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Equity and Inclusion in Pediatric Gastroenterology Telehealth: A Study of Demographic, Socioeconomic, and Digital Disparities

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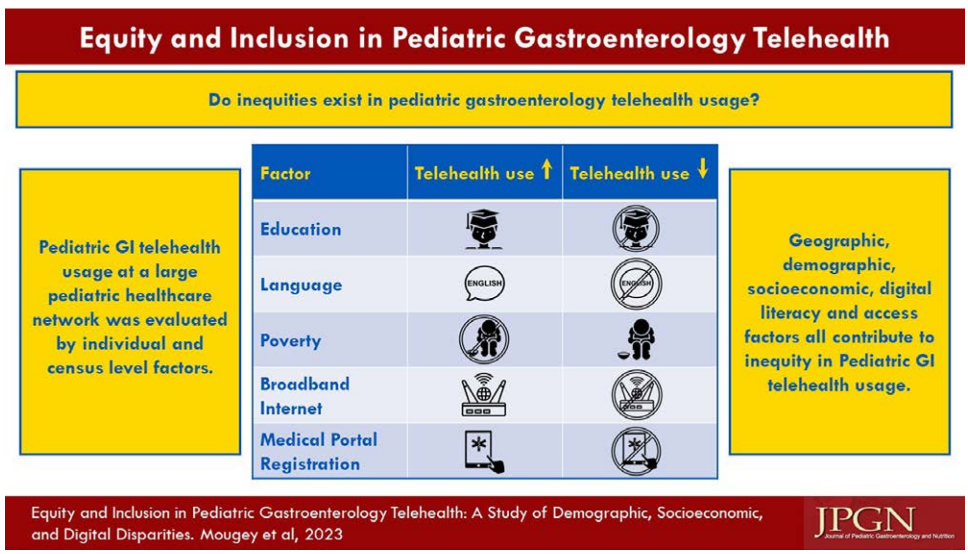

See Invited Commentary: "Telemedicine Across the Digital Divide in Pediatric Gastroenterology" by Steven D. Miller on page 315.

ABSTRACT

Objectives: The purpose of our study is to compare in-person and telehealth pediatric care ambulatory visits for gastroenterology (GI) at the Nemours Children's Health System in the Delaware Valley (NCH-DV) based on geospatial, demographic, socioeconomic, and digital disparities.

Methods: Characteristics of 26,565 patient encounters from January 2019 to December 2020 were analyzed. U.S. Census Bureau geographic identifiers were assigned to each participant and aligned with the American Community Survey (2015–2019) socioeconomic and digital outcomes. Reported odds ratios (OR) are telehealth encounter/in-person encounter.

Results: GI telehealth usage increased 145-fold in 2020 compared to 2019 for NCH-DV. Comparing telehealth to in-person usage in 2020 revealed that GI patients who required a language translator were 2.2-fold less likely to choose telehealth [individual level adjusted OR ($I\text{-}OR_a$) [95% confidence interval, CI], 0.45 [0.30–0.66], $P < 0.001$]. Individuals of Hispanic ethnicity or non-Hispanic Black or African American race are 1.3–1.4-fold less likely to utilize telehealth than non-Hispanic Whites ($I\text{-}OR_a$ [95% CI], 0.73 [0.59–

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0.89], $P = 0.002$ and 0.76 [0.60–0.95], $P = 0.02$, respectively). Households in census block groups (BG) that are more likely to utilize telehealth: have broadband access (BG-OR = 2.51 [1.22–5.31], $P = 0.014$); are above the poverty level (BG-OR = 4.44 [2.00–10.24], $P < 0.001$); own their own home (BG-OR = 1.79 [1.25–2.60], $P = 0.002$); and have a bachelor's degree or higher (BG-OR = 6.55 [3.25–13.80], $P < 0.001$).

Conclusions: Our study is the largest reported pediatric GI telehealth experience in North America that describes racial, ethnic, socioeconomic, and digital inequities. Advocacy and research for pediatric GI focused on telehealth equity and inclusion is urgently needed.

Key Words: disparities, equity, inclusion, telehealth, telemedicine

(*JPGN* 2023;77: 319–326)

What Is Known

- Inclusion and equity in pediatric health care are key areas of concern.
- Telehealth for pediatric gastroenterology (GI) has significant potential for growth.

What Is New

- Significant disparities are identified in pediatric GI telehealth usage compared to in-person visits.
- A need for a language interpreter represents a significant barrier to equity in telehealth.
- Disparities in broadband access, poverty, and education all predict lower telehealth utilization among pediatric GI patients.

A recent position paper from the Telehealth Special Interest Group of the North American Society of Gastroenterology, Hepatology, and Nutrition states that individuals and professional organizations should support digital health equity (1). Rapid expansion of remote health care access using real-time, 2-way voice, and video communication (known as synchronous telehealth), has been essential in maintaining continuity of care for pediatric gastroenterology (GI) during the COVID-19 public health emergency (PHE). However, there are emerging concerns regarding inequity in telehealth access and delivery that have not been well characterized. Understanding these disparities represents an urgent need as remote health care delivery has entered the mainstream with institutions planning to provide long-term access to telehealth.

