted the need for robust data systems and human resources to conduct healthcare equity research. One participant emphasized that for effective research, organizations must provide accessible data and support data collection. They stated, "if people are going to research this, then organizations must be able to provide the data to conduct the research and/or support data collection. A lot of times data is being pulled from electronic health records. EPIC is not always the easiest at getting data out…So you need to be able to provide an infrastructure that's going to support the research." Improved data collection and research infrastructure could help identify healthcare disparities and support effective interventions.

During the interviews, the importance of dedicated teams focusing on equity issues and having a direct pipeline to leadership for healthcare employees was highlighted. As one participant stated, "I think having a coordinated approach to examining and then re-examining all the things that we do is really important. You need to have a group…that is…given the mandate to be able to think about this." Additionally, participants emphasized the importance of having a diverse workforce in order to effectively take care of a diverse patient population. One participant explained that having a variety of perspectives in the clinical care setting and work environment can be helpful, stating, "I think sometimes it helps…address things that we've never even thought about because it's so far away from the reality that we know."

Participants expressed concerns about the lack of diversity among healthcare professionals, particularly among nursing, APPs, and physicians. One participant pointed out that the numbers of Black males applying to medical school have dropped, stating that "we have fewer black males applying to medical school now than we did during the Civil Rights. This is a problem." The participant went on to explain that poverty and lack of access to STEM learning and higher education are barriers that must be addressed in order to achieve health equity. They emphasized the need for a racially and ethnically diverse workforce in order to create an anti-racist healthcare system. Another participant echoed these sentiments, stating that "there's got to be some pipeline and pathway at a young age to break that cycle of poverty, making it accessible to folks...whether you're in respiratory therapy, or whatever your role is in healthcare."

Participants highlighted the importance of external factors such as financial reimbursement and policy changes in creating an ideal system. One participant emphasized that policy changes are necessary to promote equitable healthcare, stating that "it just really has to be at the policy level. There has to be advocacy and policy. Otherwise, institutions just won't do the right thing." They elaborated that the healthcare system is currently designed to produce certain results and without external forces, meaningful change will not occur. The participant further emphasized the need for advocacy and policy-setting at the state and federal levels to address these issues.

Participants suggested using incentives or reimbursement links to drive equity improvement, similar to what has been done for patient safety in the past. One participant proposed a healthcare financing system that rewards equity measurement improvements, saying, "If we were paid to get rid of the disparity in infant mortality, it would be gone. If we were paid to get rid of the disparities in asthma, it would be gone." They continued, "We'd spend a lot less money on doctors and glass and steel buildings, and a lot more money on home visitors and early intervention and universal pregnancy income and some other innovative things."

Finally, participants highlighted their desire for opportunities to learn from others. One participant stated that they would love “to have the opportunity to learn from peers who are going through it simultaneously or have been far ahead in terms of what they've done.” When discussing networks that existed for topics such as patient safety, one participant stated that “there's nothing like that for equity, nobody is meeting and saying, "This is us, and we're all getting together, and we're sharing interesting results," in part, because there are not enough people doing it, and in part, because people don't feel safe yet. Another participant also shared their dream of “bringing together children's hospitals to talk about, what are the different indicators we should be measuring? Around health equity, at least start with something that these are the things we're going to measure...” A participant emphasized the importance of external collaboration in developing metrics, stating, “there's a sevenfold difference (in Black and White infant mortality) from neighborhood to neighborhood... but a three-to-one difference across the whole county. What level do you measure these things at, how should healthcare systems be accountable, and how do you control neighborhood-by-neighborhood variation when the data is not that way?...I think that is not clear to most people...we need to break those things down." The participant also stressed the value of understanding interventions that can change true health equity and breaking down overwhelming statistics on infant mortality or life expectancy by neighborhoods into addressable components.

Additional participant quotes describing an ideal system can be found in table 4.

Influencing Factors to Achieving an Ideal System

> *"The money machine is so effective, why would you change it? When you think about the increasing number of dollars going to healthcare every year and certain institutions are getting better and better and better at doing it, and the monopoly situations we find ourselves in allow us to demand more and more and more. And it's a natural business tendency and organizational tendency is to try to grow and maximize, I mean, these are corporations, so they maximize revenue, and I don't blame them for that, but it's costing society a lot."*

After describing their ideal system for identifying and addressing healthcare disparities, participants were asked to identify factors that might influence, either as a facilitator or barrier, the implementation of their ideal system. Influencing factors include data systems and the understanding and acceptance of data, financial concerns, staff capacity, buy-in and training, time, public disclosure, leadership support, and partner collaboration.

Participants highlighted the importance of data system factors such as availability or access to data, quality of data, and staff capacity to work with equity data. One participant emphasized the need for data, stating "Without data, forget it, so you have to find a way to get the data." However, another participant expressed frustration with accessing data, saying "We can't find this data, we can't get this data. I don't even know where it is... We collected, but I have no idea where it is. I don't even know who to ask." In addition to access, participants also discussed challenges with the quality of data and inconsistencies in data fields within electronic medical records. One participant noted:

> "Even something as simple as language...there's a field for language for its parental language. It turns out that there's a secondary field that is, child language. For reasons that I don't entirely understand. So, which one do you use then? And why are there two fields...it's so confusing. So, we had to come up with this complex algorithm…if they are concordant, then we use this one, but if their discordant, then we use this one, versus that one, even just these two fields are super complicated to try to figure out what to do with."

Several participants shared the challenges of EMR data being the primary source of equity data. One participant explained reasons why it’s challenging to use, as well as highlighted the need for expertise, “the EMR was never set up to be a tool for disparities, right? The EMR was set up to be… ‘Hey, can we have better communication with patients, and can that improve outcomes?’ The goal was more of a tracking over time and not necessarily… a referral or research tool. So, it's not set up to do that…It is very cumbersome. So having someone who has expertise that knows the ins and outs of mining, and EMR is extremely challenging and extremely important. Especially if they also have some level of statistical expertise.”

Participants discussed the challenge of gaining acceptance of disparity data, even among colleagues. One participant shared an experience where a colleague dismissed the data by saying, "'We have a lot more black patients. So of course, it's going to be worse.'...It's not a numerator. It's not, there's a more number. It's a rate. Their rate is higher." Similarly, another participant recounted a frustrating encounter when sharing data with a colleague who thought they were being called racist, "I've literally had someone say to me, 'You are saying I'm racist'. Whoa, whoa, let's just unpack that for a minute. I presented this observational data. I presented this observational data. I said, you are a racist. I didn't. It's like our data showed I wasn't talking about you personally and I never used the word racism. And I think it's hard. I find it very invigorating and challenging to try to figure out how to do this, but I wish somebody could tell me, could give me some tips."

Staff buy-in played a crucial role in reducing disparities, as it hinged on their grasp of the issues at hand and willingness to take on additional responsibilities. A participant emphasized the importance of educating the staff, and shared an example of how this was achieved: "then the nurse practitioner group invited one of my coaches to come…talk to them about the coaching she had given the staff, but also so that they could discuss different scenarios with her to help coach them. And so that is how you get to decreasing the health disparities at the bedside."

When it came to incorporating disparities work into their workday, staff felt that their current workload was underappreciated, "I'd say the majority of the pushback actually is from our nursing staff, they're our biggest workforce team. And I think it's the combination of them feeling like we don't understand how hard their day to day is. It is hard, and so when you've got a family and there's conflict between the team and the family… the bedside nurse has to be there for 12 hours and has to be in the room all the time. And so, I think our disservice to the nursing group to get them on board was not actually giving them the skills, like the basic skills of therapeutic relationships and de-escalation skills and those types of things, and then asking them to be anti-racist on top of that is tough."

Even when staff were willing to embrace disparities work, a concern shared by participants was the additional time that this might add to an already understaffed workforce. As one participant explained, "I think a large factor would be time. I mean, screening and data analysis and community needs assessments all take a lot of time. It's not just the time of whoever's doing the investigation from the provider side of things, but it would take a lot of time from the families and from the folks in the community as well." This sentiment was shared by another participant when discussing concerns of social workers in undertaking additional screenings of social determinants of health, "our social workers said, 'We're already understaffed. And if you start screening everybody. Number one, we don't know if we can.' Because certainly the screener is the trigger for further evaluation. And so, our social workers said, 'We don't know if we can handle you screening more people because of the workload that it might mean to us.'"

Participants also shared how challenging it could be for clinicians being educated on awareness to accept this new outlook on care, especially given that inequities can be traced all the way back to how healthcare providers were trained. As one participant shared, "it does require experts in their field to step outside of their expertise and say, yikes, I didn't think about how this would play out. I wasn't trained to think about it in this way; no one was. I mean, my husband's a physician, and he's like, even looking at somebody's skin, all my medical books had white skin. And so, when you bring a black kid in and you want me to diagnose him with Kawasaki's Disease, and I have no idea what that looks like on a black kid's chest compared to a white kid's chest, I'm at a disadvantage. And I can make the choice to say, you're calling me racist and you're threatening my expertise, or you can say, I was not trained to do this, how do I expand my knowledge?"

The ability to publicly disclose and critically evaluate a hospital's data on disparities was aptly described by one participant, "I think there needs to be a path to very freely disseminate that type of stuff, and it to be okay to critically reevaluate what's happening in your backyard." However, there were concerns around the safety of dissemination with one participant sharing, "There's nothing like that for equity, there's nobody meeting and saying, 'This is us and we're all getting together, and we're sharing interesting results', in part, because there's not enough people doing it, and in part because people don't feel safe yet." The ability to address healthcare disparities, as well as the freedom to disseminate data, was described by participants as being highly dependent on leadership support.

The importance of leadership support was emphasized by participants. One participant stressed the need for genuine commitment from senior executives, saying, "First, senior leadership or executive leadership has to support this. It can't be lip service, has to say, 'We need to do better, we need to do better by our patients and families.'" Another participant emphasized the need for equity to be prioritized at the highest levels of the institution, noting that without this, diversity, equity, and inclusion efforts may not be integrated into the healthcare delivery structure; "it's going to be viewed as like ‘that's so nice’, but not as a critical piece of the pie in delivering adequate patient care.” This participant explained that support for diversity and equity should extend to areas such as recruitment and retention of faculty, funding for DEI research, and “support for patients in navigating a system or even having a patient advocate that can help in their language or a patient advocate who is African American” which can also enhance the delivery of adequate patient care. The linkage to creating a positive image for leadership was aptly described by one participant:

> “First, the executives at the top want to be paid differently and they want marketing success. They want to see their hospital as a leader, they want to be known as the kids' place, they want to show everybody that they're collaborating with everybody in the community. The mayor loves us when we talk about reducing infant mortality and high school graduation, those are things that he can go out on the campaign trail with...and we give him data and we show him how it's improving, and so suddenly the mayor is our friend. Suddenly the corporations are saying, "You guys are great. Da, da, da, da, da." The CEO loves that stuff!”

Regarding leadership support, one participant emphasized that to gain support, it was necessary to consider the hospital's bottom line and the priorities of administrators:

> "You have to think about it from a business perspective also for better, for worse...what is the bottom line of the administrators you're working with. That's how I found some wins. I've only found wins with data and then...explaining the ‘what's in it for me’ part of it, because if you don't look at it from their perspective, they're not going to buy into your

> vision. They're going to say, well, that's nice to help people, but also Medicaid reimburses very poorly.”

Participants emphasized that incentives such as reimbursement and standards established by reputable organizations such as JCAHO and ONC, as well as rankings by US News and World Report, can be effective levers for driving change. Linking Medicaid payments to equity, like how it was incorporated into patient safety was suggested by one participant, “But what about Medicaid? If the Medicaid programs said, ‘We're not going to just pay you based straight on volume or fees’… CMS changed their payments structure around some of these things and hospitals all responded. I mean people jumped, and it wasn't even a big change.” A participant highlighted the significance of standards set by influential organizations in promoting data disaggregation, stating: "If US News and World Report said we'll have a standard, a metric by which we say you disaggregate your data, that would mean something. What JCAHO says means a lot...So as far as what has actually moved mountains at my institution, it's ONC's 21st Century Cures Act. It's anything JCAHO says. And then of course it's reimbursement if the insurance companies will reimburse ...So those are the kind of levers that I see really make a difference."

Despite the many barriers that might be faced when implementing an ideal system, a participant shared hope that with the right commitments, healthcare systems will get onboard:

> “When you go around and find clinics that have terrible outcomes and watch their patients suffer, you go to a sickle cell clinic, and you give them real resources and tell me they won't be excited. You go to your clinics like rheumatology, nephrology, or neurology, where they've seen terrible fetal malformations and infant mortality. They

> don't want that; they will do anything to try to prevent that. So, find early wins. And then secondly, when you go to the general clinics, if they feel like they have support to do this stuff, like backing as part of a big strategic plan, people love this stuff, we have secretaries volunteering to help, we have 250 nurses that mentor kids in schools to try to help with high school graduation. It's become an attractant for our employees. So, I'm not saying everybody gets on, but I'm saying when people truly believe you're serious and going to stick with it, they're coming out of the woodwork with ideas."

More participant quotes describing influencing factors can be found in Table 5.

Discussion

The present study aimed to investigate the views of hospital leaders from free-standing acute care Children's hospitals across the United States on healthcare disparities, including the factors that facilitate or impede their identification and addressing them in patient care and outcomes. The participants identified a range of health care disparities affecting their institutions, including disparities related to race, ethnicity, transportation, access to care, language, health, literacy, implicit bias, treatment differences, sex, mental health, and perceived discrimination. Among these, transportation, and access to care, were reported as major drivers of disparities, with language barriers also identified as a significant issue. Implicit bias was found to contribute to disparities related to race, and participants noted that health literacy was frequently overlooked. Notably, the disparities identified by the participants aligned with those reported in the existing literature. These findings underscore the persistence of health care disparities and the importance of ongoing efforts to identify and address them.

The identification of transportation and access to care as key drivers of disparities highlight the need for interventions to improve access to health care services for marginalized populations. Children and their families from low-income or marginalized communities often face challenges in accessing healthcare services due to lack of reliable transportation, limited availability of public transportation, and inadequate infrastructure.[17,18] This results in missed appointments, delayed or cancelled treatments, and overall reduced access to care.[17,18] In some cases, families may have to travel long distances to access specialized care for their child, resulting in additional financial and emotional burden.[19]

Language barriers have been identified as a significant contributor to health care disparities experienced by children and families who speak languages other than English.[20]. These disparities can manifest in the form of delayed or inappropriate care, medication errors, and an increased risk of adverse events. Limited access to interpretation and translation services can exacerbate these disparities, resulting in reduced access to care as families may struggle to navigate the healthcare system and access necessary resources and services. Furthermore, inadequate interpretation services can result in misunderstandings and miscommunication between clinicians and patients or their families. For instance, parents or guardians who are not proficient in English may face challenges understanding discharge instructions, while clinicians may lack a comprehensive understanding of the patient's history, potentially leading to delays in care or medical errors.[20] A study on pediatric appendicitis discovered that patients who did not speak English had two-fold increased odds of having visited the Emergency Department or pediatrician for additional healthcare before being diagnosed, and an increased hospital length of stay once hospitalized.[20,21]

Additionally, the recognition of implicit bias as a contributor to disparities related to race underscores the need for interventions to promote cultural competence and reduce bias among healthcare providers. Participants spoke of implicit bias through the lens of security and how patients or family members were treated differently based on the color of their skin. Within the healthcare setting, a Code Purple is used when someone feels "unsafe". Designed to address threatening behaviors or violence in any context, there is evidence to suggest that it is disproportionately used in situations involving people of color.[22] Studies have found that Black patients, particularly Black men, are more likely to be subjected to security response activations than their white counterparts.[22] Additionally, even after adjusting for sociodemographic and clinical characteristics, Black children are more likely to be physically restrained in the emergency department than White Children.[23] This overuse of restraints and Code Purple in Black patients and their families may reflect implicit biases held by healthcare providers, who may be more likely to perceive Black patients as threatening or violent. In addition, it may have serious consequences, including physical harm and psychological trauma for the patient and families. It can also further erode trust between Black patients and healthcare providers, perpetuating existing healthcare disparities. To address these issues, healthcare systems must work to identify and address implicit biases among staff and develop alternative strategies for managing potential violence that do not rely solely on Code Purple activations.[22,23] Finally, the acknowledgment of health literacy is a factor in health care disparities highlights the need for interventions to improve patient education and communication.

