

Differences in Child Opportunity Index for pediatric patients who travel for subspecialty colorectal care: A Pediatric Colorectal and Pelvic Learning Consortium (PCPLC) Study

Kate McNevin

University of Washington

Paul McClure

Paul.McClure@SeattleChildrens.org

University of Washington

Kelly Austin

University of Pittsburgh

Jeffrey R Avansino

University of Washington

Samuel E Rice-Townsend

University of Washington

Andrea Badillo

Children's National Hospital, George Washington University

Casey M Calkins

Children's Wisconsin, Medical College of Wisconsin

Rachel C Crady

University of Utah

David Darcy

University of Rochester Medical Center

Belinda H Dickie

Harvard University

Megan M Durham

Emory University

Julia E Grabowski

Ann & Robert H. Lurie Children's Hospital of Chicago, Northwestern University

Jamie C Harris

University of Arizona

Ankur Rana

University of Texas Austin

Ron W Reeder

University of Utah

Rebecca M Rentea

University of Missouri-Kansas City

Michael D Rollins

University of Utah

Payam Saadai

UC Davis Children's Hospital, University of California Davis

Hira Ahmad

University of California Irvine School of Medicine

K. Elizabeth Speck

University of Michigan

Cristine S Velazco

Orlando Health Arnold Palmer Hospital for Children, Florida State University College of Medicine

Richard J Wood

Nationwide Children's Hospital, The Ohio State University

Caitlin A Smith

University of Washington

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Abstract

Purpose

The Child Opportunity Index (COI) measures the quality of resources available to a child based on their neighborhood. Children with congenital colorectal conditions are often managed at a limited number of specialty centers, and many families travel substantial distances for care. We compared the COI of patients who traveled with those who did not.

Methods

This retrospective cohort study evaluated patients enrolled in the Pediatric Colorectal and Pelvic Learning Consortium (PCPLC) registry with a valid ZIP code, which was used to determine COI. Travel was defined as living at least 50 miles (straight-line distance) from the PCPLC center where care was received. Groups were compared using Fisher's exact test and the Cochran-Armitage trend test.

Results

Of 6258 included patients, 3804 (60.8%) did not travel and 2454 (39.2%) traveled. Patients who traveled were more likely to be from low-COI (21.7% vs 15.8%), moderate-COI (26.9% vs 20.7%), and rural (38.3% vs 9.8%) neighborhoods, whereas those who did not travel were more likely to be from very high-COI neighborhoods (28.2% vs 18.3%) (all $p < 0.001$).

Conclusion

Patients who traveled for specialty colorectal care more often resided in low- or moderate-COI and rural neighborhoods. Screening for resource support is essential to avoid healthcare disparities across communities.

Introduction

Social determinants of health, including socioeconomic status, educational opportunities, and neighborhood conditions, significantly influence health outcomes for pediatric surgical patients in the United States [1–4]. These factors have been shown to contribute to disparities in access to care, treatment adherence, and overall health outcomes [5]. The Child Opportunity Index (COI) quantifies the quality of resources available to a child based on their neighborhood. It serves as a valuable tool for assessing community-level impact on surgical outcomes [6, 7]. By leveraging this index, researchers can better examine the relationship between social determinants and healthcare utilization.

Pediatric patients requiring specialized colorectal care may travel long distances to access treatment, which can impose an additional burden on patients and their families [8–10]. Travel-related challenges, including financial strain, time away from work or school, and difficulty coordinating follow-up care, can exacerbate healthcare disparities, particularly for individuals from under-resourced communities [9, 11]. Limited access to specialty care has been associated with delayed diagnoses, increased complication rates, and poorer long-term outcomes [9]. Understanding how geographic and socioeconomic factors intersect is crucial for addressing barriers to equitable healthcare access.