Access to pediatric health care is known to be influenced by demographic, insurance, language, socioeconomic, and digital factors. The digital divide is defined as the increasing inequity between those who are or are not able to access and utilize technology infrastructure, including broadband internet (2–5). Results of previous studies focusing on telehealth usage during the COVID-19 PHE are conflicting, with some studies demonstrating increased racial, socioeconomic, and regional disparities and others showing that telehealth usage may significantly reduce disparities between groups (6–10). To date, studies of pediatric GI telehealth access have been small-scale, single-institution studies focused on demographic data (11). In contrast, the current study focuses on both individual level and census block group (BG) level data from a large-scale pediatric GI network serving the Delaware Valley (DV – Delaware, Maryland, New Jersey, and Pennsylvania).

As telehealth evolves, it is critical to identify factors responsible for disparities in access and delivery. Our study aims to identify geospatial, demographic, socioeconomic, and digital factors that may determine access to remote ambulatory pediatric GI health care in the DV.

METHODS

Human Participant Research

Methods used for this retrospective cohort study were approved by the Nemours Institutional Review Board (IRB) and adhere to the revised common rule (5,12). Strengthening the Reporting of Observational Studies in Epidemiology guidelines were followed during the development of the study design and in the preparation of this report (13).

Study Setting

Nemours Children's Health System in the Delaware Valley (NCH-DV) includes a free-standing hospital, pediatric subspecialty clinics, and a network of pediatric primary care clinics. Nemours has offered telehealth in the DV since 2015 at parity reimbursement, although this service was underutilized until 2020. Interpreter services were available for both in-person and telehealth encounters, however prior to the PHE they had to be requested through a separate telephone number. Early in the PHE access to interpreter service was streamlined through integration with the electronic medical record system (EPIC, Epic Systems Corporation, Verona, WI). The Nemours telehealth platform is a version of AmWell (American Well Corporation, Boston, MA) and the preferred patient access portal prior to 2021 was the CareConnect app (MCT Technology, Inc., Diamond Bar, CA). If technical issues occurred, FaceTime (Apple Incorporated, Cupertino, CA), Skype (Skype Technologies, Microsoft, L-2165 Luxembourg), and Google Hangouts (Alphabet Inc., Mountain View, CA) were used as backup telehealth platforms.

Data Extraction

Data for this study included in-person and telehealth (but excluded telephone only) records for patient encounters conducted by NCH-DV providers (APRNs/MDs/DOs) for the period from January 1, 2019 to December 31, 2020. Encounter data for both new and returning ambulatory patients included: participant demographics and characteristics (age, gender, race, ethnicity, primary language, use of interpreter service, insurance, and address); and encounter characteristics (in-person vs telehealth encounter, computer vs smart phone). Participant encounters were partitioned into 4 primary cohorts by year (2019 vs 2020) and visit type (in-person vs remote). Initially, we analyzed encounter volume data for both 2019 and 2020 to determine how volume changed between the years, however due to the low numbers of telehealth encounters that occurred in 2019, we subsequently chose to focus the remainder of our analysis on data for 2020. All extracted protected health information (PHI) data was stored in a password protected database (PostgreSQL 13.5, PostgreSQL Global Development Group) and access was restricted to IRB authorized study personnel.

Census BG Level Analysis

U.S. Census Bureau (Washington, DC) geographic identifiers (GEOIDs) were assigned to each participant by obtaining the geospatial coordinates for their address and reverse geocoding the coordinates as previously described (14). Census BGs are stable geographic units of a census tract (CT; ≤9 BG per CT) containing 600–3000 people and are the smallest geographical unit for which data is provided (15). To obtain BG level data for socioeconomic proxies (race, education, employment status, income, home ownership, vehicle ownership, broadband internet access, etc.), average aggregate data for 2015–2019 was downloaded from the U.S. Census Bureau's American Community Survey 5 (ACS5) (16,17).

CT Level Analysis

We used the community deprivation index (CDI) (14) and Rural-Urban Commuting Area (RUCA) codes (18) in our logistic regression models as CT level proxies of socioeconomic status and rural versus urban residence setting, respectively. The CDI is based on 6 different variables from the 2018 ACS (fraction of households with an income below the poverty level, with at least a high school education, with no health insurance coverage, receiving public assistance, the fraction of houses that are vacant, and the median household income). RUCA codes classify U.S. CTs using measures of population density, urbanization, and daily commuting. Assignment of RUCA codes to participants at the CT level was accomplished through GEOIDs and the 2010 RUCA Codes (revised July 3, 2019) (18).

Heatmaps

Heatmaps were rendered by overlaying terrain (map tiles by Stamen Design, under CC BY 3.0. Data by OpenStreetMap, under ODbL), position label, heatmap, multipolygon, and legend layers as previously described (19–21). The scale for heatmap legends is determined by the range of participant residence numbers per 2.6 km^2 (1.0 mi^2).

Statistical Analysis

Analyses were conducted in R base v4.1.2 (2021, R Foundation for Statistical Computing, Vienna, Austria) (22). The study cohorts were described using frequency, means, and median values. Unadjusted and adjusted odds ratios (OR and OR_a) with 95% confidence intervals (95% CI) were determined using multivariate logistic regression modeling. Confounding variables of age, race, ethnicity, insurance type, and requirement for interpreter were used to calculate OR_a where appropriate. Forest plots were made using function *forestplot* from package *forestplot* (23). Geospatial statistical analysis was used to determine if the distribution of participant residences were different between cohorts. Geographic regions with the highest participant density were selected (DV Counties: Cecil, Chester, Delaware, Montgomery, Philadelphia, New Castle, Salem, Gloucester, and Camden) and the mean $k = 1$ nearest neighbor distance (aNND) was determined (24,25). The mean nearest neighbor index (aNNI) is the ratio between the actual and theoretical aNND of a randomly distributed population of equal number within the same geographic area (average of 1000 iterations). An aNNI < 1.0 suggests that the points are more closely clustered than predicted for a random distribution. Binary logistic regression modeling was used to assess associations between census BG level factors as a proxy for characteristics of individuals who live within a BG. OR is interpreted as the likelihood of choosing a telehealth encounter by an individual living within the BG as the fraction of households meeting the independent variable criteria approaches 100%, relative to BGs where the variable approaches 0%.