Participants were asked to describe how healthcare disparities are identified within their healthcare system, including methods and metrics. Responses encompass both standardized and non-standardized approaches., use of external databases, health equity dashboards, and involvement of health equity teams.

Examples of standardized approaches to identifying healthcare disparities were limited and primarily included screening of patients and their families for social determinants of health with the emphasis that this process was in the planning or early implementation phase. Outpatient screening for SDOH has been found to improve families access to resources, however, few studies have looked at if and how inpatient providers are screening for SDOH. A multicenter descriptive study of 146 hospitalists and 227 nurses at 4 children's hospitals did not use a specific screening tool, and only 26% reported consistently communicating SDH needs with primary care providers.[17] The inpatient setting presents a unique opportunity to assess families with social needs, but few hospitalists and nurses reported routinely screening for SDH. Professional development activities and enhancing existing resources may improve SDH screening.[17] Non-standardized, or unofficial, methods for identifying healthcare disparities were the most common method described by participants and involved individuals within programs examining disparities data on their own. However, it was noted that if inequities were found, it wasn’t always clear if there was a strategic goal or issue attached to it and it was up to individuals and divisions to decide whether to act.

Until recently, there was no national standard method for capturing data on key variables needed to assess health equity, and there were no standard measures for assessing performance in improving health equity.[18] However, organizations such as the National Committee on Quality Assurance (NCQA) have now required select Healthcare Effectiveness Data and Information Set (HEDIS) measures to be stratified by race and SES.[19] Additionally, the Centers for Medicare & Medicaid Services (CMS) has been designing a dashboard that eventually will provide a Health Equity Summary Score to Medicare Advantage (MA) contracts and the CMS Innovation Center has recommended that health equity should be included in every model.[19] Our study found that incorporating equity metrics into existing quality measures was favored by participants in identifying healthcare disparities. Participants highlighted the need to pick precise and measurable metrics, adding equity components to existing measures, and including metrics that capture root causes of health care disparities, such as well-being indicators. Additionally, participants emphasize the importance of health equity teams in creating and gathering metrics, emphasizing the importance of such teams in identifying and addressing disparities, and the use of health equity dashboards to report metrics from multiple sources.

The idea of including non-traditional metrics in measuring healthcare disparities, such as high school graduation rates or teen pregnancy rates, was a common theme among participants. However, it was recognized that these process measures alone were not true health equity measures and needed to be subservient to metrics that focused on equity. Thus, the participants advocated for a comprehensive approach that includes multiple measures to truly address healthcare disparities.

During the interviews, the participants emphasized the importance of using external data sources to identify healthcare disparities and fill in data gaps. Despite potential limitations, using external databases such as the Childhood Opportunity Index (COI), Medicaid data and the Social Vulnerability Index (SVI) were mentioned as potential solutions for identifying healthcare disparities. External databases such as the SVI and COI can be useful tools for identifying healthcare disparities. These databases provide information on factors such as socioeconomic status, race, and geographic location, which can impact access to healthcare and health outcomes.[20–23] By analyzing data from these databases alongside patient data, healthcare systems may use this information to target interventions specific to the vulnerable populations they serve.[20,23] Overall, the participants recognize the challenges associated with using external data sources but acknowledged their potential usefulness in identifying healthcare disparities and promoting equity and patient care and outcomes. With the adoption of consistent metrics, we can gain a deeper understanding of the origins of healthcare disparities and develop effective solutions to address them.[15]

The participants in this study described various interventions that their health care facilities implemented to address health care disparities. Participants identified six themes of interventions, including awareness of equity issues, language barriers, the use of navigators and community engagement. As previously mentioned, language barriers were identified as a significant source of health care disparities. Participants highlighted interventions for addressing language barriers, such as the use of interpreters and providing text messaging services in different languages.

Resource navigators were also discussed as playing an important role in addressing health care disparities by connecting patients and their families to the resources they need. They can help reduce disparities and ensure that all patients have access to the care they need by providing individualized assistance and addressing the unique needs of each family. A randomized clinical trial found that families who worked with a volunteer navigator reduced their risk of child hospitalization, while another study found that in-person resource navigation services significantly decreased families' reports of social needs and improved children's health.[24,25]

Community engagement was another theme of interventions identified by participants. One participant emphasized the importance of engaging the community to identify and prioritize disparities. Additionally, alternative treatment sites have been implemented and healthcare systems have taken advantage of community events to provide essential health services in more accessible venues. The concept of community engagement involves establishing enduring connections founded on trust, mutual exchange, and shared vision.[26] Its objective is to foster partnerships that enable joint action towards addressing the health needs and priorities of the local community.[26] Community engagement can occur within multiple contexts at healthcare centers, including education, clinical activities linked with community-based organizations, research, health policy, and community service.[27] It can involve many types of community-based partners, including schools and workplaces, local government public health officials, and community-based coalitions.[27]

Participants in this study were asked to describe their vision for an ideal system to identify and address healthcare disparities. Participants' visions centered around six themes, including family and community involvement, addressing the underlying causes of disparities, the use of data systems, healthcare staffing, external pressure through policy or reimbursement, and opportunities to learn from peers. Participants emphasized the importance of partnering with communities to understand the changes happening within the local community, as well as the need to address the root causes of healthcare disparities, which are often linked to social and structural determinants of health. Participants also highlighted the importance of collecting and using social determinants of health data to guide clinical decision-making, clinical decision support, and electronic health records to reduce variation in care. Additionally, participants emphasized the importance of dedicated teams focusing on equity issues and having a diverse workforce to effectively take care of a diverse patient population. Furthermore, participants suggested using incentives or reimbursement links to drive equity improvement and emphasized their desire for opportunities to learn from others. Overall, these findings suggest that healthcare facilities need to address healthcare disparities through a multifaceted, community-based approach that involves addressing the root causes of disparities, using data-driven decision making, and incorporating external factors such as policy changes and reimbursement initiatives. Additionally, it is essential to foster a diverse workforce and provide opportunities for learning and collaboration to improve health equity across communities.

Participants were asked to identify factors that might influence the implementation of an ideal system for identifying and addressing healthcare disparities. Several factors were identified as facilitators or barriers, including data systems, financial concerns, staff capacity, buy-in and training, time, public disclosure, leadership support, and partner collaboration. Participants emphasized the importance of data system factors such as availability or access to data, quality of data, and staff capacity to work with equity data. However, accessing data was a challenge for some participants, with inconsistencies in data fields with electronic medical records (EMR) also posing problems. Participants felt that EMR data was the primary source of equity data and highlighted the need for expertise to navigate these systems.

The study also found that gaining acceptance of disparity data, even among colleagues, was challenging. Participants shared experiences where colleagues dismissed the data or felt accused of racism. Staff buy-in was found to play a crucial role in reducing disparities, and staff education was seen as important in reducing disparities at the bedside. Participants felt that the ability to publicly disclose and critically evaluate a hospital's data on disparities was highly dependent on leadership support. The importance of leadership support emphasized by participants, with participants stressing the need for genuine commitment from senior executives. Participants believed that incentives such as reimbursement and standards established by reputable organizations could be effective levers for driving change.

Overall, this study highlights key factors to current practices and key factors that can influence the implementation of an ideal system for identifying and addressing healthcare disparities. Future research should explore these factors more in-depth to better understand the challenges and opportunities for addressing healthcare disparities.

Limitations

While we were able to achieve national geographic representation, our in-depth interviews were limited to 12 participants from 10 Children's hospitals. To some extent, even within these 12 interviews, perceptions and experiences varied depending on the individual interviewed. The individuals interviewed tended, as we should expect, to be sympathetic to addressing healthcare disparities in the pediatric healthcare population.

Conclusion

In conclusion, identifying and addressing healthcare disparities is a complex and multifaceted task that will need to involve the community, patients and families, and all levels of the healthcare workers. Despite the many challenges that must be overcome, participants expressed hope that with the right commitments and early wins, healthcare systems can successfully address healthcare disparities. By exploring these issues in depth, we aim to make meaningful progress towards ensuring that all children, regardless of background or medical condition, receive equitable access to high-quality healthcare.

TABLE 1: Participant Quotes Describing Perceived Healthcare Disparities	
Theme	Example
Perceived access to care	"...one thing we notice when we're looking at vaccination of kids, there's a particular area...where only 20% of the children are up to date with their childhood vaccines. Well, that is because it's [particular area] a healthcare desert. There's not one pediatric clinic within 10 square miles ...that's an inequity because you have clinics in grocery stores, you have clinics on every corner. But in this particular area, there's nothing.." "When you look at the access to care...for families with private insurance or families of means, they can essentially choose to go anywhere they want in the country. And they may not necessarily get better care, but they at least have the choice...Whereas two-thirds of our patients are on some form of government insurance…They don't get a choice, so they have to come to us.... if they have a requirement or a surgery that can only be done elsewhere, it takes a lot more effort to get them elsewhere as opposed to somebody who may have private insurance. And that's for people who understand the system to even look and ask. Then you take into account the families who may not have the educational background, the language to understand that they have choices."
Language	"When we have some of the Indigenous languages of Mexico...or Bhutanese or Burmese...it sometimes is really challenging to actually get an interpreter through the video or the phone system in a timely manner, if at all. Sadly, I've had instances where that's been a challenge, and sometimes it's been a day or two before we can actually get someone who speaks the patient and family's primary language."
Treatment Differences (gender and racial minority)	"Looking at things such as the treatment of girls who have a low hemoglobin versus boys because we have a very standard protocol for how to treat the girls if they have a low hemoglobin because it severely negatively impacts their overall health. But if your clinicians don't see it as being important, they may say, "Oh, you just have low hemoglobin because you're on your menstrual cycle, so we're going to send you home, take some Motrin." When really the protocol says they should get a blood transfusion." We've known for a while that there are issues with pain management. There's a difference in how they treat black people and white people. That has not stopped. My daughter was a victim of that when she was younger. And so, I am a staunch advocate for children in pain."

	“Well, I honestly think that we don’t offer black moms’ breast milk as often as we do our White families” “We've written two papers ...where the simple premise is ... somebody had cardiac surgery and they had a major complication. And so the question ... not to like any individual person, but to the collective is, how aggressive are you going to be to rescue this patient from that complication? It's not modeling this one person's behavior, but modeling the collective, everything from the surgeons to the cardiologist, to the intensivists and the nurses to the RTs of like how aggressive in aggregate are you as a collective trying to rescue this patient from a complication? In that paper, we showed that if you were black, you were more likely to die after that complication, whatever the complication was. Even major complications compared to your white counterparts, which is to say that there is like a collective difference in policy as to how we treat patients.”

TABLE 2: Participant Quotes Describing Identification of Healthcare Disparities

Theme	Example
Dedicated Health Equity Team	“We have a Center for Health Equity …they're responsible for helping to create roadmaps and blueprints and strategies for the enterprise as a whole... But I think that the sounding mantra that they've resounded loud and clear… is that equity is everybody's job every day. Just like safety, that it is not our job to come in and say, have you thought about equity, that it is really the role of everybody to do that. …to identify disparities,
Health Equity Dashboard	“…how do we present this data...it depends on who's your audience. Is it the CEO or the board or is it your quality improvement leader? Is it the clinician and the clinic? It depends on who the audience is, how you're going to monitor this data. I think it's still in the early stages of figuring this out, but I think in any change management model or framework that you use, I think we're at least at the awareness, raising the burning platform level of this is important and we need to do it. And we've got leaders on board who are aware of the importance and who are bought in. And I think then it just comes to the operationalizing or implementing these dashboards and then beginning to show this data, say pretty much across the board.”

TABLE 3: Participant Quotes Describing Addressing Healthcare Disparities

Theme	Example
Community Engagement	“That's how we do it. We partner with our EMR, we partner with our healthcare plan, with the community health workers, and with the community service line, which is the Houston Food Bank. In fact, our screening and our referral process was so successful, that we broke the food bank. They actually had to hire more people to handle the referrals that we were giving them, because they were just like, oh my

	god. It was like the most successful partnership ever, because we were doing it in a way that the families really felt safe to access these services." "From a community standpoint, we do several different things. We engage with our community partners to host different events. For instance…I was co-managing the community COVID-19 vaccine clinics for our hospital…we would very intentionally pick out areas that were in an underserved area and we would host vaccine clinics for families. Of course, we really wanted to get the kids vaccinated, but we didn't limit it to the kids. It was for the entire family. And a lot of families liked that, especially if they had smaller kids because they could come and they know that we're the kid experts, so who else can you trust? And then we're going to kind of handle the adults with our kid experts, which makes them feel even better."
Community Navigators	"We offer…a cultural navigator to the family. They can accept or decline it. It's really the cultural navigator sitting down with the family sometimes with an interpreter, depending on if they speak the primary language and really trying to form a relationship with them to say, "We're here to help bridge the gaps in not just communication, but cultural gaps that are existing between you and the healthcare team or teams that you're working with," to make sure one, that they are fully understanding what we're trying to communicate to them and vice-versa, that we're fully understanding what they're trying to communicate to us and then helping us understand what, if any, cultural nuances are impacting the decisions they are or they aren't making." "The resource navigator, they are people who provide whatever is needed. So, if a family says they have food insecurity. Well, here's some resources. You can go to this food shelter, or I can send you this link to this, or I can have food sent out to you. We can get you some food boxes, whatever. They determine what the need is and then they help the family work through that to make sure that need is met, whether it's financial, non-financial or whatever." "We have community health navigators and asthma navigators, we have inpatient navigators, digital health navigators in their role currently right now…they'll call them (patients)…to say, 'Hey, you have a video visit appointment this afternoon, just calling to see if you need any help connecting, have you logged in recently? Because logging in can be tricky.' And then they're also there at the time of the video visit. If the provider can't get through to the patient or to the family, (the physician) will ping the navigator 'Hey, can you reach out to them? I got to move on to the next patient. Just let me know if they're having issues. Can you troubleshoot with them? I'll hop onto my next call and then come back'."

Alternative Treatment Sites	And we just…reach out to the community however they need us to. We've done events, neighborhood events where there was a street fair…Several different organizations came together and we had our mental health professionals out there, we had our gynecologist group out there, and they were handing out condoms and doing sexual education with the teenagers right there in the street.
Language	“Everybody does not speak English. Everybody does not read English. Everybody does not read in their own language. And so what we did was we created videos that reviewed all of the information so that they could have it in their written language as well as in hearing it and seeing it. And then we created QR codes so that we can just hand them the flyer in the clinic or in the patient room.”

TABLE 4: Participant Quotes Describing the Ideal System for Identifying and Addressing Healthcare Disparities

	Example
Community and Family Engagement	“I think that people need to know what it means to co-design and co-create a healthcare system with the community it serves. It doesn't feel great to work at a healthcare system that the community had no role in building. Like how do we even know what we're talking about? Like even in this conversation, the only reason I feel confident in it is because The Center for Diversity and Health Equity is really co-created based on what the community tells us they need. And that we have such a strong relationship with our…Clinic and community, and what that looks like. And so I think that from a place of integrity if you can't say that the community has endorsed this, they're not doing the work.” “It has to be the work of school, after school programs, faith-based programs, healthcare systems, youth development programs where... you know what I mean? Where screening happens but, at the same time where, where there's systems for closed loop communication and referrals, I think that's a big gap. Like people are always like, you identify a need, but what happens next?” “If there is a particular domain that is the most important to families or they feel like it distracts them the most from being able to focus on being able to manage a chronic disease or being able to budget so that they can purchase the medications or be able to afford healthy food or whatever it is, I think that would definitely impact the interventions that come out of both of those things.”
Address root cause (i.e.., social and structural	“But also, to ask them, "What do you need in addition to this healthcare?" Wouldn't it be amazing if I could take my mobile clinic and we see patients and we do their well child check, and, "Oh, you need vaccines? Oh, you need some food? Well, here's a food box. Or here's a gift certificate that's provided by the state for you to...

determinants of health)	Oh, you need some social services? Well, we have a social services individual in the other room, and they can help get you signed up for medical assistance or Medicaid or what."
External Pressure	"If the Medicaid programs said, "We're not going to just pay you based straight on volume or fees, we're going to start experimenting …So safety and quality readmissions, I mean, CMS changed their payments structure around some of these things and hospitals all responded. I mean people jumped, and it wasn't even a big change. And the hospitals in Maryland have certainly changed because they've changed their financing system. And accountable care organization, will change some, but frankly there's a real need to push payments down toward improving these outcomes, rather than just hoping that well, if I do slightly better with my asthma prescribing in the clinic for Black and white kids, that'll save the day, because it's not going to work." "And unless you are either forced by regulations, like you're a federal contractor and there's all these rules associated with collecting race and ethnicity data…So there are definitely hospitals that do whatever they can to put this data under lock and key."
Use of data systems	And that not only are the data disaggregated…and visualized, but there is accountability and transparency. Maybe it's on public facing websites…when you don't disaggregate it, we're pretty good at our immunization rates…But when you look at Medicaid versus private, you see that Medicaid kids, only half of them are up to date with their vaccines. And we made that publicly available and more accountable to it, to our community…And the CEO and the board of trustees are held accountable to close these gaps and to invest real dollars where it matters, where it hurts to say, "We're going to make some decisions to not open this other new hospital. We're going to use that money instead to close these gaps around vaccines." "Organizations need to be more equipped and better suited to collect social determinants of health, and I think that data needs to be collected and used in a way that frames what your hospital provides. And I think there's always a difference between what the hospital thinks should happen and how we do it, compared to what the reality is of the community that you're serving."
Incorporates Employees	"I think in terms of some of those deeper educational gaps or the disparities there; I think there's a huge opportunity or a lack of engagement kind of early on. As I think about the difference in education and the kind of, how do we change that? How do we address that? I wonder if some of those early education initiatives are the more impactful ones to invest early and help stimulate that trajectory or that path or the dreams of higher education and all of those things early on and continue to support people throughout that process, throughout that journey."