The Pediatric Colorectal and Pelvic Learning Consortium (PCPLC) is a group of 25 pediatric centers with specialty and multidisciplinary experience treating pediatric patients with pelvic anomalies [12]. Member institutions contribute standardized demographic, diagnostic, and treatment data to a shared prospective registry, making the consortium uniquely positioned to examine geographic and socioeconomic patterns in access to specialized colorectal care. We hypothesized that children who travel to a specialty colorectal center are more likely to reside in communities with lower COI scores, reflecting limited resources and opportunities.

Methods

Study design

This was a retrospective cohort study using data from the PCPLC registry from January 2017 to March 2026. Specialty colorectal centers were defined as PCPLC member institutions, which provide multidisciplinary, specialized care for children with complex colorectal and pelvic conditions. Inclusion criteria were patients with valid ZIP codes who received specialty colorectal care at a PCPLC center and had completed enrollment forms. Exclusion criteria included missing enrollment forms, an invalid ZIP code, and/or a missing ZIP code.

Child Opportunity Index

The COI (version 3.0) was determined using patients' ZIP codes. The COI categorizes neighborhoods into five opportunity levels: very low, low, moderate, high, and very high. These categories reflect the quality of resources and opportunities available within a community.

Travel definition

Travel was defined as residing at least 50 miles (straight-line distance) from the PCPLC center where care was received. Distance was defined as the number of miles from the centroid of the patient's residence ZIP code to the centroid of the PCPLC center ZIP code. Patients were grouped into two cohorts: those who traveled (≥ 50 miles) and those who did not (less than 50 miles). The mode of travel was not assessed. The 50-mile threshold was specified a priori to approximate travel beyond a typical

local catchment area. Because nearly all PCPLC centers are in urban areas, we also compared the urbanicity (urban, suburban, or rural) of patients' home neighborhoods to help distinguish the effect of travel distance from that of rural residence.

Statistical analysis

Demographic data, including age, sex, COI, and urbanicity, were compared between the two cohorts using Fisher's exact test. The Cochran-Armitage trend test was used to assess the distribution of COI levels across the groups. A significance level of $p < 0.05$ was used and tests were 2-tailed. All analyses were conducted in SAS software version 9.4 (SAS Institute).

Results

Patient characteristics

A total of 6258 patients met the inclusion criteria (Fig. 1). Of these, 3804 (60.8%) did not travel for care, while 2454 (39.2%) did travel (Table 1). The median current age was 9.0 years in both groups. Those who did not travel lived a median of 15.8 miles from the medical center where they received care, with a range of 0 to 50 miles. Those who traveled lived a median of 148.6 miles from the center, with a range of 50.1 to 4520.3 miles. Demographic characteristics were compared between groups. There were no significant differences in sex ($p = 0.478$) or insurance status ($p = 0.678$). Significant differences were observed in race, ethnicity, and the need for an interpreter ($p < 0.001$ for each). In terms of race, Black or African American patients were more likely not to travel for care ($n = 505$, 13.3% compared to $n = 140$, 5.7%). Additionally, patients identifying as Hispanic or Latino were less likely to travel ($n = 773$, 20.3% vs. $n = 280$, 11.4%). Families who required an interpreter to communicate were more likely not to travel ($n = 364$, 9.6%, compared to $n = 92$, 3.8%).