RESULTS

Nemours Health System GI providers in the DV recorded 26,565 encounters from 2019 to 2020, all of which are included in this analysis. During the COVID-19 PHE the number of distinct patients who utilized telehealth for pediatric GI increased 145-fold compared to 2019. Qualitatively, the increase in telehealth utilization was driven by patients from all regions of the service area, roughly in proportion to the densities seen for in-person encounters in 2019 (Fig. 1A vs Fig. 1D). While in-person encounters fell by 29.5% in 2020, the increase in telehealth utilization limited the decrease in the total number of 2020 GI encounters to only 3.5%, relative to 2019 levels (Table 1). The loss in total GI encounters for 2020 occurred exclusively among new patients (a decrease of 20% relative to 2019 levels), while encounters from existing patients increased by 0.85%. Quantitatively, a comparison of the cumulative distribution of aNND between 2019 in-person encounters and 2020 telehealth encounters did not demonstrate any statistically significant difference in patient clustering within the 9-county area immediately surrounding the Nemours Children's Hospital in Wilmington, DE (Fig. 1, purple boundary). This suggests that, at this level, both groups have a similar geographic distribution (data not shown).

Individual-Level Analysis

Due to the low number of telehealth encounters that occurred during 2019, the remainder of the analysis will focus on data for 2020. Odds ratios for the association of individual level factors with choice of, or access to GI telehealth in 2020 are given in Table 2. The strongest predictor of low telehealth utilization was an inability to speak English. Individuals who required a translator were 2.2-fold less likely to choose telehealth relative to English speaking individuals ($I\text{-}OR_a$ [95% CI], 0.45 [0.30–0.66], $P < 0.001$). Individuals of Hispanic ethnicity or non-Hispanic Black race were 1.3–1.4-fold less likely to utilize telehealth than non-Hispanic Whites ($I\text{-}OR_a$ [95% CI], 0.73 [0.59–0.89], $P = 0.002$ and 0.76 [0.60–0.95], $P = 0.02$), respectively. Interestingly, relative to patients who were 12–17 years old, patients who were ≥18 years old and did not require parental participation favored telehealth encounters 1.8-fold over in-person encounters ($I\text{-}OR_a$ [95% CI], 1.80 [1.37–2.37], $P < 0.001$). Patients who relied on Medicaid as a payor were less likely to utilize telehealth than individuals with commercial payors ($I\text{-}OR_a$ [95% CI], 0.89 [0.77–1.03], $P = 0.117$).

While not required for telehealth visits, patients with an active Nemours patient portal registration were 1.5-fold more likely to utilize telehealth ($I\text{-}OR_a$ [95% CI], 1.51 [1.32–1.73], $P < 0.001$). The percent of patients with an active portal registration in 2020 differed significantly between racial groups (54.9% for non-Hispanic Whites vs 45.1% for non-Hispanic Blacks, I-OR [95% CI] = 0.68 [0.59–0.78], $P < 0.001$) and between ethnicities (54.9% for non-Hispanic Whites vs 42.2% for Hispanics, I-OR [95% CI] = 0.60 [0.52–0.69], $P < 0.001$). Regarding proximity to provider, as the radius from provider exceeds 60 miles, the odds of telehealth utilization trended upwards ($I\text{-}OR_a$ [95% CI], 1.22 [0.92–1.61], $P = 0.153$). A drive time of >60 minutes from the hospital increased the odds of a telehealth encounter by over 1.5-fold ($I\text{-}OR_a$ [95% CI], 1.56 [1.19–2.02], $P = 0.001$). Of the 1762 telehealth patients in 2020 for which the encounter method was recorded (75.9% of the total patients), almost three-quarters of them used smartphones (70.4%) relative to 29.6% who used desktop or laptop computers.

BG-Level Analysis

Odds ratios for the association of census BG-level factors with choice of or access to telehealth encounters in 2020 are given in Figure 2. Among the BG proxies examined, the strongest predictor of telehealth utilization is the highest level of education in the household. Telehealth utilization is predicted to increase