TABLE 5: Participant Quotes Describing Influencing Factors	
Theme	Example
Data Systems	“So, if I have to summarize the barriers, one, I would say is where data is collected generally and how people record it in systems. Two is this interoperability between the different systems where they collect this data and how you reconcile them. And then it's also resources to work on this because some hospitals, as you said, you wanted to do this quickly and they couldn't sort of do it.”
Time	“So, if there's one other thing I'd add, it'd be that the burnout thing is a real thing. The people leaving academic medicine is a real thing. And I think we need to find ways to mitigate this by really putting our money where our mouth is and saying, this is how we're going to support these efforts, not just saying this is important and we need to have another committee. I don't know how many other committees we can have that say this is important. It has to go beyond just a committee that meets voluntarily every Thursday or something.” “I think that it is unfair to minority physicians who are constantly being asked to do this work to not give us back protected time or funding or promotion considerations for the work that we're doing because I am now being asked to do this on top of all the other things that you're asking me to do, and I'm just supposed to do it because I'm Hispanic. The problem is I want to do it because I know what I went through and I want to help other people in the pipeline, but it doesn't help the bottom line of keeping me in this without being totally burnt to a crisp.”
Leadership support	“And then the George Floyd lynching happened, and attitudes changed, and we became the flavor of the month...we got our CEO on record saying black lives matter and supported all of us to step away from work to go protest, and identified that anti-black racism are not political statements, they're public health. It's like a response that requires a public health response, and that as a healthcare system it's our job to eradicate racism from our system. And if we can't eradicate to mitigate it so that it's not something that we tolerate. And so, I think once our CEO went on record that gave us more fuel if you will, to push back and to say no, we're not settling on this.” “And getting the ear of someone in leadership to kind of buy into your vision. Either being at the table or having a really good friend at the table or something to be able to buy into your vision. I feel like there's a lot of individuals who have now bought into that vision and that's been very, very helpful, but in order for them to see your vision you can't just come at it from an emotional perspective because it's the right thing to do. That's just not going to work here, so there has to be some combination of what's in it for me.”
Financial concerns	“The biggest is the wealth of the children's hospitals and other hospitals...They have massive amounts of cash on hand, large endowments, and they have large revenue

	every year. Do you know any big business that's raking in cash and not paying taxes and is willing to change? I don't know of any. And so, there are lots of things we could do around the edges, and I will tell you that...the accountable care organization here, has forced us to look for some other things, because it does force us, even though it's not quite a full payment toward equities, there are several equity issues that impact our payment stream. So doing more in that area would go a long way, but the biggest thing would be...if our very wealthy hospitals were paid differently." "And then resources. A lot of it comes from an organization. There's no way I have any capacity to create a dashboard, it's going to be a massive financial investment and a time investment. You're going to need an IT person, and things like that. I don't know. That's probably the two biggest ones." "Of course, resources are always limited. Everyone's dealing with decreasing reimbursements from payers and having to do value-based care, which it's the right thing to do. Sometimes it's a little bit difficult depending on where you live. And if your payer mix is a little lopsided, then that makes it even more difficult. And so trying to identify the resources to do the work, where is this money coming from? Because we don't just have a money tree sitting over there, we can just go shake it. And one of the things that we deal with is that some hospitals may not deal with is competing priorities when it comes to donors." "There's stuff like that, but unfortunately you cannot divorce the bottom line of the institution or state or whatever entity you're working with. You can't divorce their financial bottom line from the work that you want to do because if you do, then it's just a grant or it's a description with no solution or it's a short-term solution or something that's not sustainable."
Multi-partner collaboration	"You don't screen for something if you don't necessarily have a way to support that or to address it with an intervention. For our food insecurity project, we were linking people up with the local SNAP... it was the partner program that worked to get people hooked up with SNAP benefits...They would reach out to families who were not yet enrolled, or if there were issues with families who were enrolled and they were having trouble with their benefits, then they would work with them in order to make sure that they address those things. One of the interesting things that we found with our data though, is that even in the families who were part of that program, were part of SNAP and were receiving those benefits, that there were still a large number who continued to be food insecure, even with those benefits, which begs the question of, what other things can we do in order to address those needs?" "We have a partnership with a community partner that offers food boxes to our ambulatory patients. We're trying to figure out what does that look like for our inpatients?...We haven't done anything really related to social determinants of health for inpatients. And so, as a big umbrella, how do we assess and refer for social determinants of health? And that is where we are now. It's going to be difficult at

	best, but we are determined to make it happen. And so, we just have to keep assessing. Because it would be nice if we could just duplicate what we do in ambulatory, but we know we can't. But let's take the process we do an ambulatory and see what parts of it we can apply inpatient, and then what do we need to change?”

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CHAPTER 3: Examining the Association Between Child Opportunity Index and Pediatric Cardiac Surgical Outcomes Across One Georgia Metropolitan Area, 2010-2020

Abstract

Background: Congenital heart defects are associated with significant morbidity and mortality; social determinants of health (SDOH) have been shown to impact cardiac surgical outcomes. Singular measures of SDOH do not fully capture the complex influences on child health outcomes. This study aims to assess the relationship between the Childhood Opportunity Index (COI), a more comprehensive measurement of SDOH, and the COI domains on specific outcomes following congenital cardiac surgery in metro Atlanta-Sandy Spring-Roswell, Georgia.

Methods: In this retrospective chart review, we included patients who underwent an index operation for CHD between 2010 and 2020 at Children's Healthcare of Atlanta. Patients' addresses were geocoded and mapped to census tracts. Descriptive statistics, univariable analysis, and multivariable regression models were employed to assess associations between variables and outcomes. All statistical analyses were performed using R studio.

Results: Of the 7460 index surgeries, 3798 (51%) met eligibility criteria. The composite quality metric revealed that 498 (13%) patients experienced poor outcomes, with children from very low COI areas showing higher risks in univariable regression (cOR=1.64; 95% CI: 1.20-2.27). Postoperative hospital length of stay (PHLOS) was significantly associated COI ($p<0.001$) in both univariable and multivariable regression models. There were 515 (14%) instances of readmission within 30 days of hospital discharge, with no significant association between COI and readmission in univariable ($p<0.094$) and multivariable ($p=0.49$) models.

Discussion: We identified significant associations between COI and poor outcomes in patients after congenital heart surgery. By understanding the role of COI in these outcomes, targeted interventions can be developed to improve health equity and reduce disparities in healthcare outcomes for vulnerable populations.

Background

Congenital heart defects (CHD) affect approximately 1% of all live births, about 40,000 live births annually, in the United States and are associated with both the highest mortality and the highest inpatient resource use when compared to other noncardiac congenital malformations.[1,2] Although surgical techniques and medical care for CHD have advanced significantly, evidence is growing that social and structural determinants of health (SDOH) can impact the outcomes of surgical interventions for children with CHD.[3–6] Studies have found that children from low-income families, underrepresented racial and ethnic minority groups, and those residing in rural areas are more likely to experience worse surgical outcomes following cardiac surgery.[2–5] Neighborhood-level factors have also been associated with surgical outcomes in children with CHD.[2]

Lower-income neighborhoods are known to lack healthcare infrastructure compared to higher-income neighborhoods, which can contribute to healthcare disparities. In addition, physical living conditions and distressed social environments, such as dilapidated, substandard, or overcrowded housing, exposure to environmental pollution, lack of safe public recreational spaces, and higher levels of crime, also impact health outcomes.[7] Children from lower-income neighborhoods are more likely to experience worse health outcomes for conditions such as obesity, asthma, and low birth weight.[7] The disproportionate impact of physical living conditions, distressed social environments, and limited access to healthcare infrastructure on children's health outcomes in lower-income neighborhoods exemplifies how social and structural determinants of health are inequitably distributed across communities.

One study linked data from the Pediatric Health Information System database and the US Census Bureau to explore potential inequities in outcomes and resource use after hospitalization for cardiac surgery based on the neighborhood of residence.[2] The study examined associations between median and annual household income by zip code and mortality, length of stay, inpatient standardized costs, and costs per day for children undergoing cardiac surgery while controlling for the effects of race and insurance payer.[2] This national retrospective study found that children from lower-income neighborhoods experienced higher mortality rates, longer lengths of stay and utilized more inpatient resources than children from higher-income neighborhoods. Furthermore, these disparities persisted across ages, races, insurance types, and geographic regions and were observed for children undergoing both high-risk and low-risk procedures.

While singular measures of SDOH have been studied in the context of congenital heart disease, these measures do not fully capture the complex and interconnected influences of broader community and social contexts on child health outcomes.[6] Factors such as housing, educational opportunities, and environmental exposures can all impact a child's health, and may be particularly important for children with CHD. To better understand the impact of these SDOH, it is important to consider a more global approach that accounts for the convergent influences of these factors on child health outcomes.[6] The Childhood Opportunity Index (COI) provides a more comprehensive measurement of the social context in which families live and how it may impact their health outcomes, offering a holistic description of the barriers to healthcare faced by families in their respective neighborhoods.[6,8] The COI defines "opportunity" as "neighborhood-based conditions and resources conducive to healthy child development".[8] The COI is a publicly available database, created by The Heller School for Social Policy and Management at Brandeis

University in collaboration with the Kirwan Institute, and includes a variety of measures enumerating relative opportunity for 29 variables across 3 domains (i.e., educational, health and environmental, social and economic opportunities).[9] Census tracts are placed into quintiles (very low, low, moderate, high, and very high opportunity) based on their overall COI scores and their 3 domain scores.[8,9] Studies have found that the COI can be used to examine how neighborhood-level factors impact children's health outcomes, including asthma, diabetes, and obesity.[6,8] Children living in neighborhoods with higher COI scores tend to have better health outcomes and lower rates of hospitalizations and emergency department visits for various conditions.[6,8]

There are few studies evaluating the association between childhood opportunity level and outcomes after congenital cardiac surgery and we could find none that examined the association between the metro-normed COI, including the three opportunity domains (i.e., educational, health and environment, social and economic opportunities), and congenital cardiac surgery outcomes. Therefore, we aimed to assess the relationship between overall childhood opportunity level and the childhood opportunity domains on specific outcomes following congenital cardiac surgery while accounting for established risk factors of adverse postoperative outcomes in one metro area, Atlanta-Sandy Spring-Roswell, Georgia.

Methods

Population

This retrospective chart review included patients ≤ 18 years of age who underwent an index operation for CHD between January 1, 2010, and December 31, 2020, at Children's Healthcare of Atlanta (CHOA). An index operation is defined as the first cardiac operation conducted during that specific hospitalization. If a child was discharged and then admitted for another surgery, then that is considered a new index case. We included all operations reported to the Society of Thoracic Surgeon's Congenital Heart Surgery Database (STS) registry and accordingly had a STAT (The Society of Thoracic Surgeons-European Association for Cardio-Thoracic Surgery) mortality category assigned. The complexity of each case was determined using the STAT score, a validated tool for assessing the risk of mortality associated with various congenital heart operations.[10,11] The street address at the time of each patient's index surgery was geocoded and mapped to a census tract using 2015 census data. Patients living outside of metro Atlanta-Sandy Springs-Roswell and those patients with missing or incomplete addresses which could not be geocoded were excluded.

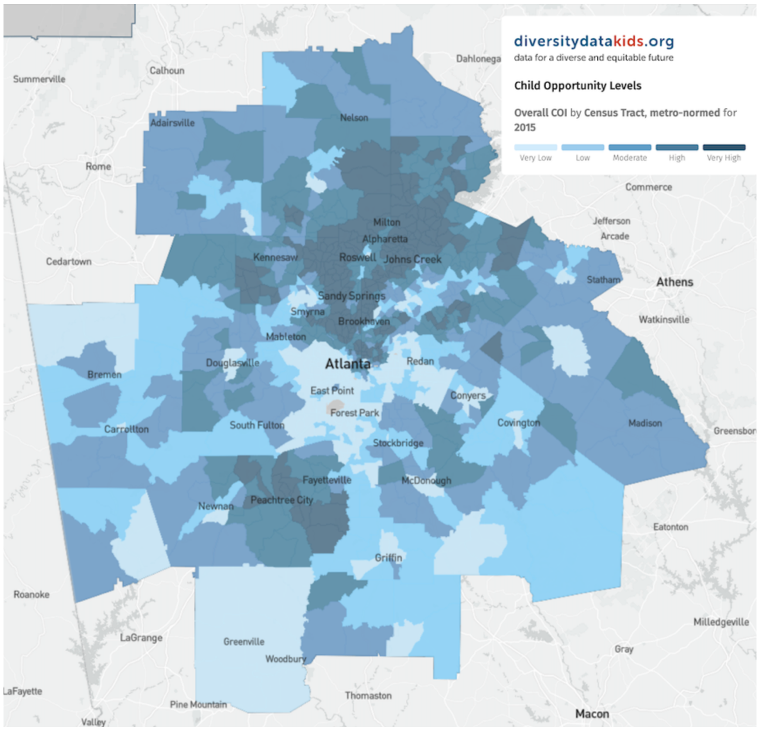
CHOA is an urban not-for-profit pediatric health system, including 3 freestanding children's hospitals: 1 academic tertiary care center with 330 licensed beds, 1 community tertiary care center with 319 licensed beds, and 1 academic secondary care center with 24 licensed beds, with more than 45,000 hospitalizations in 2022. CHOA serves diverse patients from across the State of Georgia: in 2021, the population served by CHOA was 37% White, 37% Black, 18% Hispanic/Latino, 4% Asian and 4% 'Other'.[12]

This study was deemed non-human participants research by CHOA's Institutional Review Board.

Childhood Opportunity Index

The COI is comprised of 29 indicators that impact children's healthy development across three domains: education, health and development, and social and economic factors. The first, education, includes early childhood education, elementary education, secondary/postsecondary education, and educational and social resources.[13] The second, health and environment, includes measures of healthy environments, environmental pollutants, and health resources and health insurance coverage.[13] The third, social and economic, includes measures of economic opportunities and economic and social resources.[13] Each indicator is transformed into a standardized z-score within and across census tracts, and then a weighted average is obtained for each domain.[13] These domain z-scores are then combined using similar weighting strategies to create an overall score (OCOI).[13] The weighting of each indicator reflects its impact on children's long-term health and economic outcomes.[13] The resulting scores are used to categorize neighborhoods into quintiles (very low, low, moderate, high, and very high) that each contain 20% of the child population.[13] The COI data are available at national, state, and metro levels; we chose to use the metro-normed Child Opportunity Levels to better capture the inequality within the Atlanta metro area. Compared to the state or nationally normed index, the metro-normed levels are more sensitive to the differences in opportunity levels across neighborhoods in each metro area.[13,14] For instance, the nationally normed index could mask within-metro area inequalities in places where most neighborhoods are assigned to the "high" and "very high" opportunity levels. By using the metro-normed levels, we can better explore the disparities in childhood

Figure 1: Child Opportunity Levels by Census Tract, metro normed, 2015 (Atlanta-Sandy Springs-Roswell)



opportunities within the Atlanta metro area, defined as the Atlanta-Sandy Springs-Roswell, GA metro area (Figure 1).