Table 1
Description of Patient Cohort Demographics

	Traveled 50 Miles or More			
	No	Yes	Overall	P-value
	(N = 3804)	(N = 2454)	(N = 6258)	
Approximate distance from patient home to PCPLC site (miles)				
Median [Q1, Q3]	15.8 [8.9, 26.9]	148.6 [86.1, 350.5]	31.1 [13.2, 107.4]	
(Min, Max)	(0.0, 50.0)	(50.1, 4520.3)	(0.0, 4520.3)	
Current age (years)				
Median [Q1, Q3]	9.0 [5.0, 13.0]	9.0 [6.0, 14.0]	9.0 [6.0, 14.0]	
(Min, Max)	(0.0, 43.0)	(1.0, 46.0)	(0.0, 46.0)	
Sex: Male	2234 (58.7%)	1410 (57.5%)	3644 (58.2%)	0.478 ¹
Race				< .001 ¹
American Indian or Alaska Native	11 (0.3%)	28 (1.1%)	39 (0.6%)	
Asian	282 (7.4%)	157 (6.4%)	439 (7.0%)	
Black or African American	505 (13.3%)	140 (5.7%)	645 (10.3%)	
Native Hawaiian or Other Pacific Islander	30 (0.8%)	9 (0.4%)	39 (0.6%)	
White	2290 (60.2%)	1812 (73.8%)	4102 (65.5%)	
More than one	86 (2.3%)	32 (1.3%)	118 (1.9%)	
Unknown or Not Reported	599 (15.7%)	276 (11.2%)	875 (14.0%)	
Unknown	1 (0.0%)	0 (0.0%)	1 (0.0%)	
Ethnicity				< .001 ¹
Hispanic or Latino	773 (20.3%)	280 (11.4%)	1053 (16.8%)	
¹ Fisher's exact test.				

	Traveled 50 Miles or More			P-value
	No (N = 3804)	Yes (N = 2454)	Overall (N = 6258)	
Not Hispanic or Latino	2811 (73.9%)	2019 (82.3%)	4830 (77.2%)	
Unknown or Not Reported	220 (5.8%)	155 (6.3%)	375 (6.0%)	
Publicly subsidized insurance: Yes	2014 (52.9%)	1313 (53.5%)	3327 (53.2%)	0.678 ¹
Family needs an interpreter to communicate				< .001 ¹
No	3440 (90.4%)	2362 (96.3%)	5802 (92.7%)	
Yes, Spanish	272 (7.2%)	68 (2.8%)	340 (5.4%)	
Yes, Other language	92 (2.4%)	24 (1.0%)	116 (1.9%)	
Child Opportunity Levels, overall COI, nationally-normed				
Very Low	480 (12.6%)	251 (10.2%)	731 (11.7%)	
Low	601 (15.8%)	532 (21.7%)	1133 (18.1%)	
Moderate	787 (20.7%)	660 (26.9%)	1447 (23.1%)	
High	863 (22.7%)	560 (22.8%)	1423 (22.7%)	
Very High	1073 (28.2%)	448 (18.3%)	1521 (24.3%)	
Unknown	0 (0.0%)	3 (0.1%)	3 (0.0%)	
Urbanicity				< .001 ¹
Urban	758 (19.9%)	220 (9.0%)	978 (15.6%)	
Suburban	2646 (69.6%)	1266 (51.6%)	3912 (62.5%)	
Rural	372 (9.8%)	941 (38.3%)	1313 (21.0%)	
¹ Fisher's exact test.				

	Traveled 50 Miles or More			P-value
	No (N = 3804)	Yes (N = 2454)	Overall (N = 6258)	
Unknown	28 (0.7%)	27 (1.1%)	55 (0.9%)	
¹ Fisher's exact test.				

Table 2
Child Opportunity Index and Travel Status

	Traveled 50 Miles or More			P-value
	No (N = 3804)	Yes (N = 2454)	Overall (N = 6258)	
Child Opportunity Levels, education domain, nationally-normed				< .001 ¹
Very Low	517 (13.6%)	344 (14.0%)	861 (13.8%)	
Low	539 (14.2%)	602 (24.5%)	1141 (18.2%)	
Moderate	766 (20.1%)	610 (24.9%)	1376 (22.0%)	
High	864 (22.7%)	507 (20.7%)	1371 (21.9%)	
Very High	1118 (29.4%)	388 (15.8%)	1506 (24.1%)	
Unknown	0 (0.0%)	3 (0.1%)	3 (0.0%)	
Child Opportunity Levels, health and environment domain, nationally-normed				< .001 ¹
Very Low	602 (15.8%)	260 (10.6%)	862 (13.8%)	
Low	731 (19.2%)	422 (17.2%)	1153 (18.4%)	
Moderate	924 (24.3%)	594 (24.2%)	1518 (24.3%)	
High	784 (20.6%)	610 (24.9%)	1394 (22.3%)	
Very High	763 (20.1%)	565 (23.0%)	1328 (21.2%)	
Unknown	0 (0.0%)	3 (0.1%)	3 (0.0%)	
Child Opportunity Levels, social and economic domain, nationally-normed				< .001 ¹
Very Low	485 (12.7%)	290 (11.8%)	775 (12.4%)	
¹ Cochran-Armitage trend test.				