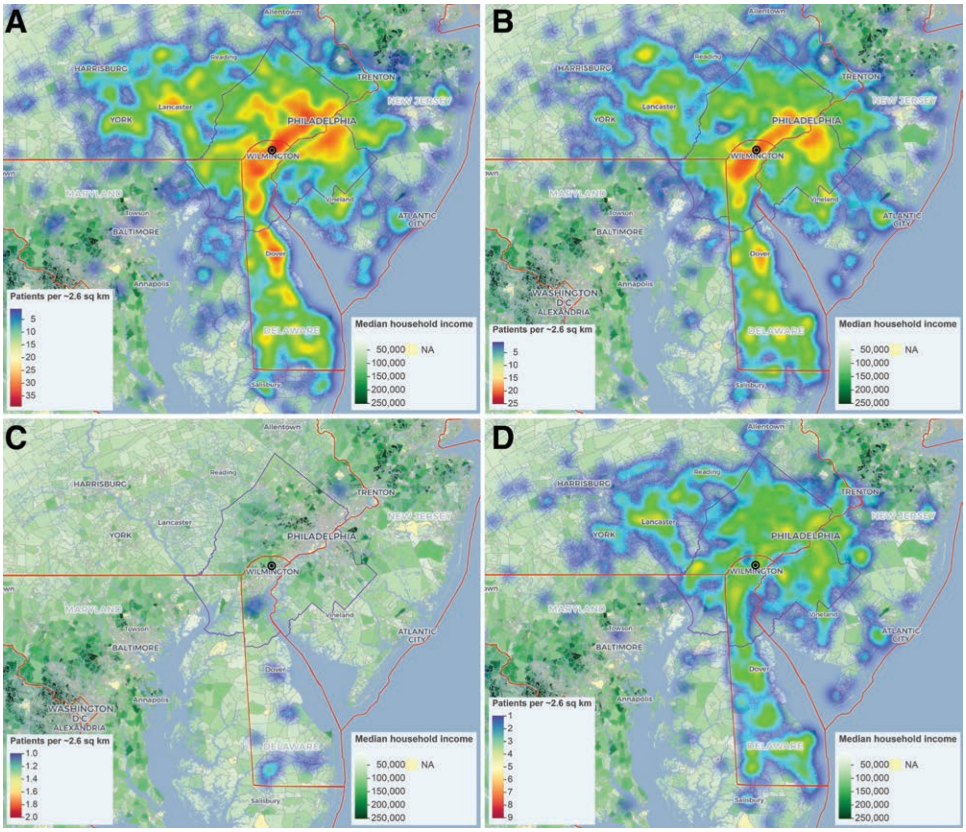

FIGURE 1. Heat maps of Nemours GI patient residence densities in the DV. (A) In-person 2019. (B) In-person 2020. (C) Telehealth 2019. (D) Telehealth 2020. DV = Delaware Valley; GI = gastroenterology.

almost 20-fold for individuals living in BGs in which the percentage of households with professional degree holders approaches 100% (BG-OR [95% CI], 19.58 [2.61–139.18], $P = 0.003$). The trend steps downward from a professional degree to a bachelor's degree (BG-OR [95% CI], 6.55 [3.25–13.18], $P < 0.001$), a high school degree (BG-OR [95% CI], 0.37 [0.19–0.72], $P = 0.003$), and to less than a high school degree, which are >6-fold less likely to use telehealth (BG-OR [95% CI], 0.15 [0.055–0.37], $P < 0.001$).

Regarding race and ethnicity, individuals living in BGs in which the percentage of non-Hispanic Asian households approaches 100% have a 9.5-fold greater odds of utilizing telehealth (BG-OR [95% CI], 9.46 [2.59–33.6], $P < 0.001$). Individuals living in BGs in which non-Hispanic Black households approaches 100% are 2-fold less likely to utilize telehealth (BG-OR [95% CI], 0.52 [0.34–0.77], $P = 0.002$), and individuals living in BGs where the percentage of Hispanic households approaches 100% are 4-fold less likely to utilize telehealth (BG-OR [95% CI], 0.23 [0.11–0.47], $P < 0.001$). Individuals living in BGs in which the percentage of Spanish speaking-only households approaches 100% are almost 8-fold less likely to utilize telehealth (BG-OR [95% CI], 0.13 [0.038-0.423], $P < 0.001$).

Two key socioeconomic indicators, income below the poverty level for the previous 12 months and households that rent their home, also predict telehealth utilization. Individuals living in BGs in which the percentage of households below the poverty level approaches 100%, are 8-fold less likely to utilize telehealth (BG-OR [95% CI], 0.13 [0.03–0.46], $P = 0.002$). Individuals living in BGs in which the percentage of renters approaches 100%, are 1.8-fold less likely to utilize telehealth (BG-OR [95% CI], 0.56 [0.39–0.80], $P = 0.002$). As expected, as the percentage of households within the BG that have access to broadband data services approaches 100%, the odds of choosing telehealth increases by >2.5-fold (BG-OR [95% CI], 2.51 [1.22–2.60], $P = 0.002$). Individuals living in BGs in which the percentage of households without internet access approaches 100% are almost 4-fold less likely to use telehealth (BG-OR [95% CI], 0.26 [0.07–0.86], $P = 0.031$).

Census Track-Level Analysis

The CT level CDI predicts that the odds of telehealth utilization will decrease by 5.5-fold as the CDI approaches 1 (greater deprivation), relative to CTs in which the CDI approaches 0 (CT-OR [95% CI], 0.18 [0.12–0.28], $P < 0.001$).

Finally, we reasoned that whether an individual lives in a rural versus an urban area may also play a role in determining choice of or access to telehealth for their health care needs. Families living in CTs classified as micropolitan (roughly corresponding to the suburbs), or small towns are 2.0-fold and 2.7-fold less likely to utilize telehealth, respectively, than individuals living in metropolitan CTs (CT-OR_a [95% CI], 0.50 [0.31–0.77], $P = 0.002$ and 0.36 [0.12–0.88], $P = 0.04$, respectively).