Measures

Outcomes

Outcomes of interest included 1) postoperative hospital length of stay (PHLOS) which is defined as the number of days from the date of surgery to the date of hospital discharge, 2) readmission within 30 days of hospital discharge and 3) an adapted STS composite quality metric.[15] The composite quality metric is an accepted metric used to assess pediatric cardiac surgery outcomes and includes a mortality domain and a morbidity domain.[15] The mortality domain includes the measure of operative mortality defined per the STS Registry as any death occurring in hospital, and/or any deaths occurring after discharge but within 30 days of the operation, whichever comes last.[15] The morbidity domain includes major postoperative complications including renal failure requiring dialysis, neurologic deficit persisting at discharge, arrhythmia requiring permanent pacemaker, paralyzed diaphragm/phrenic nerve injury, mechanical circulatory support, and unplanned re-intervention (includes surgical or catheter-based unplanned interventions, and cardiac and noncardiac procedures).[15] The included complications follow audited, standardized definitions established by the STS Registry. The composite quality metric includes PHLOS; however, for the purpose of this analysis, we chose to look at PHLOS separately from the mortality and major complications.

Predictors and Covariates

The primary predictor was OCOI; secondary predictors of interest were the three childhood opportunity level domains (i.e., education, social and economic, health and environment). Covariates of interest included known risk factors for adverse outcomes identified by subject matter experts or found in the literature: prematurity (less than 37 gestational weeks vs. >= 37 weeks), age (in years, continuous and categorical), presence of syndromes or genetic abnormalities (yes/no), STAT score (categorical 1-5), presence of preoperative mechanical circulatory support (yes/no), presence of preoperative mechanical ventilation (yes/no), cross-clamp time (<60 minutes vs ≥ 60 minutes,)[16] and if the chest was left open after surgery (yes/no).

Statistical Analysis

We mapped all index surgeries and linked each to the metro-normed childhood opportunity index by census tract. We then used descriptive statistics to characterize key patient-level and perioperative variables using frequencies for categorical variables and distributions (including median and IQR) for continuous variables. We compared baseline patient-level factors and perioperative characteristics for associations across OCOI using the chi-square for categorical variables or Kruskal Wallis test for continuous. The primary predictor variable (OCOI), as well as the three domains (education, health and environment, social and economic), were compared for association to each outcome of interest using the chi-square or Kruskal Wallis test. Univariable analysis was conducted to examine our predictor variable COI to estimate the crude odds ratio (cOR) and 95% confidence intervals (CIs) for the three outcomes of interest. Associations between OCIO, the composite quality metric and readmission within 30 days of hospital discharge (yes/no) were modeled using logistic regression. Linear models assessed the log-transformed PHLOS to examine the relationship between OCOI and PHLOS. The log-transformed outcome variable was used to account for right-tailed skewness. We then built multivariable regression models adjusted for our selected covariates. OCOI and the three domains were treated as categorical variables, with the very high opportunity level used as the reference in all regression analyses. Odds ratios (OR) and regression coefficients were reported with 95% CI. If a childhood opportunity domain (education, health and environment, social and economic) was significantly associated with an outcome of interest based on the chi-square or Kruskal Wallis test, then univariable and multivariable analyses were also conducted for the significant domain and outcome of interest. All analyses were performed in R, version 3.6.1 (R Group for Statistical Computing).

Results

Of 7460 index surgeries occurring between January 1, 2010, and December 31, 2020, 3798 (51%) met the eligibility criteria; 3297 (44%) were excluded due to either living outside the designated metro area or a missing or incorrect address, 173 (0.02%) were removed due to missing STAT score and 192 (0.03) were over the age of 18 years. Table 1 summarizes baseline patient-related and perioperative characteristics by OCOI. The median age was 6 months (IQR, 0.2, 4.6), 1777 (47%) were female, 736/3189 (23%) were preterm, 1103 (29%) had a syndrome or genetic abnormality, 36 (0.9%) had preoperative extracorporeal membrane oxygenation (ECMO), 349 (9.2%) required preoperative ventilation, 283 (7.5%) required their chest to be left open after surgery, and 1285/3101(41%) had a cross-clamp time of greater than 60 minutes. The majority of children were White (52%) with 37% being Black, 5% Asian, and 5.3% falling into the other or unknown category. Primary sources of insurance were public insurance (58%) or private insurance (42%). There was a significant association ($p<0.05$) between OCOI and preterm birth, age, race, ethnicity, public and private insurance, and preoperative ventilation.

Outcomes of interest by OCOI are summarized in Table 2 and by COI domains in Table 3. There were 498 (13%) who experienced a poor outcome as defined by the composite quality metric. In a univariable logistic regression, children with very low OCOI had a significantly higher risk of having a poor outcome (cOR = 1.64; 95% CI: 1.20 – 2.27) compared to children with very high childhood opportunity (Table 4). After adjusting for selected demographic and perioperative factors, OCOI was no longer significantly associated with having a poor outcome (p=0.39). When examined according to COI domains (Table 5), the social and economic domain was significantly associated with having a poor outcome (p=0.005), while health and environment (0.077) and education (p=0.31) were not associated. In a univariable logistic regression focused on social and economic level, children with very low (cOR = 1.76; 95% CI: 1.29 – 2.43), low (cOR = 1.43; 95% CI: 1.04 – 1.99), and high (cOR = 1.47, 95% CI: 1.06 -2.04) level had a significantly higher risk of having a poor outcome compared to children with a very high social and economic domain level (p=0.05). After adjusting for selected demographic and perioperative factors, the social and economic domain was no longer significantly associated with having a poor outcome (p=0.39).

The median PHLOS was 5 days (IQR, 3-10) and was significantly associated with OCOI with PHLOS staying the same or decreasing as we moved from very high to very low opportunity (Figure 2). For children living in very low opportunity areas, the median length of stay was 6 days (IQR, 4, 12) compared to 5 days (IQR, 3, 8) for children living in very high opportunity areas (p<0.001) (Table 2). The univariable linear model, using the log-transformed PHLOS, showed that children with very low (ß= 0.27; 95% CI: 0.18 – 0.36), low (ß = 0.13; 95% CI: 0.04 – 0.22), moderate (ß = 0.12; 95% CI: 0.04 – 0.21), and high (ß= 0.13; 95% CI: 0.04 – 0.22), OCOI levels had significantly longer PHLOS versus those with very high opportunity (Table 6).

OCOI continued to be significant at the very low (ß= 0.12; 95% CI: 0.04 – 0.20), and high (ß= 0.11; 95% CI: 0.03 – 0.19) levels even after adjusting for our chosen covariates for PHLOS (Table 6). When examined according to COI domain (Table 3), all three COI domains were significantly associated with PHLOS (all domains: p<0.001). In univariable logistic regression models, children with very low (ß= 0.24; 95% CI: 0.15 – 0.33), low (ß= 0.12; 95% CI: 0.03 – 0.20), and moderate (ß= 0.12; 95% CI: 0.04 – 0.20) social and economic domain levels had a significantly longer PHLOS compared to children with very high social and economic levels (Table 7). When examining health and environment, those children with very low (ß= 0.25; 95% CI: 0.17 – 0.34) low (ß= 0.15; 95% CI: 0.07 – 0.24), moderate (ß= 0.12; 95% CI: 0.03 – 0.20), and high (ß= 0.09; 95% CI: 0.01 – 0.18) health and environment domain levels had significantly longer PHLOS compared to children with a very high health and environment level (Table 7). For the education domain, children with very low (ß= 0.20; 95% CI: 0.12 – 0.29), low (ß= 0.11; 95% CI: 0.02 – 0.20), and moderate (ß= 0.10; 95% CI: 0.02 – 0.19) education domain levels had a significantly longer PHLOS compared to those children with very high education domain levels (Table 7). After adjusting for selected covariates, social and economic (p = 0.28), health and environment (p=0.13) or education domains (p=0.50) were no longer significantly associated with a longer PHLOS (Table 8).

There were 515 (14%) instances of readmission within 30 days of hospital discharge. There was no significant overall association between OCOI level and readmission within 30 days of hospital discharge in either the univariable (p<0.094) or multivariable (p=0.49) model (Table 9). There was also no significant association between readmission within 30 days of hospital discharge and the three domains: social and economic (p=0.076), health and environment (p=0.29), or education (p=0.22) (Table 3).

Discussion

Our study aimed to assess the association between overall childhood opportunity index and the three COI domains, social and economic, health and environment, and education on healthcare outcomes in children who underwent congenital heart surgery. We identified several key findings. First, there was a significant association ($p<0.05$) between OCOI and preterm birth, age, race, ethnicity, public and private insurance, and preoperative ventilation. Second, living in a very low OCOI level was independently associated with having a poor outcome, as defined by our composite quality metric, compared to those children living in a very high OCOI level. When examined by domain, the social and economic domain showed that children living in very low, low, and high social and economic COI levels had a higher chance of poor outcomes compared to children living in very high-level social and economic COI levels. This finding was no longer significant after adjusting for prematurity, age, syndromes or genetic abnormalities, STAT score, preoperative mechanical circulatory support, preoperative mechanical ventilation, cross-clamp time, and if the chest was left open after surgery. Third, PHLOS was significantly associated with OCOI, and all three domains, with lengths of stay increasing as childhood opportunity levels decreased from very high to very low. Finally, we found no significant association between readmission within 30 days of discharge and OCOI or the three domains.

The COI has been shown to be a unique and valuable proxy for measuring SDOH and we found significant associations between OCOI and race, ethnicity and insurance. Previous studies have found that the wider the gap in scores between very low- and very high-opportunity neighborhoods, the larger the gap in scores between the neighborhoods of White children and the neighborhoods of Black or Hispanic children.[14] In addition, children in poverty have vast racial and ethnic inequities in neighborhood opportunity, with 66 percent of poor Black children and 50 percent of poor Hispanic children living in very low-opportunity neighborhoods.[14] This data could potentially explain the racial and ethnic disparities in congenital heart surgery morbidity and mortality that has been documented in the literature and may contribute to the differences in adverse outcomes that we found in our study.[3,5,17–19]

We also found a significant association between OCOI and pre-operative ventilation which is the one perioperative risk factor not directly influenced by cardiac status and could potentially be linked to neighborhood risk factors such as air quality. These findings are consistent with a previous study conducted at CHOA which found that lower COI levels were significantly associated with acute respiratory failure requiring invasive mechanical ventilation in critically ill children. [20]

Our study found a significant association between OCOI and postoperative hospital length of stay following pediatric cardiac surgery. This finding has important implications for patients, families, and hospitals. For patients and families, longer PHLOS can lead to increased stress, anxiety, and financial burden associated with extended hospital stays, missed work, and additional care responsibilities.[20–22] This may be especially challenging for families from low and very low opportunity levels given the extra strain on already limited resources. Additionally, longer PHLOS can increase the risk of hospital-acquired infections and other complications, potentially leading to further health issues and costs.[23,24] For hospitals, longer PHLOS can result in increased costs associated with prolonged hospital stays, including staffing, equipment, and other resources.[25] Additionally, longer PHLOS can limit bed availability and disrupt the flow of patients through the hospital, potentially leading to increased wait times and decreased access to care or other patients.[26,27]

One possible explanation for the increased PHLOS for children living in lower COI levels could include CHOA's requirements for discharge. CHOA has implemented a program, "Ticket to Home", which requires all parents to complete a checklist of activities including required trainings, obtaining all equipment and medications needed for home, and a "rooming in" experience which allows parents to act as if they are caring for the child at home for an extended period. This requires the parent to administer all medications, feedings and cared based on a provided schedule and the length of the "rooming in" is based on parents' progress. If a parent is struggling with the care concepts or if there are difficulties in obtaining equipment or medications due to insurance, then this could extend a patient's PHLOS. By identifying the role of OCOI in PHLOS following pediatric cardiac surgery, healthcare systems can develop targeted interventions aimed at improving neighborhood opportunity and reducing disparities in healthcare outcomes for vulnerable populations and reduce operating costs for the hospital, ultimately benefiting patients, families, and hospitals alike.

The COI offers a new perspective by focusing on opportunities, rather than just challenges, in the assessment of social and structural determinants of health. This approach provides a positive framework for designing population health interventions that aim to improve child health outcomes. In addition, the COI has the potential to identify contextual factors that are modifiable through interventions and policies, and to highlight populations and patients who are at risk for "double jeopardy" - limited opportunity and heightened risk for morbidity and mortality.[8]

A modifiable factor found in our study that could impact morbidity and mortality of children undergoing cardiac surgery is addressing disparities associated with preterm births. Women who do not receive prenatal care are at significantly higher risk of preterm birth than those who attend the recommended visits.[15] Our study found a significant association between OCOI and preterm births which is consistent with previous research indicating socioeconomic, race/ethnicity, and geographic barriers to prenatal detection of congenital heart disease.[28] Studies have linked neighborhood poverty to very preterm births in Black women and increased exposure to income inequality to very preterm births in Hispanic women.[16] Our finding of a significant association between OCOI and preterm births serves as an opportunity to focus on improving access to prenatal care and reducing the burden of preterm births in underserved populations by enhancing prenatal detection of congenital heart disease and subsequently, reducing morbidity and mortality and financial strain on families and healthcare systems.

Increased awareness of inequities in the healthcare sector may present openings for addressing neighborhood opportunity. Along with increasing attention to social and structural determinants of health and social interventions, some healthcare systems are using neighborhood-level data to identify patients for targeted social risk screening and referrals to social services and to identify vulnerable communities.[14] Health equity dashboards are becoming an increasingly popular tool used by healthcare systems to track and monitor healthcare outcomes, including disparities in outcomes.[29–31] Incorporating the Childhood Opportunity Index into a dashboard could provide valuable data on external factors influencing healthcare outcomes, particularly for pediatric populations. By including COI data, specifically metro-normed COI, healthcare systems could more accurately assess, and address healthcare disparities related to socioeconomic factors. This information could also help target interventions and allocate resources to communities with the greatest need for support. As healthcare systems continue to prioritize health equity, incorporating metrics like the COI into health equity dashboards could be a key step in improving health outcomes for vulnerable populations.

Moving forward, further research is needed to understand the specific mechanisms by which neighborhood opportunity influences healthcare outcomes for children undergoing congenital heart surgery. This could include investigating the role of access to healthcare services, social support networks, and exposure to environmental hazards in areas with low COI. Additionally, interventions aimed at improving neighborhood opportunity and reducing disparities in healthcare outcomes should be developed and evaluated. These interventions could include community-based programs to enhance access to prenatal care, interventions to address social determinants of health and policy changes to improve the built environment, a structural feature of the social determinants of health. By continuing to prioritize health equity and by incorporating metrics like the COI into healthcare decision-making, healthcare systems can work towards reducing disparities and improving outcomes for all children, regardless of their socioeconomic background.

Limitations

There are several limitations to consider when interpreting the results of this study. One limitation is the use of retrospective data, which is subject to limitations such as missing data and inaccurate or incomplete documentation. Additionally, the generalizability of our findings is limited to patients attending tertiary care pediatric hospitals in metro Atlanta, Georgia. Outcomes might be very different for children living in rural Georgia or other metropolitan areas. In addition, the study focused only on children undergoing cardiac surgery, so the findings may not be generalizable to other pediatric populations.

Conclusion

Our study found that lower childhood opportunity levels were associated with a greater risk of poor outcomes and a longer postoperative hospital length of stay. The COI provides valuable insights into the SDOH that are present within a community and can significantly impact the healthcare outcomes of children undergoing congenital heart surgery. By identifying areas of low opportunity, healthcare providers and policymakers can develop targeted interventions that can address the specific needs of these communities. These interventions may include improving access to healthcare services, reducing exposure to environmental pollutants, increasing access to healthy foods, and providing safe public recreational spaces. Ultimately, by addressing the SDOH, we can improve healthcare outcomes and reduce health disparities among vulnerable pediatric populations.