	Traveled 50 Miles or More			P-value
	No (N = 3804)	Yes (N = 2454)	Overall (N = 6258)	
Low	615 (16.2%)	484 (19.7%)	1099 (17.6%)	
Moderate	781 (20.5%)	618 (25.2%)	1399 (22.4%)	
High	833 (21.9%)	579 (23.6%)	1412 (22.6%)	
Very High	1090 (28.7%)	480 (19.6%)	1570 (25.1%)	
Unknown	0 (0.0%)	3 (0.1%)	3 (0.0%)	
Child Opportunity Levels, overall COI, nationally-normed				< .001 ¹
Very Low	480 (12.6%)	251 (10.2%)	731 (11.7%)	
Low	601 (15.8%)	532 (21.7%)	1133 (18.1%)	
Moderate	787 (20.7%)	660 (26.9%)	1447 (23.1%)	
High	863 (22.7%)	560 (22.8%)	1423 (22.7%)	
Very High	1073 (28.2%)	448 (18.3%)	1521 (24.3%)	
Unknown	0 (0.0%)	3 (0.1%)	3 (0.0%)	
¹ Cochran-Armitage trend test.				

COI distribution

The overall COI was assessed alongside each domain, including education, health and environment, and social and economic (Table 2).

When evaluating the overall COI, patients who did not travel were more likely to reside at the extremes of COI (Very Low and Very High), a statistically significant difference ($p < 0.001$). A total of 480 (12.6%) patients from Very Low COI neighborhoods did not travel, and 251 (10.2%) did. In Very High COI neighborhoods, 1073 (28.2%) patients did not travel, compared with 448 (18.3%) who did. Patients who

traveled were more likely to reside in Low- and Moderate-COI neighborhoods (Low: n = 532 (21.7%), Moderate: n = 660 (26.9%)).

Urbanicity also differed significantly between the two groups. Among patients who did not travel, 19.9% lived in urban, 69.6% in suburban, and 9.8% in rural neighborhoods, whereas among patients who traveled, 9.0% lived in urban, 51.6% in suburban, and 38.3% in rural neighborhoods ($p < 0.001$). Patients who traveled were therefore nearly four times as likely to live in a rural neighborhood as those who did not travel.

Discussion

This study highlights significant differences in the distribution of the COI of patients who traveled more than 50 miles for specialty colorectal care and those who did not. Notably, patients who did not need to travel were more likely to reside in neighborhoods at the extremes of the COI spectrum—either in the Very Low or Very High categories, which are likely to reflect the urban and suburban populations in the cities where the medical center is located. Conversely, those who traveled predominantly came from areas with low or moderate COI rankings. These findings underscore the potential role of geographic accessibility in exacerbating healthcare disparities, particularly for individuals from under-resourced communities who may already face systemic barriers to care [4]. Black or African American patients and Hispanic or Latino patients were less likely to travel, and this likely reflects the increased diversity of the population in urban areas where many specialty centers are located. Because our cohort includes only children who were ultimately seen at a PCPLC center, these patterns should not be interpreted as evidence that minority families face less travel burden; locally residing families, concentrated in the diverse urban areas where specialty centers are located, may simply be more likely to reach these centers, while families living farther away may be less likely to travel even when specialty care is indicated. The denominator of all children with these conditions in the underlying source population is unknown.