DISCUSSION

With the rapid implementation of telehealth during the COVID-19 PHE, patients and families could access their health care providers via web and mobile-based visits. The present study is the first to describe significant telehealth disparities with patient and census level data focused on pediatric GI patients and families.

TABLE 1. Individual level characteristics of the NCH-DV GI cohorts

	2019		2020	
	In-person 2019	Telehealth 2019	In-person 2020	Telehealth 2020
Number of patients				
Number of distinct new patients	4847 (54.8%)	0 (0%)	3331 (53.4%)	544 (23.4%)
Number of distinct established patients	5424 (61.3%)	16 (100%)	3643 (58.4%)	1843 (79.4%)
Total number of distinct patients*	8852 (100%)	16 (100%)	6241 (100%)	2320 (100%)
Gender				
Female	4314 (48.7%)	9 (56.3%)	3155 (50.6%)	1161 (50%)
Age group				
<1 y	933 (10.5%)	0 (0%)	790 (12.7%)	247 (10.6%)
1–4 y	1732 (19.6%)	1 (6.3%)	1161 (18.6%)	465 (20%)
5–11 y	2871 (32.4%)	4 (25%)	1865 (29.9%)	673 (29%)
12–17 y	3018 (34.1%)	8 (50%)	2157 (34.6%)	735 (31.7%)
≥18 y	369 (4.2%)	3 (18.8%)	310 (5%)	204 (8.8%)
Race/ethnicity				
Non-Hispanic White	5890 (66.5%)	11 (68.8%)	4000 (64.1%)	1669 (71.9%)
Non-Hispanic Black	1032 (11.7%)	1 (6.3%)	760 (12.2%)	226 (9.7%)
Hispanic	1116 (12.6%)	4 (25%)	866 (13.9%)	211 (9.1%)
Other	657 (7.4%)	0 (0%)	487 (7.8%)	168 (7.2%)
Unknown	157 (1.8%)	0 (0%)	128 (2.1%)	46 (2%)
Payor				
Medicaid	2889 (32.6%)	8 (50%)	2221 (35.6%)	698 (30.1%)
Primary language spoken				
ESL (Spanish primary language)	431 (4.9%)	3 (18.8%)	354 (5.7%)	33 (1.4%)
Interpreter service				
Interpreter service needed	466 (5.3%)	3 (18.8%)	373 (6%)	48 (2.1%)
Telehealth connection				
Mobile	1590 (18%)	4 (25%)	1308 (21%)	1240 (53.4%)
Web	616 (7%)	0 (0%)	476 (7.6%)	522 (22.5%)
RUCA				
Metropolitan	6221 (70.3%)	7 (43.8%)	4381 (70.2%)	1648 (71%)
Micropolitan	240 (2.7%)	3 (18.8%)	177 (2.8%)	47 (2%)
Small town	98 (1.1%)	1 (6.3%)	80 (1.3%)	15 (0.6%)
Rural area	15 (0.2%)	0 (0%)	6 (0.1%)	1 (0%)
Portal registration†				
Active	6415 (46.7%)	10 (0.073%)	4009 (36.6%)	1670 (15.1%)

EMR data is expressed as count (% of total). Not all categories sum to 100% due to missing data and the use of "Total Number of Distinct Patients" as denominator. DV = Delaware Valley; ESL = English as a second language; GI = gastroenterology; NCH = Nemours Children's Health; RUCA = rural-urban commuting area. *Number of distinct patients is generally less than the sum of new patients and established patients since one patient could be both during a given period. †Distinct encounters that occurred when the patient's portal registration was active.

Patient level demographics demonstrated significant inequity and telehealth exclusion for Hispanics, Black people, Medicaid recipients, and those with English as a second language (ESL). Hurdles to accessibility of telehealth for ESL patients has been a consistent finding, and steps need to be taken to address these disparities (26). During 2020, there were 2 different workflows available for DV patients who required interpreter services: (1) Use a separate status cart from the device used to connect with the patient or (2) Use the "invite guest" feature within CareConnect to invite an interpreter via email from a 3rd party vendor. Since these solutions were not directly integrated into the telehealth platform providers reported prolonged wait times, resulting in a frustrating and difficult experience for the patient (per personal communications). In addition, there was no way to select the appropriate language upfront. The system would default to Spanish and if another language was needed, then additional triage was required to connect with a specific language interpreter.

On July 29, 2021, Nemours switched its telehealth platform to an EPIC-integrated solution. This allows the provider to request that an interpreter join the video visit by selecting the specific language required up-front. Once the invitation is initiated, a medically qualified interpreter will join the visit in 30 seconds or less, establishing a 3-way video call between the provider, the patient, and the interpreter. All video visits are fully encrypted and Health Insurance Portability

TABLE 2. Results of binary logistic regression modeling of the association between individual level factors and choice of or access to telehealth for NCH-DV GI encounters in 2020