Table 1: Patient and Perioperative Characteristics by Metro-Normed Child Opportunity Index

Variable	Overall N=3791	Very High N=618	High N=806	Moderate N=844	Low N=750	Very Low N=779	p-value^2
Gestational Age							**0.014**
Preterm	2453 (77%)	407 (79%)	555 (80%)	543 (77%)	463 (75%)	485 (73%)	
Term	736 (23%)	105 (21%)	139 (20%)	159 (23%)	154 (25%)	179 (27%)	
Missing	608	106	112	142	133	115	
Age							**0.001**
0-6 Months	1688 (44%)	257 (42%)	389 (48%)	362 (53%)	313 (42%)	367 (47%)	
6-23 Months	776 (20%)	105 (17%)	151 (19%)	184 (22%)	158 (21%)	178 (23%)	
2-4 Years	444 (12%)	93 (15%)	90 (11%)	97 (11%)	90 (12%)	74 (9.5%)	
5-12 Years	587 (15%)	103 (17%)	107 (13%)	130 (15%)	137 (18%)	110 (14%)	
13- 17 Years	60 (9.7%)	60 (90.7%)	69 (8.6%)	71 (8.4%)	52 (6.9%)	50 (6.4%)	
Sex							0.61
Female	1777 (47%)	279 (45%)	377 (47%)	384 (45%)	357 (48%)	380 (49%)	
Male	2020 (53%)	339 (55%)	429 (53%)	460 (55%)	393 (52%)	399 (51%	
Race							**<0.001**
White	1984 (52%)	469 (76%)	501 (62%)	494 (59%)	329 (44%)	191 (25%)	
Black	1422 (37%)	69 (11%)	199 (25%)	296 (35%)	342 (46%)	516 (66%)	
Asian	188 (5.0%)	56 (9.1%)	54 (6.7%)	16 (1.9%)	29 (3.9%)	33 (4.2%)	
Other/Unknown	203 (5.3%)	24 (3.9%)	52 (6.5%)	38 (4.5%)	50 (6.7%)	39 (5.0%)	
Ethnicity							**<0.001**
Hispanic	522 (14%)	37 (6.0%)	97 (12%)	112 (13%)	154 (21%)	122 (16%)	
Not Hispanic	3182 (84%)	566 (92%)	690 (86%)	714 (85%)	572 (76%)	640 (82%)	
Unknown	93 (2.4%)	15 (2.4%)	19 (2.4%)	18 (2.1%)	24 (3.2%)	17 (2.2%)	
Public Insurance^3	2206 (58%)	145 (23%)	339 (42%)	535 (63%)	536 (71%)	651 (84%)	**<0.001**
Private Insurance^3	1579 (42%)	470 (76%)	463 (57%)	309 (37%)	211 (28%)	126 (16%)	**<0.001**
Syndrome	1103 (29%)	164 (27%)	224 (28%)	256 (30%)	219 (29%)	240 (31%)	0.36
STAT Score							0.13
1	1226 (32%)	237 (38%	234 (33%)	252 (30%)	240 (32%)	233 (30%)	
2	1066 (28%)	169 (27%)	226 (28%)	236 (28%)	210 (28%)	225 (29%)	
3	488 (13%)	70 (11%)	105 (13%)	117 (14%)	106 (14%)	90 (12%)	
4	843 (22%)	122 (20%)	174 (22%)	197 (23%)	157 (21%)	193 (25%)	
5	174 (4.6%)	20 (3.2%)	37 (4.6%)	42 (5.0%)	37 (4.9%)	38 (4.9%)	
Preoperative ECMO	36 (0.9%)	7 (1.1%)	7 (0.9%)	11 (1.3%)	8 (1.1%)	3 (0.4%)	0.39
Preoperative Ventilation	349 (9.2%)	46 (7.4%)	66 (8.2%)	66 (7.8%)	78 (10%)	93 (12%)	**0.009**
Chest Left Open After Surgery	283 (7.5%)	41 (6.6%)	57 (7.1%)	66 (7.8)	59 (7.0%)	60 (7.7%)	0.88
Cross-Clamp Time (mins)							0.30
≤ 60	1816 (59%)	307 (62%)	381 (60%)	395 (56%)	361 (59%)	372 (57%)	
> 60	1285 (41%)	189 (38%)	259 (40%)	308 (44%)	249 (41%)	280 (43%)	
N/A	696	122	166	141	140	127	

[1] Median (IQR) or Frequency (%)

[2] Pearson's Chi-squared test; Kruskal-Wallis rank sum test

[3] Self-pay excluded due to small sample size

Table 2. Outcomes of Interest by Metro-Normed Childhood Opportunity Index

Outcome	**Overall**, N = 3,797[1]	**Very High**, N = 618[1]	**High**, N = 806[1]	**Moderate**, N = 844[1]	**Low**, N = 750[1]	**Very Low**, N = 779[1]	**p-value**[2]
Composite Quality Metric[3]	498 (13%)	65 (11%)	110 (14%)	93 (11%)	104 (14%)	126 (16%)	**0.008**
Readmission within 30 days	515 (14%)	65 (11%)	110 (14%)	121 (14%)	99 (13%)	120 (15%)	0.10
Postoperative Length of Stay	5 (3, 10)	5 (3, 8)	5 (3, 10)	5 (3, 10)	5 (3, 10)	6 (4, 12)	**<0.001**

[1] Median (IQR) or Frequency (%)

[2] Pearson's Chi-squared test; Kruskal-Wallis rank sum test

[3] The composite quality metric includes a mortality domain and a morbidity domain. The mortality domain includes the measure of operative mortality defined as any death occurring in the hospital, and any deaths occurring after discharge within 30 days of the operation. The morbidity domain includes major complications including renal failure requiring dialysis, neurologic deficit persisting at discharge, arrhythmia requiring permanent pacemaker, paralyzed diaphragm/phrenic nerve injury, mechanical circulatory support, and unplanned re-intervention (includes surgical or catheter-based unplanned interventions, and cardiac and noncardiac procedures)

Table 3: Outcomes of Interest by Childhood Opportunity Index Domains

Social and Economic Domain

Outcome	**Overall**, N = 3,797[1]	**Very High**, N = 677[1]	**High**, N = 714[1]	**Moderate**, N = 850[1]	**Low**, N = 780[1]	**Very Low**, N = 776[1]	**p-value**[2]
Composite Quality Metric[3]	498 (13%)	67 (9.9%)	99 (14%)	100 (12%)	106 (14%)	126 (16%)	**0.005**
Readmission within 30 days	515 (14%)	74 (11%)	97 (14%)	120 (14%)	100 (13%)	124 (16%)	0.076
Postoperative Length of Stay	5 (3, 10)	5 (3, 8)	5 (3, 10)	5 (3, 10)	5 (3, 10)	6 (4, 12)	**<0.001**

Health and Environment Domain

Outcome	**Overall**, N = 3,797[1]	**Very High**, N = 685[1]	**High**, N = 799[1]	**Moderate**, N = 779[1]	**Low**, N = 822[1]	**Very Low**, N = 712[1]	**p-value**[2]
Composite Quality Metric[3]	498 (13%)	76 (11%)	91 (11%)	110 (14%)	112 (14%)	109 (15%)	0.077
Readmission within 30 days	515 (14%)	77 (11%)	105 (13%)	116 (15%)	114 (14%)	103 (14%)	0.29
Postoperative Length of Stay	5 (3, 10)	5 (3, 9)	5 (3, 10)	5 (3, 11)	5 (3, 10)	6 (4, 12)	**<0.001**

Education Domain

Outcome	**Overall**, N = 3,797[1]	**Very High**, N = 662[1]	**High**, N = 777[1]	**Moderate**, N = 775[1]	**Low**, N = 759[1]	**Very Low**, N = 824[1]	**p-value**[2]
Composite Quality Metric[3]	498 (13%)	86 (13%)	91 (12%)	96 (12%)	100 (13%)	125 (15%)	0.31
Readmission within 30 days	515 (14%)	72 (11%)	104 (13%)	110 (14%)	106 (14%)	123 (15%)	0.22
Postoperative Length of Stay	5 (3, 10)	5 (3, 9)	5 (3, 10)	5 (3, 11)	5 (3, 10)	6 (4, 12)	**<0.001**

[1] Median (IQR) or Frequency (%)

[2] Pearson's Chi-squared test; Kruskal-Wallis rank sum test

[3] The composite quality metric includes a mortality domain and a morbidity domain. The mortality domain includes the measure of operative mortality defined as any death occurring in the hospital, and any deaths occurring after discharge within 30 days of the operation. The morbidity domain includes major complications including renal failure requiring dialysis, neurologic deficit persisting at discharge, arrhythmia requiring permanent pacemaker, paralyzed diaphragm/phrenic nerve injury, mechanical circulatory support, and unplanned re-intervention (includes surgical or catheter-based unplanned interventions, and cardiac and noncardiac procedures)

Table 4. Logistic Models of Composite Quality Metric[2] and OCOI

Predictor	**OR[1]**	**95%CI[1]**	**p-value**
Unadjusted analysis			
Childhood Opportunity Level			**0.008**
Very High	—	—	
High	1.34	0.97, 1.87	
Moderate	1.05	0.75, 1.48	
Low	1.37	0.99, 1.91	
Very Low	1.64	1.20, 2.27	
Adjusted analysis			
Childhood Opportunity Level			0.39
Very High	—	—	
High	1.05	0.71, 1.57	
Moderate	0.82	0.55, 1.22	
Low	0.99	0.66, 1.49	
Very Low	1.17	0.79, 1.73	
Preterm			0.15
Term	—	—	
Preterm	1.23	0.93, 1.63	
Age, years	0.98	0.94, 1.01	0.16
Syndrome			**0.002**
no	—	—	
yes	1.50	1.16, 1.94	
STAT Score			**<0.001**
1	—	—	
2	1.89	1.28, 2.82	
3	1.72	1.11, 2.68	
4	3.41	2.32, 5.07	
5	6.41	3.88, 10.7	
Preoperative ECMO	2.78	1.11, 6.59	**0.030**
Preoperative Ventilation	1.91	1.35, 2.68	**<0.001**
Chest Left Open after Surgery			**<0.001**
No/Unknown	—	—	
Yes	2.52	1.80, 3.52	
Cross-Clamp Time (mins)			**0.027**
≤ 60	—	—	
>60	1.34	1.03, 1.73	

[1] OR = Odds Ratio, CI = Confidence Interval

[2] The composite quality metric includes a mortality domain and a morbidity domain. The mortality domain includes the measure of operative mortality defined as any death occurring in the hospital, and any deaths occurring after discharge within 30 days of the operation. In-hospital deaths include deaths in the hospital while performing the operation, or in another acute care facility to which the patient is transferred, or in a long-term care facility up to 6 months after transfer. The morbidity domain includes major complications including renal failure requiring dialysis, neurologic deficit persisting at discharge, arrhythmia requiring permanent pacemaker, paralyzed diaphragm/phrenic nerve injury, mechanical circulatory support, and unplanned re-intervention (includes surgical or catheter-based unplanned interventions, and cardiac and noncardiac procedures)

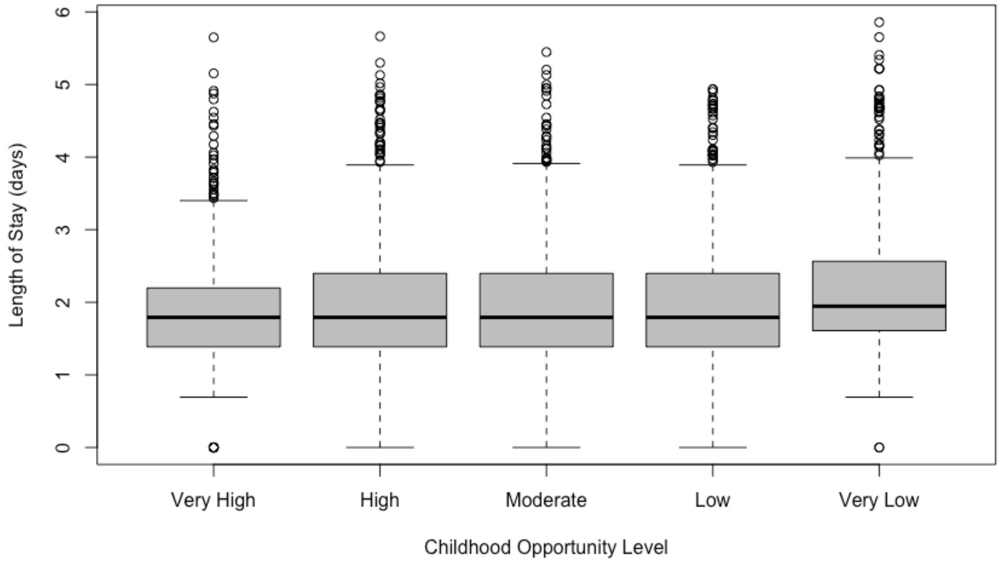


Figure 2: Childhood Opportunity Level and PHLOS

Table 5: Logistic Models of Composite Quality Metric[2] and COI Social and Economic Domain

Predictor	**OR[1]**	**95% CI[1]**	**p-value**
	Unadjusted analysis		
COI Social and Economic Domain			**0.005**
Very High	—	—	
High	**1.47**	**1.06, 2.04**	
Moderate	1.21	0.88, 1.69	
Low	**1.43**	**1.04, 1.99**	
Very Low	**1.76**	**1.29, 2.43**	
	Adjusted analysis		
COI Social and Economic Domain			0.39
Very High	—	—	
High	1.34	0.90, 2.00	
Moderate	1.05	0.71, 1.58	
Low	1.10	0.73, 1.66	
Very Low	1.34	0.91, 2.00	
Preterm			0.16
Term	—	—	
Preterm	1.23	0.92, 1.62	
Age, years	0.98	0.94, 1.01	0.15
Syndrome			**0.002**
no	—	—	
yes	**1.51**	**1.17, 1.95**	
STAT Score			**<0.001**
1	—	—	
2	**1.88**	**1.27, 2.80**	
3	**1.69**	**1.09, 2.63**	
4	**3.34**	**2.27, 4.97**	
5	**6.22**	**3.77, 10.4**	
Preoperative ECMO	**2.81**	**1.13, 6.64**	**0.028**
Preoperative Ventilation	**1.93**	**1.37, 2.70**	**<0.001**
Chest Left Open after Surgery			**<0.001**
No/Unknown	—	—	
Yes	**2.52**	**1.80, 3.51**	
Cross-Clamp Time (mins)			**0.030**
≤ 60	—	—	
>60	**1.33**	**1.03, 1.72**	

[1] OR = Odds Ratio, CI = Confidence Interval

[2] The composite quality metric includes a mortality domain and a morbidity domain. The mortality domain includes the measure of operative mortality defined as any death occurring in the hospital, and any deaths occurring after discharge within 30 days of the operation. In-hospital deaths include deaths in the hospital while performing the operation, or in another acute care facility to which the patient is transferred, or in a long-term care facility up to 6 months after transfer. The morbidity domain includes major complications including renal failure requiring dialysis, neurologic deficit persisting at discharge, arrhythmia requiring permanent pacemaker, paralyzed diaphragm/phrenic nerve injury, mechanical circulatory support, and unplanned re-intervention (includes surgical or catheter-based unplanned interventions, and cardiac and noncardiac procedures)

Table 6: Linear Models of Postoperative Hospital Length of Stay

Predictor	**Beta**	**95% CI[1]**	**p-value**
Unadjusted analysis			
Childhood Opportunity Level			**<0.001**
Very High	—	—	
High	0.13	0.04, 0.22	
Moderate	0.12	0.04, 0.21	
Low	0.13	0.04, 0.22	
Very Low	0.27	0.18, 0.36	
Adjusted analysis			
Childhood Opportunity Level			**0.014**
Very High	—	—	
High	0.11	0.03, 0.19	
Moderate	0.04	-0.03, 0.12	
Low	0.07	-0.01, 0.15	
Very Low	0.12	0.04, 0.20	
Preterm			**<0.001**
Term	—	—	
Preterm	0.12	0.06, 0.17	
Age, years	-0.03	-0.03, -0.02	**<0.001**
Syndrome			**<0.001**
no	—	—	
yes	0.24	0.19, 0.30	
STAT Score			**<0.001**
1	—	—	
2	0.32	0.25, 0.38	
3	0.27	0.19, 0.34	
4	0.67	0.59, 0.74	
5	1.1	0.96, 1.2	
Preoperative ECMO	0.47	0.22, 0.72	**<0.001**
Preoperative Ventilation	0.58	0.49, 0.67	**<0.001**
Chest Left Open after Surgery			**<0.001**
No/Unknown	—	—	
Yes	0.34	0.24, 0.43	
Cross-Clamp Time (mins)			**0.002**
≤ 60	—	—	
>60	0.08	0.03, 0.14	

[1] CI = Confidence Interval

Table 7: Linear Models of Postoperative Hospital Length of Stay By COI Domain (Unadjusted analysis)