The disparities associated with travel requirements likely reflect broader inequities in healthcare access for individuals residing in low-opportunity neighborhoods. Patients from these communities may encounter multiple logistical and financial obstacles that hinder their ability to obtain specialized medical treatment. Travel-related barriers, including transportation costs, the need for extended time off work, and caregiving responsibilities, can disproportionately impact individuals with limited financial means or job flexibility, further restricting their access to essential healthcare services [13]. Additionally, these challenges patients and their families face may contribute to a delay in seeking care, leading to worse health outcomes and increased disease burden for already vulnerable populations [14].

Despite the important insights gained from this study, there are notable limitations that warrant consideration. One significant limitation is the lack of data on patients' modes of transportation (e.g., public transit, private vehicle, or air travel), which may have substantial implications for accessibility and overall healthcare costs. Furthermore, while this study assessed COI distribution, urbanicity differed

markedly between the groups, with patients who traveled nearly four times as likely to live in rural neighborhoods (38.3% vs 9.8%); this close link between travel distance and rural residence makes it difficult to fully disentangle the independent contributions of neighborhood opportunity and rurality to travel burden [9, 15]. Rural patients, for example, may face longer travel distances and fewer public transportation options, whereas urban patients may face alternative barriers such as traffic congestion or strained healthcare systems. An additional methodological consideration is that COI was assigned at the ZIP-code level rather than by census tract; because ZIP-code estimates aggregate opportunity across multiple census tracts, this approach may attenuate neighborhood-level variation in opportunity and could misclassify a minority of patients [16].

Future research should explore whether these COI differences persist after accounting for rurality and aim to characterize the broader source population of children with these conditions to quantify unmet need among those who never reach specialty centers. Addressing these disparities requires a multifaceted approach that includes screening for social determinants of health, implementing policies to support transportation assistance programs, and providing financial aid to offset the indirect costs of care [17]. By proactively identifying and mitigating these barriers, healthcare systems can work toward ensuring more equitable access to specialty care, ultimately improving health outcomes for all patients, regardless of socioeconomic status or geographic location. Based on these data, we recommend social work screening for all pediatric surgical patients, regardless of whether they traveled for care, to identify ways our healthcare system can support vulnerable patients and families. By identifying these disparities, our study aims to inform strategies that promote equitable access to specialized surgical care, mitigate healthcare inequities, and ultimately improve patient outcomes. Findings from this research may help guide policy changes, resource allocation, and the development of targeted interventions to support vulnerable populations.

Conclusion

Pediatric patients who travel for specialty colorectal care are more likely to live in low- or moderate-COI neighborhoods, highlighting disparities in healthcare access. Addressing these inequities through targeted interventions, increased screening, and resource support is critical to reducing healthcare disparities and improving outcomes for vulnerable populations.

Declarations

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Competing Interests The authors have no financial or non-financial conflicts of interest to disclose.

Ethics Approval The PCPLC registry contains only de-identified patient information and this study is thus considered non-human subjects research exempt from IRB approval.

Author Contributions All authors contributed substantively to patient accrual, data entry, manuscript writing or revision and have reviewed this manuscript prior to submission.