	I-OR [95% CI], *P*	I-OR$_a$ [95% CI], *P*
	Telehealth 2020 vs In-Person 2020	Telehealth 2020 vs In-Person 2020
Gender		
Female vs male	0.95 [0.872–1.036], 0.249	0.883 [0.772–1.008], 0.066
Age group		
<1 y vs 12–17 y	0.892 [0.768–1.035], 0.135	0.81 [0.645–1.012], 0.066
1–4 y vs 12–17 y	1.104 [0.976–1.248], 0.116	0.996 [0.824–1.202], 0.966
5–11 y vs 12–17 y	1.035 [0.927–1.157], 0.54	1.006 [0.847–1.196], 0.942
≥18 y vs 12–17 y	1.796 [1.508–2.135], <0.001	1.804 [1.37–2.367], <0.001
Race/ethnicity		
Non-Hispanic Black vs Non-Hispanic White	0.713 [0.619–0.82], <0.001	0.726 [0.592–0.887], 0.002
Hispanic vs Non-Hispanic White	0.572 [0.493–0.661], <0.001	0.758 [0.598–0.954], 0.02
Payor		
Medicaid vs commercial	0.722 [0.645–0.808], <0.001	0.891 [0.772–1.029], 0.117
Primary language spoken		
Spanish vs English	0.232 [0.164–0.317], <0.001	ND*
Interpreter service		
Interpreter service needed vs Not needed	0.314 [0.235–0.412], <0.001	0.45 [0.303–0.655], <0.001
Telehealth connection		
Mobile vs Web	0.632 [0.181–1.716], 0.411	ND†
RUCA (census tract level)		
Micropolitan vs Metropolitan	0.632 [0.457–0.855], 0.004	0.495 [0.311–0.766], 0.002
Small town vs Metropolitan	0.456 [0.211–0.875], 0.029	0.364 [0.122–0.875], 0.04
Portal registration		
Active vs Inactive	1.658 [1.519–1.81], <0.001	1.514 [1.324–1.732], <0.001
Proximity to provider		
Radius from provider, >60 miles vs ≤60 miles	0.982 [0.841–1.144], 0.822	1.224 [0.924–1.61], 0.153
Drive time to hospital‡, >60 min vs ≤60 min	1.417 [1.234–1.625], <0.001	1.557 [1.193–2.023], 0.001

CI = confidence interval; DV = Delaware Valley; GI = gastroenterology; I-OR$_a$ = individual level adjusted odds ratio; NCH = Nemours Children's Health; min = minutes; ND = not determined; RUCA = rural-urban commuting area; vs = versus. *Not determined as Spanish language was largely colinear with and a subset of interpreter service needed. †Analysis did not converge due to incomplete data for device type. ‡Analysis was conducted for encounters that occurred at the NCH-DV only.

and Accountability Act (HIPAA) compliant. It is expected that once the capabilities of the new system have disseminated throughout the region, that much of the disincentive for non-English speaking patients to participate in telehealth encounters will disappear.

In addition, the patient portal, a common method by which patients access telemedicine, may be another barrier limiting this patient population. Prior to August 2021, Nemours telehealth services could be accessed through VIDYO or CareConnect portals. However, these portals only support English, a situation common to many health care providers (27,28). The ability to send a direct visit link via text or email is also supported, allowing patients to access their remote visit without portal registration. Yet, studies have shown that similar racial disparities still exist when access to patient portals is equitable among races. In a previous study, White patients accessed the portal more frequently than non-Hispanic Black and Hispanic patients (29). Spanish-speaking patients have reported being less aware of portal use and having more difficulty in navigating the portal (30). Our data shows that for Nemours, an active portal registration associates with 1.5-fold increased odds of choosing a telehealth encounter (Table 2), suggesting that increasing language support in these tools could help to mitigate language-based disparities.

The digital divide has 4 components including: infrastructure (ie, broadband speed/coverage/smartphone ownership), inclusivity (ie, affordability/equity and usage of broadband), institutions (broadband strategy/public services/monopolies), and digital proficiency (ability to effectively utilize available services) (2). Census BG data provides insights into telehealth's digital inequities and evidence of the digital divide in pediatric GI telehealth. Our present study supports that households are more likely to utilize telehealth if they live in census BGs with high levels of: (1) broadband access (BG-OR = 2.51, $P = 0.014$; infrastructure); (2) families above the poverty level (BG-OR = 4.44, $P < 0.001$; inclusivity) and home ownership (BG-OR = 1.79, $P = 0.002$; inclusivity); and (3) families with a bachelor's degree or higher (BG-OR = 6.54, $P < 0.001$; digital proficiency).

Families overwhelmingly used mobile smartphone devices to access telehealth, which are now ubiquitous for most families in the United States. Future telehealth platform improvements are focused primarily on mobile smartphone applications and reducing the required bandwidth. Several solutions for increased broadband access include a tax on internet advertisement or "Romer" tax (https://www.nytimes.