Characteristic	Beta	95% CI[1]	p-value
Social and Economic Domain			**<0.001**
Very High	—	—	
High	0.08	-0.01, 0.16	
Moderate	**0.12**	**0.04, 0.20**	
Low	**0.12**	**0.03, 0.20**	
Very Low	**0.24**	**0.15, 0.33**	
Health and Environment Domain			**<0.001**
Very High	—	—	
High	0.09	0.01, 0.18	
Moderate	**0.12**	**0.03, 0.20**	
Low	**0.15**	**0.07, 0.24**	
Very Low	**0.25**	**0.17, 0.34**	
Education Domain			**<0.001**
Very High	—	—	
High	0.05	-0.03, 0.14	
Moderate	**0.10**	**0.02, 0.19**	
Low	**0.11**	**0.02, 0.20**	
Very Low	**0.20**	**0.12, 0.29**	

[1] CI = Confidence Interval

Table 8: Linear Models of Postoperative Hospital Length of Stay By COI Domain (Adjusted analysis)

	Social and Economic			Health and Environment			Education		
Predictor	**Beta**	**95% CI[1]**	**p-value**	**Beta**	**95% CI[1]**	**p-value**	**Beta**	**95% CI[1]**	**p-value**
COI			**0.28**			**0.13**			**0.50**
Very High	—	—		—	—		—	—	
High	0.06	-0.02, 0.14		0.03	-0.05, 0.11		0.01	-0.07, 0.09	
Moderate	0.04	-0.04, 0.11		0.02	-0.05, 0.10		0.01	-0.07, 0.08	
Low	0.05	-0.03, 0.13		0.02	-0.06, 0.09		0.02	-0.06, 0.10	
Very Low	0.08	0.01, 0.16		0.09	0.02, 0.17		0.06	-0.02, 0.14	
Preterm			**<0.001**			**<0.001**			**<0.001**
Term	—	—		—	—		—	—	
Preterm	0.12	0.06, 0.17		0.11	0.06, 0.17		0.12	0.06, 0.17	
Age, years	-0.03	-0.03, -0.02	**<0.001**	-0.03	-0.03, -0.02	**<0.001**	-0.03	-0.03, -0.02	**<0.001**
Syndrome			**<0.001**			**<0.001**			**<0.001**
no	—	—		—	—		—	—	
yes	0.24	0.19, 0.30		0.24	0.19, 0.30		0.24	0.19, 0.29	
STAT Score			**<0.001**			**<0.001**			**<0.001**
1	—	—		—	—		—	—	
2	0.31	0.25, 0.38		0.32	0.25, 0.38		0.32	0.25, 0.38	
3	0.27	0.19, 0.30		0.27	0.19, 0.35		0.27	0.19, 0.35	
4	0.66	0.59, 0.74		0.67	0.60, 0.74		0.67	0.59, 0.74	
5	1.1	0.95, 1.2		1.1	0.96, 1.2		1.1	0.96, 1.2	
Preoperative ECMO	0.47	0.22, 0.72	**<0.001**	0.47	0.22, 0.71	**<0.001**	0.46	**0.22, 0.71**	**<0.001**
Preoperative Ventilation	0.58	0.49, 0.67	**<0.001**	0.59	0.50, 0.67	**<0.001**	0.58	**0.49, 0.67**	**<0.001**
Chest Left Open after Surgery			**<0.001**			**<0.001**			**<0.001**
No/Unknown	—	—		—	—		—	—	
Yes	0.33	0.24, 0.43		0.33	0.24, 0.43		0.34	0.24, 0.43	
Cross-Clamp Time (mins)			**0.002**			**0.002**			**0.002**
≤ 60	—	—		—	—		—	—	
>60	0.08	0.03, 0.14		0.08	0.03, 0.13		0.08	0.03, 0.14	

[1] CI = Confidence Interval

Table 9: Logistic Models of Readmission within 30 days			
Predictor	**OR[1]**	**95% CI[1]**	**p-value**
Unadjusted analysis			
Childhood Opportunity Level			0.094
Very High	—	—	
High	1.34	0.97, 1.87	
Moderate	1.42	1.04, 1.97	
Low	1.29	0.93, 1.81	
Adjusted analysis			
Childhood Opportunity Level			0.49
Very High	—	—	
High	1.28	0.87, 1.89	
Moderate	1.28	0.88, 1.88	
Low	1.02	0.68, 1.53	
Very Low	1.21	0.83, 1.79	
Preterm			**0.001**
Term	—	—	
Preterm	1.54	1.19, 1.99	
Age, years	0.99	0.96, 1.02	0.47
Syndrome			0.19
no	—	—	
yes	1.18	0.92, 1.51	
STAT Score			**<0.001**
1	—	—	
2	2.20	1.58, 3.10	
3	1.96	1.32, 2.92	
4	2.46	1.71, 3.57	
5	4.76	2.89, 7.83	
Preoperative ECMO	0.73	0.17, 2.19	0.61
Preoperative Ventilation	1.53	1.07, 2.16	**0.020**
Chest Left Open after Surgery			0.13
No/Unknown	—	—	
Yes	1.33	0.92, 1.90	
Cross-Clamp Time (mins)			0.99
≤ 60	—	—	
>60	1.00	0.78, 1.28	

[1] OR = Odds Ratio, CI = Confidence Interval

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Chapter 4: The Influence of Clinical Decision Support on Differences in Influenza Vaccine Uptake in Hospitalized Children

Abstract

Objectives

Clinical decision support (CDS) can improve influenza vaccine uptake and associated outcomes. It remains unknown how CDS influences differences in uptake of evidence-based interventions by patient demographic factors and other social and structural determinants of health.

Methods

We performed a post-hoc analysis of a CDS intervention to promote influenza vaccine in hospitalized children. The outcome variable was administration of influenza vaccination; predictor variables included age, race/ethnicity, sex, insurance type, presence of complex chronic condition, time of admission, and time of discharge. Analyses were performed on cohorts of children during influenza seasons pre- and post-implementation of the CDS tool.

Results

Of those children eligible to receive the influenza vaccine, 1676 children (30.4%) had the vaccine administered during 2019-2020 (intervention) compared to 912 eligible children (13.5%) during 2018-2019 (historical controls). Among historical controls, males were 18% more likely than females to receive influenza vaccination (aOR = 1.18; 95% CI: 1.02-1.36), and Black (aOR = 1.44; 95%CI: 1.01 - 2.02) and Asian children (aOR = 1.90; 95% CI:1.18–3.00) were more likely than children of other races to receive the influenza vaccination. These differences disappeared after CDS implementation.

Conclusions

There were significant differences in influenza vaccination rates between sex and racial groups that resolved post-CDS implementation, highlighting the ability of CDS to address differences in adoption of evidence-based practices.

Background

Healthcare disparities are differences in healthcare outcomes and quality of care between groups due to social and structural determinants of health (e.g., health insurance coverage, access to and use of care) that cannot be explained by variations in health needs, patient preferences, or treatment recommendations.[1] Addressing healthcare disparities is complex due to multifactorial root causes, challenges with identifying disparities in a systematic and standardized manner, and implementing effective interventions. While studies show that racial, ethnic, and socioeconomic disparities exist in the pediatric acute care population, there is a shortage of dedicated studies designed to investigate root causes and implement studied interventions in the pediatric population.[2–9] Improved understanding of healthcare disparities that exist in healthcare systems has accelerated the recognition of a need to progress towards health equity. Health equity is defined as "the state in which everyone has the opportunity to attain full health potential, and no one is disadvantaged from achieving this potential because of social position or any other socially defined circumstance."[10]

There are over 250 children's hospitals in the United States providing multidisciplinary, specialized care to meet the unique needs of children and their families. Children's hospitals are typically located in urban centers and affiliated with academic institutions.[11] While only 1 in 20 hospitals are designated as children's hospitals, they serve larger geographical regions than general hospitals and provide over 95% of pediatric transplantations, cancer programs, and tertiary care.[11] Children's hospitals are essential, serving America's most vulnerable children. Half of the care provided at children's hospitals is provided to disadvantaged children, and 6% of those children require ongoing care for medically complex diagnoses.[11] Given the population served, children's hospitals must implement processes to identify and address healthcare inequities.

Influenza is a very common viral illness with an estimated 38 million people afflicted during the 2019-2020 influenza season, resulting in 18 million visits to a health care provider, 405,000 hospitalizations, of which more than 52,000 occurred in children aged < 18 years, and 22,000 deaths.[12] Children from lower-income households are more likely to be hospitalized and less likely to have access to outpatient healthcare where they could be vaccinated, with 27% to 84% of pediatric inpatients due or overdue for vaccines nationally.[13–15] The Advisory Committee on Immunization Practices (ACIP) recommends vaccines be offered during hospitalizations to avoid missed opportunities.[16] However, in the 2018-19 flu season, only 3.6 – 4.3% of children received their influenza vaccination in the hospital.[17] This highlights the critical need to utilize all healthcare encounters as vaccination opportunities. In our health system, Children's Healthcare of Atlanta (CHOA), a Quality Improvement project was done to improve influenza vaccination through a novel Clinical Decision Support (CDS) tool.[18] However, the impact of this CDS on differences in influenza vaccination by patient demographics and social and structural determinants of health remains unknown.

CDS is "any electrical system designed to aid directly in clinical decision making, in which characteristics of individual patients are used to generate patient-specific assessments or recommendations that are presented to clinicians for consideration."[19] CDS may include alerts, order sets, drug-dose calculation verification, summary dashboards that provide feedback on performance reminders, among others.[2,18–20] CDS has the potential to improve healthcare outcomes; however, results are varied across studies; a systematic review found that CDS may improve healthcare process measures, however, evidence for clinical, workload, and efficiency outcomes remains limited.[18,19,21]

This project aimed to determine the association between select patient demographics, including proxies for social and structural determinants of health, and receipt of influenza vaccination in pediatric patients during an inpatient admission between two influenza seasons: September through April, 2018-2019 and 2019-2020. In addition, we sought to evaluate the impact of a CDS intervention implemented in the 2019-2020 influenza season on reducing identified disparities or differences in pediatric influenza vaccination.

Methods

Setting

This study was performed at CHOA, an urban not-for-profit pediatric health system, including 3 freestanding children's hospitals: 1 academic tertiary care center with 330 licensed beds, 1 community tertiary care center with 319 licensed beds, and 1 academic secondary care center with 24 licensed beds, with more than 45,000 hospitalizations in 2022. CHOA serves diverse patients from across the State of Georgia: in 2021, the population served by CHOA was 37% White, 37% Black, 18% Hispanic/Latino, 4% Asian and 4% 'Other'.[22] All 3 sites are networked via a common electronic health record (EHR) provided by Epic Systems. Influenza vaccines were available at all 3 sites generally from September through April of each year.

Data source

This study was based on secondary data gathered at CHOA in a quality improvement study from the 2018-2019 and 2019-2020 influenza seasons. Briefly, an electronic algorithm was used to determine influenza vaccine eligibility based on: (1) if the hospitalization was during influenza season (September through April); (2) patient age was ≥ 6 months of age but ≤ 18 years at the time of their hospitalization; (3) there was no record of influenza vaccine during the current season in our health system or the Georgia Registry of Immunization Transactions and Services (GRITS) which was queried automatically at the start of each visit; (4) there was no record of anaphylaxis to any influenza vaccine in our system; and (5) the nurse did not document parental refusal or another reason for ineligibility. For each eligible hospitalization, a default-checked (dynamic default) influenza vaccine order was added to certain admission order sets. Dynamic defaults automatically have a selected order, in this case a flu vaccine order, selected as the default based on eligibility. Because the order was selected by default, ordering providers would have to consciously deselect the order if they did not want to give an influenza vaccine. Order sets are a group of bundled standard orders which have been designed based on a condition, disease, or procedure.[23] For example, CHOA has order sets for the treatment of sepsis, asthma, and so on. The content of order sets can be modified or amended based on criteria. The order sets with the influenza order were expanded over time, yielding 2 populations for study: the intervention group (used an order set with dynamic influenza vaccine order in the 2019-2020 season) and historical controls (used an order set that was later updated to include dynamic influenza vaccine orders). For the intervention and historical control groups, we extracted vaccination status and social and structural determinants of health as described below.

This study was deemed non-human participants research by the CHOA Institutional Review Board.

Measures

The outcome of interest was the receipt of influenza vaccination during the child's hospital visit. The receipt of influenza vaccination status was dichotomized as yes or no. The primary exposures of interest were the following demographics and social and structural determinants of health which were available in the dataset: sex, race, ethnicity, and type of insurance. Sex was dichotomized as male or female. Race was one-hot encoded into five categories: Black, White, Asian, Other, and Unknown. Ethnicity was grouped into three categories: Hispanic or Latino, non-Hispanic or Latino, and Unknown. Type of insurance was grouped into three categories: Public, Private and Self-pay. In addition, we also adjusted for variables potentially related to ordering and administering influenza vaccine including admission time (day or night), discharge shift (day or night) and the presence of a complex chronic condition (CCC), defined by Feudtner, et.al., as any medical condition that can be expected to last at least 12 months (unless death intervenes), involves either several different organ systems or 1 organ system severely enough to require specialty pediatric care and some period of hospitalization in a tertiary care center. [24]

Statistical analysis

Descriptive statistics, including t-tests and chi-square, were used to analyze participants' characteristics. Univariable analysis was conducted to examine each predictor variable individually to estimate the crude odds ratio and 95% confidence intervals (CIs) for the predictor variable's effect on receipt of influenza vaccination. We conducted two logistic regression analyses, stratifying on time, to assess differences in vaccination receipt in the historical control group and the intervention group to determine how the influence of select patient demographics and proxies for social and structural determinants of health, on vaccination status changed with the implementation of CDS. Multivariable logistic regression using a full model with all predictors included was used to estimate the adjusted odds ratio (aOR) and the corresponding 95% confidence intervals (95% CIs). All analyses were performed in R, version 3.6.1 (R Group for Statistical Computing).

Results

Table 1 summarizes characteristics of the children in the study by influenza season. The children were evenly divided by sex with 53.9% of the population being male among historical controls in 2018-2019 and 50.1% in the intervention group from 2019-2020. The majority of children were Black in both the historical control (52.4%) and intervention groups (50.3%) with White children following close behind in 2018-2019 (39.3%) and 2019-2020 (40.8%). The majority of children had public insurance in both the historical control (65.3%) and intervention groups (64.1%) and the majority of admissions and discharges took place during the day shift for both the historical controls (57.9%, 91.0%) and intervention groups (57.2%, 91.7%). Among intervention hospitalizations, 30.8% (n=1676) had a vaccine administered compared to 13.5% (n=912) of historical controls had a vaccine administered.

In multivariable analysis (Table 2) we found differences in influenza vaccination rates in the historical control group by sex and race. Males had 18% higher odds than females to receive influenza vaccination during their hospital visit (aOR = 1.18; 95% CI: 1.02 – 1.36). Black children (aOR = 1.44; 95% CI:1.01– 2.02) and Asian children (aOR = 1.90; 95% CI:1.18– 3.00) also had higher odds of receiving an influenza vaccination. Additionally, adolescents were less likely to receive the influenza vaccine, with 13- to 17-year-old adolescents having the lowest odds compared with 6- to 23-month-old children (aOR, 0.72; 95% CI, 0.57 -0.92). In the intervention group, these differences in receipt of influenza vaccine were no longer significant. By contrast, children with CCC were less likely to receive an influenza vaccine in the intervention group (aOR=0.75 95% CI: 0.66 – 0.86) compared to the historical controls.