References

1. Yap A, Laverde R, Thompson A et al (2023) Social vulnerability index (SVI) and poor postoperative outcomes in children undergoing surgery in California. *Am J Surg* 225(1):122–128. <https://doi.org/10.1016/j.amjsurg.2022.09.030>
2. Lechtholz-Zey E, Bonney PA, Cardinal T et al (2022) Systematic review of racial, socioeconomic, and insurance status disparities in the treatment of pediatric neurosurgical diseases in the United States. *World Neurosurg* 158:65–83. <https://doi.org/10.1016/j.wneu.2021.10.150>
3. Akbilgic O, Langham MR, Davis RL (2018) Race, preoperative risk factors, and death after surgery. *Pediatrics* 141(2). <https://doi.org/10.1542/peds.2017-2221>
4. Nafiu OO, Mpody C, Kim SS, Uffman JC, Tobias JD (2020) Race, postoperative complications, and death in apparently healthy children. *Pediatrics* 146(2). <https://doi.org/10.1542/peds.2019-4113>
5. Perez NP, Ahmad H, Alemayehu H, Newman EA, Reyes-Ferral C (2022) The impact of social determinants of health on the overall wellbeing of children: a review for the pediatric surgeon. *J Pediatr Surg* 57(4):587–597. <https://doi.org/10.1016/j.jpedsurg.2021.10.018>
6. diversitydatakids.org Child Opportunity Index (COI). <https://www.diversitydatakids.org/child-opportunity-index>. Accessed 30 January 2025
7. Tyris J, Putnick DL, Keller S, Parikh K, Yeung E (2025) The Child Opportunity Index and children's health: a meta-analysis. *Pediatrics* 155(4):e2024067873. <https://doi.org/10.1542/peds.2024-067873>
8. Mayer ML, Beil HA, von Allmen D (2009) Distance to care and relative supply among pediatric surgical subspecialties. *J Pediatr Surg* 44(3):483–495. <https://doi.org/10.1016/j.jpedsurg.2008.08.015>
9. Cockrell H, Barry D, Dick A, Greenberg S (2023) Geographic access to care and pediatric surgical outcomes. *Am J Surg* 225(5):903–908. <https://doi.org/10.1016/j.amjsurg.2023.02.010>
10. Vilanova-Sánchez A, Choueiki J, Smith CA, Callicot S, Frischer JS, Levitt MA (2020) Creating a collaborative program for the care of children with colorectal and pelvic problems. *Semin Pediatr Surg* 29(6):150985. <https://doi.org/10.1016/j.sempedsurg.2020.150985>
11. Zuckerman KE, Perrin JM, Hobrecker K, Donelan K (2012) Barriers to specialty care and specialty referral completion in the community health center setting. *J Pediatr* 162(2):409–414. <https://doi.org/10.1016/j.jpeds.2012.07.022>

12. Reeder RW, Wood RJ, Avansino JR, Pediatric Colorectal and Pelvic Learning Consortium (PCPLC) et al (2018) The Pediatric Colorectal and Pelvic Learning Consortium (PCPLC): rationale, infrastructure, and initial steps. *Tech Coloproctol* 22(5):395–399. <https://doi.org/10.1007/s10151-018-1782-5>
13. Cockrell H, Barry D, Dick A, Greenberg S (2023) Socioeconomic disadvantage and pediatric surgical outcomes. *Am J Surg* 225(5):891–896. <https://doi.org/10.1016/j.amjsurg.2023.02.002>
14. Georgeades C, Bodnar C, Bergner C, Van Arendonk KJ (2024) Association of complicated appendicitis with geographic and socioeconomic measures in children. *Surgery* 176(5):1475–1484. <https://doi.org/10.1016/j.surg.2024.07.044>
15. Georgeades C, Vacek J, Thurm C et al (2023) Association of rural residence with surgical outcomes among infants at US children’s hospitals. *Hosp Pediatr* 13(8):733–741. <https://doi.org/10.1542/hpeds.2023-007227>
16. Hogan AH, Grills NK, Hall M et al (2026) The Child Opportunity Index and pediatric hospitalizations: are ZIP codes good enough? *J Pediatr* 293:115053. <https://doi.org/10.1016/j.jpeds.2026.115053>
17. Simmons P, Beck L, Young E, Brower L, Fanta M (2026) Overcoming geographic barriers: enhancing pediatric subspecialty access for rural families. *Hosp Pediatr* 16(3):263–269. <https://doi.org/10.1542/hpeds.2024-008150>