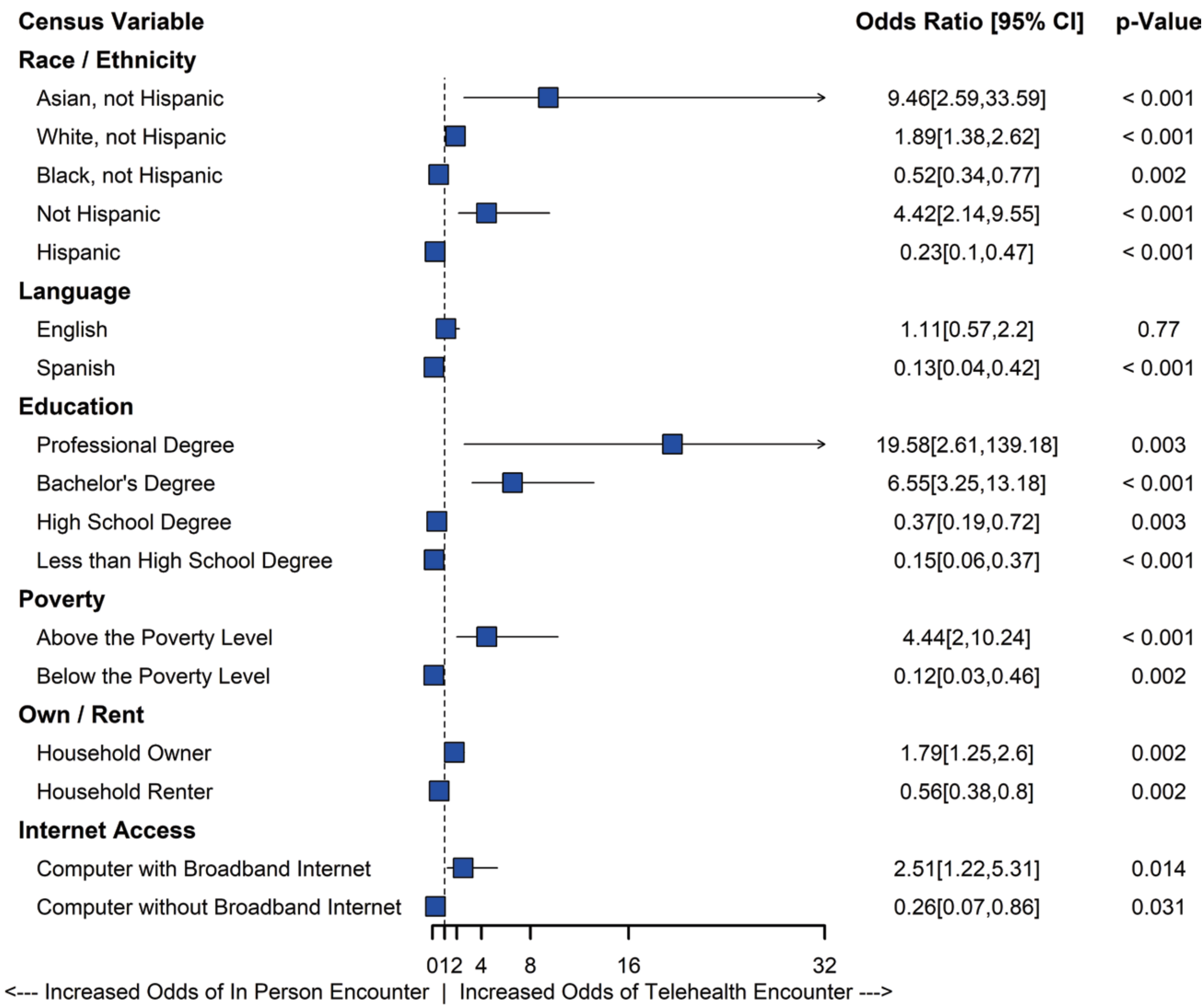

FIGURE 2. Forest plot of the association between census BG level factors and choice of or access to telehealth encounters for NCH-DV GI patients. Census BG level data were extracted from the U.S. Census Bureau's American Community Survey (ACS) 5-year aggregate (2015–2019) and linked to patients through residence GEOIDs. Data is reported as odds ratio, 95% confidence intervals, and *P* value (BG-OR [95% CI]; p). BG = block group; DV = Delaware Valley; GEOIDs = geographic identifiers; GI = gastroenterology; NCH = Nemours Children's Health.

com/2019/05/06/opinion/tax-facebook-google.html), and partnership with internet providers to address disparities. Institutional solutions to address digital disparities have begun to be implemented at every level of government. As an example, Hillsboro, Oregon has developed a Gibit Passive Optical Network with a 28-million-dollar investment in broadband internet called Fiber-to-the-Home (FTTH). Further, making the internet accessible through community kiosks or mobile telehealth vans may help to expand access (2). A recent US Congressional Bill, H.R. 1397, entitled, "Telehealth Improvement for Kids' Essential Services Act or TIKES Act" has proposed legislation to overcome existing barriers to telehealth delivery for children (31).

Digital literacy can also be improved with language-appropriate telehealth pre-visit planning and patient-family-focused education. Deploying an electronic medical records (EMR) app that includes telehealth visit technology and access to patient portal features like scheduling appointments, results review, chronic condition trackers, etc. Medical assistants can then virtually connect with the patient for a pre-visit workflow utilizing texting, email, video, and educational tools in multiple languages to ensure families are prepared before their visit. In addition, lower bandwidth software is being developed that seamlessly integrates an interpreter service vendor within the EMR.

Unexpectedly, the aNND analysis suggests that the patient residence distribution associated with in-person visits was no different than telehealth visits in the 9-county area surrounding the hospital. However, the DV area analyzed contains only a small percentage of CTs classified as rural.

The results of our study should be viewed in the context of several potential limitations. Although many analyses were performed at patient level data, census BG data represents a proxy derived from a larger population and may not accurately reflect the individual family. In addition, our study was conducted within a single large health care system in the North-Eastern United States and many not be generalizable to other health care providers.

CONCLUSIONS

In conclusion, our study is the largest reported pediatric GI telehealth experience that describes racial and/or ethnic, socioeconomic, and digital inequities. Future advocacy and research, specifically for pediatric GI patients and families, are needed to study telehealth equity and inclusion and ultimately eliminate telehealth access disparities for all children.

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REFERENCES

1. Franciosi JP, Berg EA, Rosen JA, et al. North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition position statement for telehealth. *J Pediatr Gastroenterol Nutr* 2023;76:684–94.
2. Chakravorti B. How to close the digital divide in the U.S. *Harv Bus Rev* 2021. https://hbr.org/2021/07/how-to-close-the-digital-divide-in-the-u-s.
3. Flores G; Committee On Pediatric Research. Technical report—racial and ethnic disparities in the health and health care of children. *Pediatrics* 2010;125:e979–e1020.
4. Lazar M, Davenport L. Barriers to health care access for low income families: a review of literature. *J Community Health Nurs* 2018;35:28–37.
5. Silberholz EA, Brodie N, Spector ND, Pattishall AE. Disparities in access to care in marginalized populations. *Curr Opin Pediatr* 2017;29:718–27.
6. Chunara R, Zhao Y, Chen J, et al. Telemedicine and healthcare disparities: a cohort study in a large healthcare system in New York City during COVID-19. *J Am Med Inform Assoc* 2021;28:33–41.
7. Doraiswamy S, Abraham A, Mamtani R, Cheema S. Use of telehealth during the COVID-19 pandemic: scoping review. *J Med Internet Res* 2020;22:e24087.
8. Jaffe DH, Lee L, Huynh S, Haskell TP. Health inequalities in the use of telehealth in the United States in the lens of COVID-19. *Popul Health Manag* 2020;23:368–77.
9. Kontos E, Blake KD, Chou WY, Prestin A. Predictors of eHealth usage: insights on the digital divide from the Health Information National Trends Survey 2012. *J Med Internet Res* 2014;16:e172.
10. Ye S, Kronish I, Fleck E, et al. Telemedicine expansion during the COVID-19 pandemic and the potential for technology-driven disparities. *J Gen Intern Med* 2021;36:256–8.
11. Puthenpura V, Du N, Hauptman L, Porto AF. Disparities in telehealth utilization within pediatric gastroenterology: one academic center's experience. *J Pediatr Gastroenterol Nutr* 2021;73:217–22.
12. Federal Policy for the Protection of Human Subjects. In: United States Federal Government, ed. *Federal Register: United States Federal Government*. 2017;82(12):7149–274.
13. Vandenbroucke JP, von Elm E, Altman DG, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. *PLoS Med* 2007;4:e297.
14. Brokamp C, Wolfe C, Lingren T, Harley J, Ryan P. Decentralized and reproducible geocoding and characterization of community and environmental exposures for multisite studies. *J Am Med Inform Assoc* 2018;25:309–14.
15. Census block-groups. Available at: https://www2.census.gov/geo/pdfs/reference/geodiagram.pdf. Updated November 2020. Accessed March 9, 2023.
16. American Community Survey 5-year Public Use Data (2015-2019), United States. Census Bureau; 2020.
17. Walker K, Herman M. tidycensus: Load US Census Boundary and Attribute Data as 'tidyverse' and 'sf'-Ready Data Frames. R package version 1.1. https://walker-data.com/tidycensus/. 2021.
18. Rural-Urban Commuting Area Codes. Available at: https://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes/. Updated August 17, 2020. Accessed March 9, 2023.
19. Cheng J, Karambelkar B, Xie Y. leaflet: Create Interactive Web Maps with the JavaScript 'Leaflet' Library. R package version 2.0.3.9000. http://rstudio.github.io/leaflet/. 2021.
20. Karambelkar B, Schloerke B. leaflet.extras: Extra Functionality for 'leaflet' Package. R package version 1.0.0. https://github.com/bhaskarvk/leaflet.extras, https://bhaskarvk.github.io/leaflet.extras/. 2021.
21. Walker K. tigris: Load Census TIGER/Line Shapefiles. R package version 1.5. https://CRAN.R-project.org/package=tigris. 2021.
22. R Core Team. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing; 2020. https://www.R-project.org/.
23. Gordon M, Lumley T. forestplot: Advanced Forest Plot Using 'grid' Graphics. R package version 1.10. https://CRAN.R-project.org/package=forestplot. 2020.
24. Baddeley A, Rubak E, Turner R. *Spatial Point Patterns: Methodology and Applications with R*. London: Chapman and Hall/CRC Press; 2015.
25. Massey FJ, Jr. The Kolmogorov-Smirnov test for goodness of fit. *J Am Stat Assoc* 1951;46:68–78.
26. Hsueh L, Huang J, Millman AK, et al. Disparities in use of video telemedicine among patients with limited English proficiency during the COVID-19 pandemic. *JAMA Netw Open* 2021;4:e2133129.
27. Ochoa A, 3rd, Kitayama K, Uijtdehaage S, et al. Patient and provider perspectives on the potential value and use of a bilingual online patient portal in a Spanish-speaking safety-net population. *J Am Med Inform Assoc* 2017;24:1160–4.
28. Singhal S. Making patient care bilingual: improving equitable access to patient care through Spanish MyChart Patient Portal. *Acad Med* 2022;97(6):778.
29. Clarke MA, Lyden ER, Ma J, et al. Sociodemographic differences and factors affecting patient portal utilization. *J Racial Ethn Health Disparities* 2021;8:879–91.
30. Localio AM, Klusaritz H, Morales KH, et al. Primary language and the electronic health record patient portal: barriers to use among Spanish-speaking adults with asthma. *J Asthma* 2021;1:10.
31. Blunt Rochester L. Telehealth Improvement for Kids' Essential Services Act (TIKES Act). H.R.1397 — 117th United States Congress (2021-2022).