Discussion

In the absence of a CDS tool, male sex and those who identified as Black or Asian were associated with higher influenza vaccination rates among hospitalized children prior to discharge. These findings are congruent with previous studies, including Cameron et al. (2016), which examined parental reasons for refusal among pediatric patients admitted during influenza season and found parents of females, those who identified as White, and those with private insurance were less likely to agree to vaccination.[25] The implementation of a CDS tool raised the vaccination rate across all demographic groups and eliminated significant sex and race differences. According to CDC national data, influenza vaccination coverage among children does not vary by sex; however, parental hesitancy related to sex and influenza vaccination has been documented.[12,25,26] Another study, based in France, observed three groups – parents of children aged 1–15 years, parents of girls aged 11–15 years, and 65–75-year-olds.[27] The highest rate of vaccine hesitancy was observed amongst parents of 11–15 year old girls (aOR=1.6; 95% CI: 1.3-2.1).[26,27]

In addition to child sex, we also found differences related to race. After adjusting for other predictors and covariates, Black and Asian children were more likely to receive the influenza vaccination than other races prior to CDS implementation. Since racial identity may serve as a proxy for social and structural determinants of health, such as routine access to healthcare, neighborhood socioeconomic status, and trust in medical providers and treatments, more information is needed to explain this difference and how it relates to access to influenza vaccination in the community.[28] If Black and Asian children were more likely to be on public insurance or have less access to primary care, then this could also potentially provide some explanation for the difference in vaccination rates. Since the influenza vaccine used in the inpatient setting came from the Vaccine for Children (VFC) stock, vaccination was free for children covered by public insurance. Nationally, the VFC program has been successful in narrowing racial and ethnic disparities in vaccination.[29] However, children with private insurance would incur additional costs for receiving the vaccine within the acute care setting and not from their primary care provider. This could have led to differences in both ordering by the clinician and parental consent.

Differences in influenza vaccination coverage have been documented in certain age groups with influenza vaccination rates decreasing as children age resulting in adolescents aged 13-17 years routinely having the lowest vaccination among children aged <18.[30] In our study, adolescents were less likely to receive the influenza vaccine, with 13- to 17-year-old adolescents having 28% lower odds compared with 6- to 23-month-old children. This difference went away following the implementation of CDS highlighting an innovative way to reach a typically challenging group to vaccinate.

In the presence of the CDS tool, children with CCC were 25% less likely to receive an influenza vaccination than children with CCC in the historical control group. One possible contributor was nurses' tendency to delay influenza vaccine conversations until the day of discharge.[31] Parents of children with CCC may hesitate to approve an influenza vaccination given the subsequent time needed to observe the child, thus potentially delaying discharge. Children with CCC are at increased risk of influenza-related complications, hospitalizations and deaths and literature shows that children with CCC tend to have poor influenza vaccination rates. [32,33,34] Further investigation is needed to identify factors driving this difference and successful interventions to increase influenza vaccination while hospitalized.

While outpatient practices will continue to be the primary setting for receipt of influenza vaccination, the hospital setting represents an opportunity to increase vaccination coverage among populations that are marginalized from preventative health services in outpatient settings.[8] Following the implementation of the CDS tool, our hospital system successfully increased the ordering of influenza vaccination from 15.2% to 77.1% and receipt of vaccination from 13.5% to 30.8%. Despite the improvement, the percentage of vaccination receipt remains low. Barriers to vaccine uptake after the implementation of the CDS tool, including parent refusal, preference to get the vaccine with their primary care provider, potential misidentification of vaccine eligibility, a nurse culture that may have deferred orders to discharge leading to misses due to pressures for the patient to leave, and inadequate system support to follow up on orders were identified.[31] While there are subsequent attempts to address these barriers and improve vaccine uptake, factors that influence the differences identified in this study need further investigation.

Limitations

This study had the benefit of access to a large data set encompassing three pediatric hospitals in a large urban setting. However, factors such as the priority of influenza vaccination among key stakeholders, technical infrastructure, and other factors reduce its generalizability.[18] In addition, this study demonstrated the effectiveness of our intervention in only a single influenza season which included two months of COVID-19. While emerging literature suggests lower vaccination rates during COVID-19 pandemic its effect in this study is likely limited as influenza vaccination rates tapered towards the end of influenza season.[35,36]

The potential to include an examination of the social and structural determinants of health examined were limited to proxies easily accessible and verifiable in the electronic health record, thus excluding determinants such as child’s place of residence, primary language, socio-economic status, and parental level of education, as well as other hospital-level indicators that may contribute to differences in vaccine ordering and administration. There was the possibility of potential misidentification of cases. In some orders that were cancelled, nurses noted that patients denied vaccine saying they had already received the vaccine.[31] This could happen due to patients having received the influenza vaccine at a facility that doesn't report to the state immunizations information system resulting in these children being misidentified as eligible. There is also the possibility that the parent wanted to refuse the vaccine but they preferred to avoid discussing their decision with the healthcare worker so they may misrepresent that the child has received the vaccine. Finally, in the intervention group, there remained a large percentage of patients who were not vaccinated, leaving room for improvement through other evidence-based interventions.[18]

Conclusion

This study identified differences in influenza vaccine administration by race and sex. Results suggest that the CDS tool shows promise in providing an effective intervention for addressing identified differences among hospitalized children. Future research should focus on collecting electronic health record data on additional social and structural factors that may impact vaccination such as the neighborhood socioeconomic status based on the child's residence, parental level of education and primary language, as well as additional system level data such as week vs weekend discharges. Additional research into reasons for vaccine refusal and the impact of using the CDS tool with other interventions, such as increasing parental trust in vaccines, may further improve vaccine administration rates and provide lessons to improve vaccine coverage for other disease. Finally, other opportunities for integrating and evaluating the impact of the CDS tool on healthcare disparities should be pursued and integrated into standards of care for other populations.

Table 1: Participant characteristics, by control (2018-2019) and Intervention (2019-2020) Influenza seasons at Children's Healthcare of Atlanta

		Control (N=6743)	Intervention (N=5449)	p-value
		n (%)	n (%)	
Vaccine ordered		1024 (15.2)	4199 (77.1)	<0.001
Vaccine administered		912 (13.5)	1676 (30.8)	<0.001
Age (mean (SD))		8.01 (5.9)	8.10 (5.9)	0.420
Age Group				0.005
	6-23 months	3636 (53.9)	2728 (50.1)	
	2-4 years	1363 (20.2)	1005 (18.4)	
	5-12 years	1384 (20.5)	1736 (31.9)	
	13-17 years	1471 (21.8)	1244 (22.8)	
	>=18 years	300 (4.4)	231 (4.2)	
Sex (Male)		3636 (53.9)	2728 (50.1)	<0.001
Race				0.083
	Black	3533 (52.4)	2739 (50.3)	
	White	2648 (39.3)	2224 (40.8)	
	Asian	177 (2.6)	147 (2.7)	
	Other	33 (0.5)	19 (0.3)	
	Unknown	352 (5.2)	320 (5.9)	
Ethnicity				0.064
	Hispanic or Latino	808 (12.0)	729 (13.4)	
	Non-Hispanic or Latino	5912 (87.7)	4704 (86.3)	
	Unknown	23 (0.3)	16 (0.3)	
Insurance				0.282
	Private	2084 (30.9)	1757 (32.2)	
	Public	4404 (65.3)	3493 (64.1)	
	Self-pay	255 (3.8)	199 (3.7)	
Admission Shift (day)		3902 (57.9)	3119 (57.2)	0.497
Discharge Shift (day)		6136 (91.0)	4995 (91.7)	0.203
CCC[a] (mean (SD))		1.03 (1.9)	0.89 (1.8)	<0.001
CCC >= 1		2373 (35.2)	1698 (30.0)	<0.001

[a] Complex chronic condition

Table 2: Association between characteristics of children and influenza vaccination administration before (2018-2019 season, control) and after implementation (2019-2020 season, intervention) of a clinical decision support tool

	Control		Intervention	
	cOR (95% CI)	aOR(95% CI)	cOR (95% CI)	aOR (95% CI)
Age Group				
6-23 mo.	Ref	Ref	Ref	Ref
2-4 y	1.53 (1.24 - 1.90)*	1.55 (1.25 - 1.92)*	1.11 (0.93 - 1.33)	1.13 (0.94 - 1.35)
5-12 y	1.22 (1.00 - 1.50)*	1.22 (1.00 - 1.49)	1.12 (0.94 - 1.32)	1.14 (0.97 - 1.36)
13 – 17 y	0.72 (0.57 - 0.92)*	0.75 (0.59 - 0.96)*	0.80 (0.67 - 0.96)	0.86 (0.71 - 1.04)
>= 18 y	1.17 (0.80 -1.66)	1.21 (0.82 - 1.36)	0.87 (0.63 - 1.18)	1.06 (0.76 - 1.46)
Sex				
Female	Ref	Ref	Ref	Ref
Male	1.23 (1.07- 1.42)*	1.18 (1.02 - 1.36)*	1.08 (0.96 - 1.21)	1.05 (0.93 - 1.18)
Race				
White	0.89 (0.77 - 1.03)	1.23 (0.87 - 1.71)	0.77 (0.69 - 0.87)	0.76 (0.55 - 1.03)
Black	1.08 (0.94 - 1.25)	1.44 (1.01 - 2.02)*	1.05 (0.94 – 1.18)	0.96 (0.69 - 1.32)
Asian	1.45 (1.00 - 2.06)*	1.90 (1.18 - 3.0)*	1.22 (0.87 - 1.69)	1.16 (0.75 - 1.78)
Other	0.913 (0.31 - 2.13)	0.99 (0.33 - 2.43)	2.0 (0.98 - 4.01)	1.72 (0.82 - 1.63)
Unknown	1.16 (0.89 - 1.49)	1.27 (0.88 - 1.79)	1.67 (1.37 - 2.05)	1.72 (0.82 - 1.63)
Ethnicity				
Non-Hispanic / Latino	0.84 (0.69 -1.03)	1.71 (0.49 - 10.79)	0.62 (0.53 - 0.73)	0.82 (0.30 - 2.46)
Hispanic/ Latino	1.21 (0.98 - 1.48)	2.20 (0.63 - 12.93)	1.61 (1.37 - 1.89)	1.26 (0.46 - 3.77)
Unknown	0.61 (0.10 - 2.08)	1.27 (0.88 - 1.79)	1.35 (0.46 - 3.65)	1.16 (0.75 - 1.78)
Insurance				
Public	1.08 (0.94 - 1.26)	0.74 (0.53 - 1.06)	1.22 (1.08 -1.38)*	0.93 (0.69 - 1.28)
Private	0.87 (0.75 - 1.02)	0.70 (0.50 - 1.02)	0.78 (0.69 - 0.89)	0.84 (0.61 - 1.16)
Self-pay	1.31 (0.93 - 1.19)	0.74 (0.53 - 1.06)	1.20 (0.89 -1.62)	Not Included[a]
Admission Shift				
Night	Ref	Ref	Ref	Ref
Day	0.92 (0.80 - 1.06)	1.09 (0.95 - 1.26)	0.89 (0.79 - 1.10)	0.92 (0.81 - 1.03)
Discharge Shift				
Night	Ref	Ref	Ref	Ref
Day	0.92 (0.71 - 1.18)	1.05 (0.82 - 1.36)	1.32 (1.07 - 1.65)*	1.29 (1.04 - 1.62)*
CCC[b] = 0	Ref	Ref	Ref	Ref
CCC >=1	0.98 (0.84 – 1.31)	1.00 (0.86 – 1.16)	0.74 (0.65 – 0.84)	0.75 (0.66 – 0.86)*

*cOR, crude odds ratio; aOR, adjusted odds ratio; CI, confidence interval,

*p value <0.05

[a] Not included in the adjusted model to too few examples for mixed-effects coefficient estimation

[b] Complex chronic condition

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Chapter 5: SUMMARY AND CONCLUSIONS

Summary of Results

Children's hospitals play a vital role in delivering high-quality healthcare services to pediatric patients with acute and chronic medical conditions. Nonetheless, healthcare disparities characterized by differences in access, quality, and outcomes, continue to pose significant challenges in pediatric acute care settings.[1–3] These disparities disproportionately affect children from minority and low-income backgrounds, resulting in poorer health outcomes and increased healthcare costs.[1,3,4] Social and structural determinants of health, which are non-medical factors shaped by social and economic systems, heavily influence health outcomes. These determinants encompass the conditions in which people are born, grow, work, live, and age, as well as wider forces and systems that shape daily life, such as economic policies, social norms, racism, climate change, and political systems.[5] Despite increased acknowledgement of healthcare disparities and a willingness to address them, the impact of social and structural healthcare disparities remains significant.

To prioritize healthcare equity, health systems must implement effective policies and programs targeting healthcare disparities. However, fostering meaningful change within complex health systems is a challenging endeavor that demands careful consideration of the social and structural determinants of health affecting specific patient populations.

This dissertation had three specific aims: Aim 1 focused on describing Children hospitals' leadership perceived facilitators and barriers to identifying and addressing healthcare disparities in their institution. A qualitative study was conducted, characterized by qualitative data collection using interviews and thematic analysis. Twelve healthcare leaders representing ten children's hospitals were recruited and interviewed. Participants discussed social and structural determinants of health, with disparities encompassing patients, their families, and healthcare employees. Various approaches for identifying disparities included external databases, health equity dashboards, and health equity teams were described. Interventions included raising awareness, addressing language barriers, utilizing 'navigators', and community engagement. Ideal systems involved family and community involvement, data systems utilization, diverse healthcare staffing, external pressure, and peer learning. Influencing factors comprised data systems understanding, staff capacity, buy-in and training, time, public disclosure, leadership support, and partner collaboration. The findings indicate that identifying and addressing healthcare disparities is a complex and multifaceted process. Participants expressed optimism that with proper commitment, healthcare systems can effectively address disparities.

Aim 2 examined whether the Childhood Opportunity Index (COI), a nationally available measure across census tracts within metropolitan areas, was associated with patient level morbidity and mortality following surgery for congenital heart defects in Atlanta, GA. In this retrospective chart review, patients who underwent an index operation for CHD between 2010 and 2020 at Children's Healthcare of Atlanta were included. Patients' addresses were geocoded and mapped to census tracts. Descriptive statistics, univariable analysis, and multivariable regression models were employed to assess associations between variables and outcomes. Of the 7460 index surgeries, 3798 (51%) met eligibility criteria. The composite quality metric revealed that 498 (13%) patients experienced poor outcomes, with children from very low COI areas showing higher risks in univariable regression (cOR=1.64; 95% CI: 1.20-2.27). Postoperative hospital length of stay (PHLOS) was significantly associated COI ($p<0.001$) in both univariable and multivariable regression models. There were 515 (14%) instances of readmission within 30 days of hospital discharge, with no significant association between COI and readmission in univariable (p<0.094) and multivariable (p=0.49) models. We identified significant associations between COI and poor outcomes and PHLOS. By understanding the role of COI in these outcomes, targeted interventions can be developed to improve health equity and reduce disparities in healthcare outcomes for vulnerable populations.

Aim 3 sought to determine the extent of which select demographics and proxies for social determinants of health, such as race, ethnicity, insurance status and sex impacted pediatric influenza vaccination administration, as well as evaluate the impact of a clinical decision support (CDS) tool on reducing identified disparities. This was done via a post-hoc analysis of a CDS intervention to promote influenza vaccine in hospitalized children. The outcome variable was administration of influenza vaccination; predictor variables included age, race/ethnicity, sex, insurance type, presence of complex chronic condition, time of admission, and time of discharge. Analyses were performed on cohorts of children during influenza seasons pre- and post-implementation of the CDS tool. Of those children eligible to receive the influenza vaccine, 1676 children (30.4%) had the vaccine administered during 2019-2020 (intervention) compared to 912 eligible children (13.5%) during 2018-2019 (historical controls). Among historical controls, males were 18% more likely than females to receive influenza vaccination (aOR = 1.18; 95% CI: 1.02-1.36), and Black (aOR = 1.44; 95%CI: 1.01 - 2.02) and Asian children (aOR = 1.90; 95% CI:1.18–3.00) were more likely than children of other races to receive the influenza vaccination. These differences disappeared after CDS implementation. There were significant differences in influenza vaccination rates between sex and racial groups that resolved post-CDS implementation, highlighting the ability of CDS to address differences in adoption of evidence-based practices.

In conclusion, this dissertation brings together the identification and addressing of healthcare disparities in pediatric acute care settings, focusing on the crucial role of Children's hospitals. By investigating the perceived facilitators and barriers among healthcare leaders, examining the impact of the Childhood Opportunity Index on patient outcomes, and evaluating the effectiveness of clinical decision support tools in reducing disparities, it provides valuable insights into addressing healthcare equity for pediatric patients. The next steps should involve implementing targeted interventions based on identified disparities, utilizing external databases and decision support tools, and fostering collaborations among healthcare providers, policymakers, and communities to promote lasting change. With a strong commitment to addressing social and structural determinants of health, we can ensure equitable access to high-quality healthcare for all children, regardless of their background.