Figures

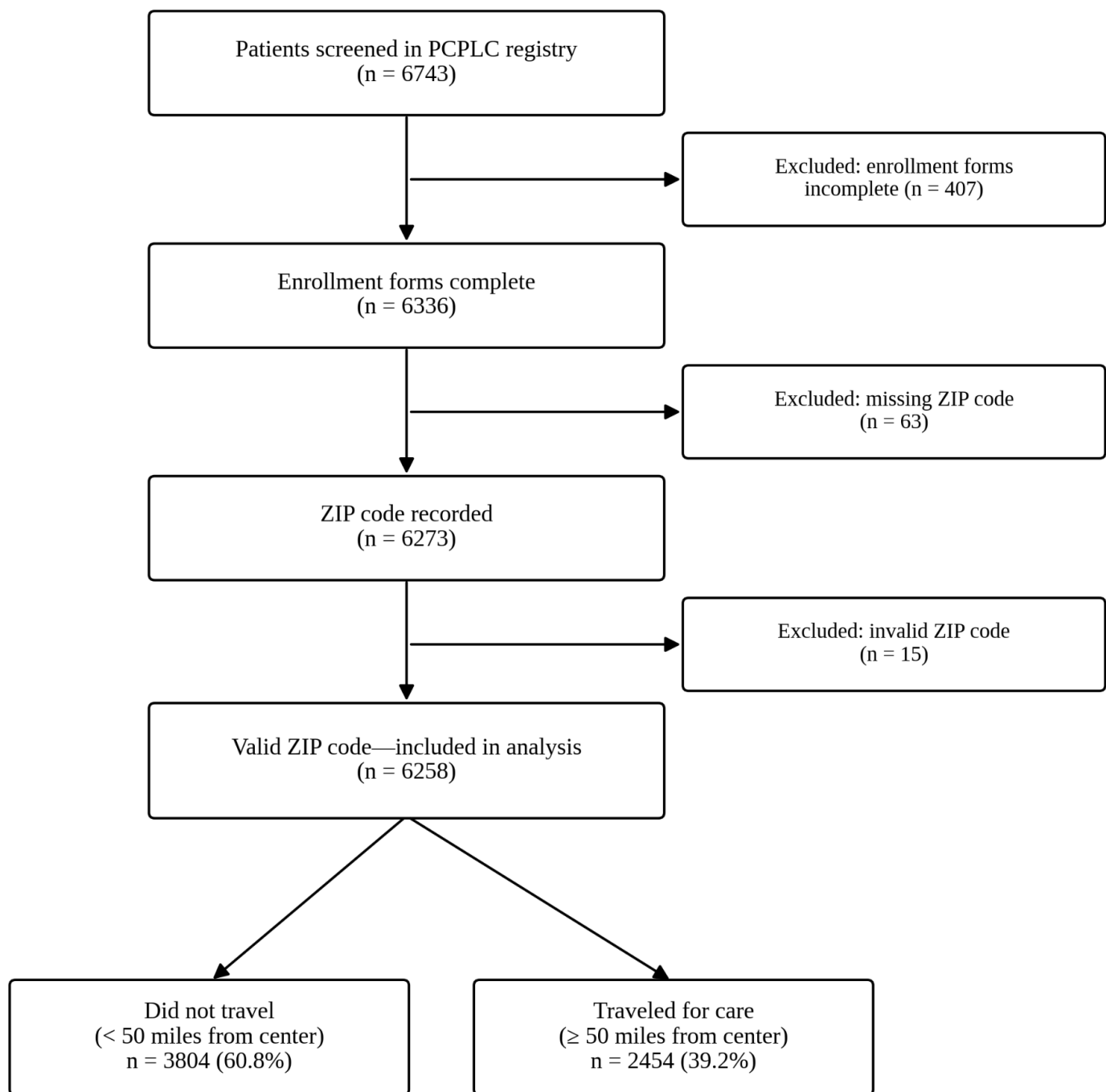


Figure 1

Flow diagram of patient inclusion, Pediatric Colorectal and Pelvic Learning Consortium (PCPLC) registry, January 2017–March 2026.