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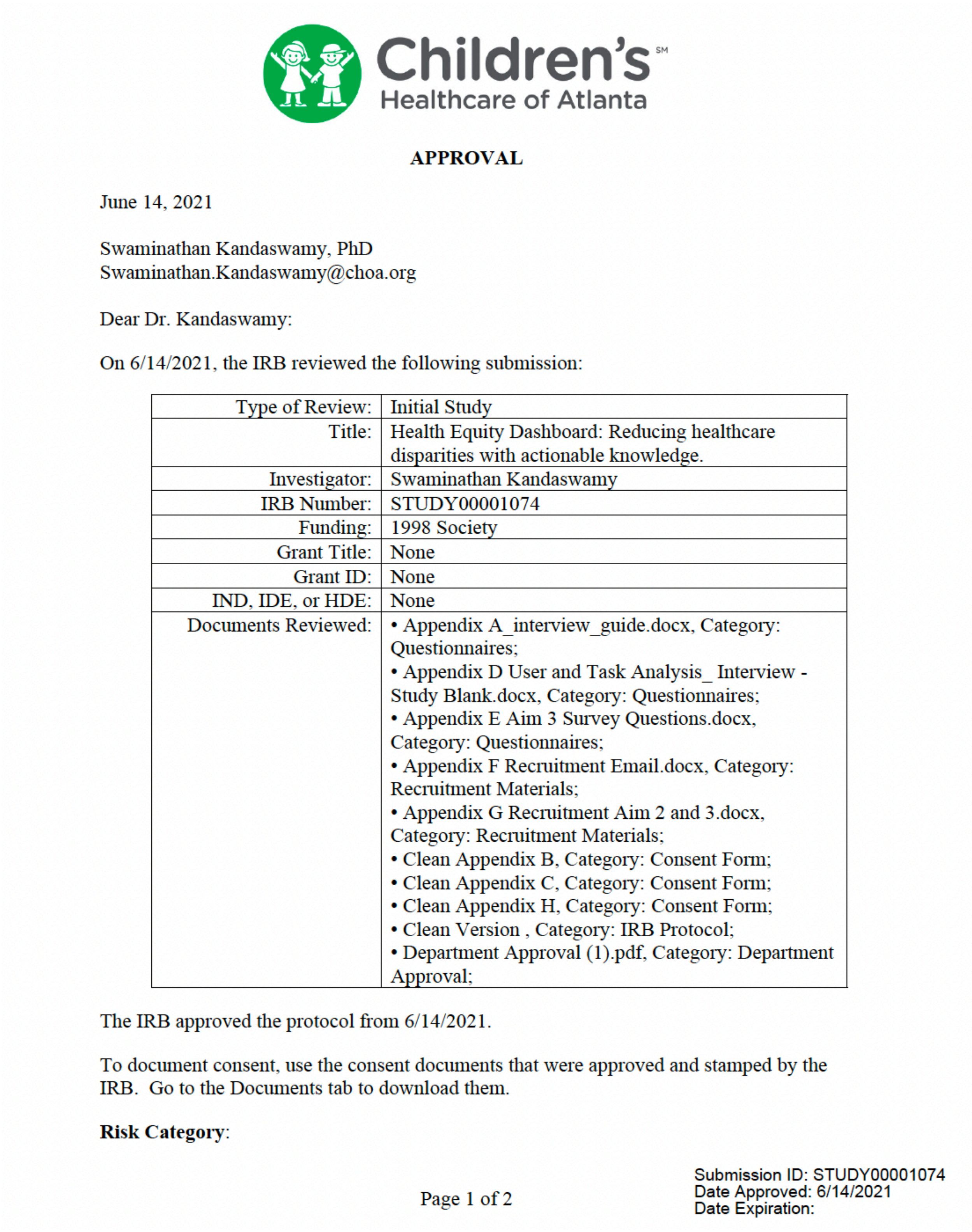
Appendix A



Children's Healthcare of Atlanta

APPROVAL

June 14, 2021

Swaminathan Kandaswamy, PhD
Swaminathan.Kandaswamy@choa.org

Dear Dr. Kandaswamy:

On 6/14/2021, the IRB reviewed the following submission:

Type of Review:	Initial Study
Title:	Health Equity Dashboard: Reducing healthcare disparities with actionable knowledge.
Investigator:	Swaminathan Kandaswamy
IRB Number:	STUDY00001074
Funding:	1998 Society
Grant Title:	None
Grant ID:	None
IND, IDE, or HDE:	None
Documents Reviewed:	• Appendix A_interview_guide.docx, Category: Questionnaires; • Appendix D User and Task Analysis_ Interview - Study Blank.docx, Category: Questionnaires; • Appendix E Aim 3 Survey Questions.docx, Category: Questionnaires; • Appendix F Recruitment Email.docx, Category: Recruitment Materials; • Appendix G Recruitment Aim 2 and 3.docx, Category: Recruitment Materials; • Clean Appendix B, Category: Consent Form; • Clean Appendix C, Category: Consent Form; • Clean Appendix H, Category: Consent Form; • Clean Version , Category: IRB Protocol; • Department Approval (1).pdf, Category: Department Approval;

The IRB approved the protocol from 6/14/2021.

To document consent, use the consent documents that were approved and stamped by the IRB. Go to the Documents tab to download them.

Risk Category:

Submission ID: STUDY00001074
Date Approved: 6/14/2021
Date Expiration:

☒ 46.404 OHRP (50.51 FDA)
☐ 46.405 OHRP (50.52 FDA)
☐ 46.406 OHRP (50.53 FDA)
☐ 46.407 OHRP (50.54 FDA)

Children's Healthcare of Atlanta Institutional Review Board approved the above referenced study.

☐ The stamped approved informed consent document for use in this study is attached. Only this original shall be used to make copies for study enrollment. You may not use any informed consent document that does not have this Institutional Review Board's current stamp of approval. The board has determined one parent signature is required.

☒ The requirement for written informed consent is waived for this study. The IRB has determined that all specified criteria described in 45 CFR 46.117(c) and 45 CFR 164.512(i)(2)(ii) has been met as necessary to obtain a waiver of documentation of informed consent.

☒ The requirement for informed consent, parental permission and assent is waived for the retrospective chart review portion of this study. The IRB has determined that all specified criteria described in 45 CFR 46.116(d) has been met as necessary to obtain a waiver.

☒ The requirement for authorization for the release of protected health information for the retrospective chart review portion is waived for this study. The IRB has determined that all specified criteria in 45 CFR 164.512 has been met as necessary to obtain a waiver of HIPAA Authorization.

☐ The requirement for HIPAA authorization of release of protected health information is partially waived for this study.

☐ This study is open for data analysis only.

In conducting this protocol, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system.

Sincerely,
Office of the IRB

Appendix B

Participant ID:
Interviewer:
Location:
Date:
Time:

Briefing script:

Thank you for taking the time to talk with me today. The purpose of this study is to understand the perceptions and experiences of hospital stakeholders in identifying and addressing healthcare disparities in patient care and outcomes within the pediatric acute care settings. For the purposes of this interview, healthcare disparities refer to differences between groups in quality of care or patient outcomes that cannot be explained by differences in health needs, patient preferences, or treatment regimens. The interview should take about an hour and the questions will focus on your experience with identifying and addressing disparities, as well as perceived facilitators and barriers. As a reminder, participation in this research study is completely voluntary, so you may choose to skip questions or stop the interview at any time.

Any information you share will remain confidential and your identity will not be disclosed. The only people who will see your responses besides myself are the research team. It's important that I remember exactly what you say, so I would like to record this zoom session. The recording will be destroyed once the final mini-study report is complete. If you are interested, I would be happy to share the de-identified results with you at the conclusion of this study.

Do you agree to participate?

Do I have your permission to record the interview to ensure all information is adequately captured?

Do you have any questions or concerns for me before we start?

Opening Questions:

1. Tell me about your position within your institution?

Probes:

- How long have you worked at this institution?
- What are your primary responsibilities?

Main Questions:

1. Describe a time when you noticed or felt there may have been a disparity in patient care or outcomes at your institution?

Probes:

- *If unaware of a time:* What are examples of a healthcare disparity that you believe exists in the pediatric acute care setting, whether at your institution or elsewhere?

2. How are healthcare disparities identified at your institution?

Probes:

- Who are the parties responsible for collecting the data?
- Who are the parties accountable for its success (e.g., providing resources, overseeing implementation)?
- Who was consulted in developing your strategy for data collection and dissemination?
- Who are the key stakeholders utilizing or consuming the data?

3. How are healthcare disparities being monitored within your institution?

Probes:

- Is this being done in a systematic way?
- What are the data sources (e.g., electronic health record, outside databases such as census data) for identifying disparities?
- What metrics are you tracking?
- How were these metrics chosen?
- How do you ensure data quality (e.g., timeliness, account for multiple responses for various social determinants of health, data harmonization, data linkages to outside databases such as census data)?

4. How are healthcare disparities being addressed within your institution?

Probes:

- What are interventions that you have found to be successful? How about unsuccessful?

- Who was consulted in developing your strategy for addressing disparities?
- Who are the parties responsible for addressing disparities?
- Who are the parties accountable for its success (e.g., providing resources, overseeing implementation)?

5. What would you consider as an ideal system for identifying and addressing healthcare disparities?

6. What are some factors that would influence whether this ideal system can be achieved?

<u>Probes:</u>

- Leadership support? Resources?

7. What are barriers to achieving this ideal system?

<u>Probes:</u>

- Leadership support? Resources?

Closing Question:

8. Is there anything else you would like to return to or add to our discussion?

Thank you so much for your willingness to take time to speak with me!

Interview Summary:

Appendix C

Children's℠
Healthcare of Atlanta

APPROVAL

April 6, 2021

Nikhil Chanani, MD
404-256-2593
chananin@kidsheart.com

Dear Dr. Chanani:

On 4/6/2021, the IRB reviewed the following submission:

Type of Review:	Initial Study
Title:	Racial and Socioeconomic Disparities in the Heart Center
Investigator:	Nikhil Chanani, MD
IRB Number:	STUDY00001005
Funding:	None
Grant Title:	None
Grant ID:	None
IND, IDE, or HDE:	None
Documents Reviewed:	• Department approval, Category: Department Approval; • Protocol, Category: IRB Protocol;

The IRB approved the protocol from 4/6/2021.

Risk Category:
☒ 46.404 OHRP (50.51 FDA)
☐ 46.405 OHRP (50.52 FDA)
☐ 46.406 OHRP (50.53 FDA)
☐ 46.407 OHRP (50.54 FDA)

Children's Healthcare of Atlanta Institutional Review Board approved the above referenced study.

☐ The stamped approved informed consent document for use in this study is attached. Only this original shall be used to make copies for study enrollment. You may not use any informed consent document that does not have this Institutional Review Board's current stamp of approval. The board has determined one parent signature is required.

☐ The requirement for written informed consent, parental permission and assent is waived for this study and an alteration of HIPAA Authorization has been granted. The IRB has determined that all specified criteria described in 45 CFR 46.117(c) and 45 CFR 164.512(i)(2)(ii) has been met as necessary to obtain a waiver of documentation of informed consent, parental permission and an alteration of HIPAA authorization.

☒ The requirement for informed consent, parental permission and assent is waived for this study. The IRB has determined that all specified criteria described in 45 CFR 46.116(d) has been met as necessary to obtain a waiver.

☒ The requirement for authorization for the release of protected health information for research purposes is waived for this study. The IRB has determined that all specified criteria in 45 CFR 164.512 has been met as necessary to obtain a waiver of HIPAA Authorization.

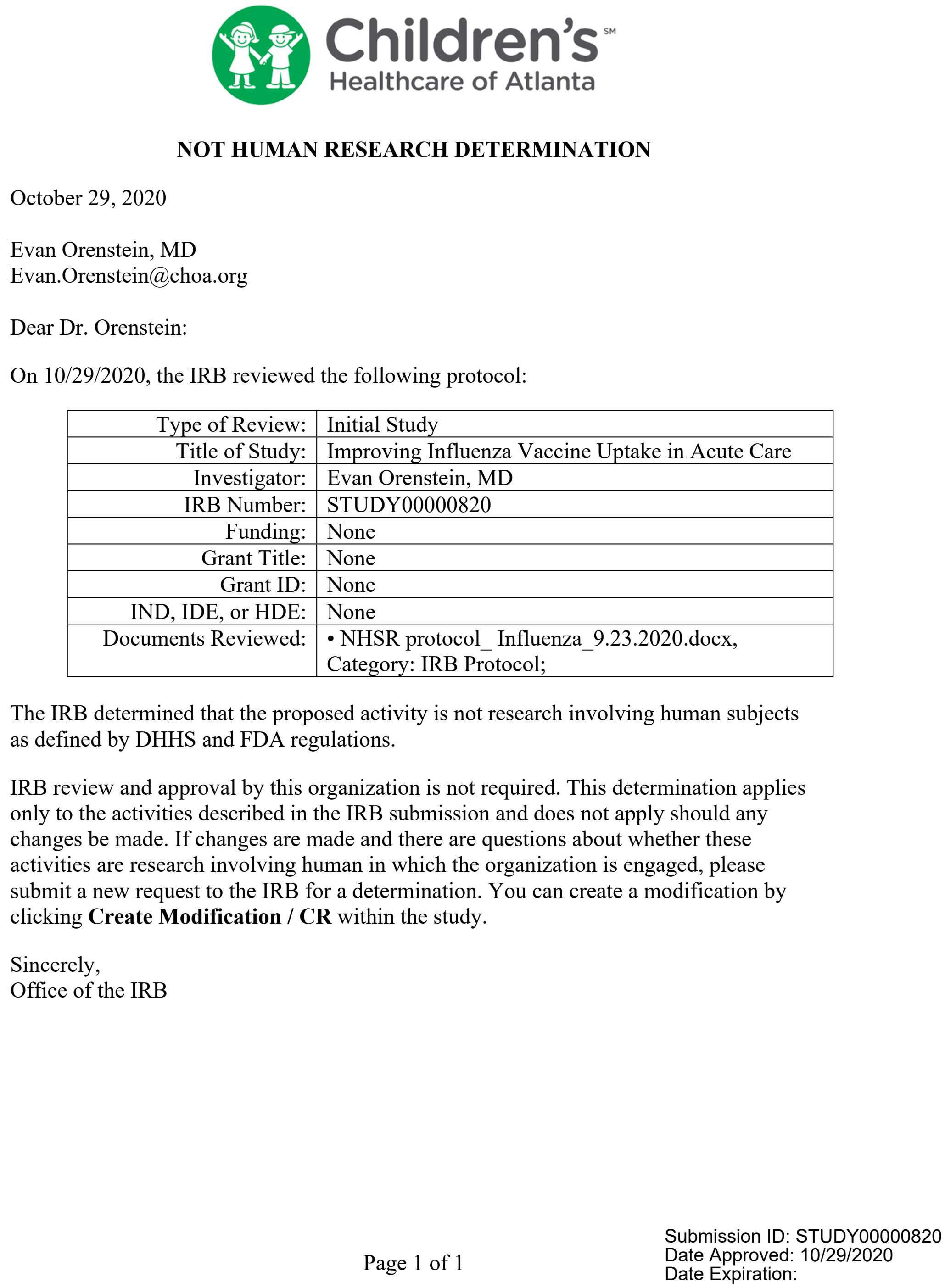
☐ The requirement for HIPAA authorization of release of protected health information is partially waived for this study.

☐ This study is open for data analysis only.

In conducting this protocol, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system.

Sincerely,
Office of the IRB

Appendix D



Children's Healthcare of Atlanta

NOT HUMAN RESEARCH DETERMINATION

October 29, 2020

Evan Orenstein, MD
Evan.Orenstein@choa.org

Dear Dr. Orenstein:

On 10/29/2020, the IRB reviewed the following protocol:

Type of Review:	Initial Study
Title of Study:	Improving Influenza Vaccine Uptake in Acute Care
Investigator:	Evan Orenstein, MD
IRB Number:	STUDY00000820
Funding:	None
Grant Title:	None
Grant ID:	None
IND, IDE, or HDE:	None
Documents Reviewed:	• NHSR protocol_ Influenza_9.23.2020.docx, Category: IRB Protocol;

The IRB determined that the proposed activity is not research involving human subjects as defined by DHHS and FDA regulations.

IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities are research involving human in which the organization is engaged, please submit a new request to the IRB for a determination. You can create a modification by clicking **Create Modification / CR** within the study.

Sincerely,
Office of the IRB

Page 1 of 1

Submission ID: STUDY00000820
Date Approved: 10/29/2020
Date Expiration: