Primary Care Practice Structural Capabilities and Emergency Department Utilization Among High-Need High-Cost Patients

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BACKGROUND: US primary care practices are actively identifying strategies to improve outcomes and reduce costs among high-need high-cost (HNHC) patients. HNHC patients are adults with high health care utilization who suffer from multiple chronic medical and behavioral health conditions such as depression or substance abuse. HNHC patients with behavioral health conditions face heightened challenges accessing timely primary care and managing their conditions, which is reflected by their high rates of emergency department (ED) utilization and preventable spending. Structural capabilities (i.e., care coordination, chronic disease registries, shared communication systems, and after-hours care) are key attributes of primary care practices which can enhance access and quality of chronic care delivery.

OBJECTIVE: The purpose of this study was to analyze the association between structural capabilities and ED utilization among HNHC patients with behavioral health conditions.

DESIGN AND MEASURES: We merged cross-sectional survey data on structural capabilities from 240 primary care practices in Arizona and Washington linked with Medicare claims data on 70,182 HNHC patients from 2019.

KEY RESULTS: Using multivariable Poisson models, we found shared communication systems were associated with lower rates of all-cause and preventable ED utilization among HNHC patients with alcohol use (all-cause: aRR 0.72, 95% CI: 0.62, 0.84; preventable: aRR 0.5, 95% CI: 0.40, 0.64) and HNHC patients with substance use disorders (all-cause: aRR 0.76, 95% CI: 0.68, 0.85; preventable: aRR 0.61, 95% CI: 0.52, 0.71). Care coordination was also associated with decreased rates of ED utilization among the overall HNHC population and those with alcohol use, but not among HNHC patients with depression or substance use disorders.

CONCLUSION: Shared communication systems and care coordination have the potential to increase the effectiveness of primary care delivery for specific HNHC patients.

KEY WORDS: high-need high-cost; primary care; structural capabilities; emergency utilization; nurse practitioner workforce.

BACKGROUND

Over the last decade, significant policy attention has been placed on developing solutions to improve care for high-need high-cost (HNHC) patients as a strategy to increase savings. The HNHC population comprise only 5% of the United States (US), yet account for half of all health care expenditures.[1,2] HNHC patients are defined as adults suffering from multiple (at least 2) chronic conditions with varying social, functional, and behavioral health needs.[1,3,4] Compared to the general population, HNHC patients are more likely to be older, African American, insured by Medicare or dually eligible for Medicaid, and have lower levels of education and income.[1,3]

HNHC patients with behavioral health conditions including anxiety, depression, and substance use disorder face particular challenges accessing timely care and managing their diseases reflected by high rates of unmet behavioral health needs, as well as higher preventable costs and emergency department (ED) utilization.[3,5,6] HNHC patients with a behavioral health diagnosis are also costly and more likely to remain in the top 10% of spending over 2 years compared to the overall HNHC population.[6] Primary care is an optimal setting for patients with co-occurring medical and behavioral health conditions enabling opportunities for patient-centered disease education, continuous monitoring, and multidisciplinary care planning involving nurses, social workers, psychiatrists, and care coordinators.[1]

However, providing high-quality primary care to HNHC patients has proved to be challenging as the US faces a national shortage of primary care physicians compounded by growing rates of an aging and chronically ill population.[7,8] Variation across HNHC patients' demographics, comorbidities, and disease severity[9,10] further challenges the ability for primary care interventions to make sustainable improvements in outcomes or costs.[11,12] Yet, little is known about the practice infrastructure or integrated features (i.e., structural

capabilities) used to enhance primary care delivery for HNHC patients.

This study evaluates four structural capabilities (i.e., care coordination, chronic disease registries, shared communication systems, and after-hours care) which remain an understudied avenue that may be effective in producing better health outcomes for HNHC patients and reducing financial costs. Care coordination, for example, consists of the integration of personnel or activities used to manage patient care across the health care spectrum. Among HNHC patients, care coordination has been shown to be associated with fewer hospitalizations and ED visits[13] and lower per beneficiary episode costs by $4,295.[14] Effective coordination is critical for HNHC patients as fragmented care across settings and specialists is associated with increased costs and rates of preventable hospitalizations.[15] After-hours care, which extends practice hours during the evening and on weekends, is associated with 10.4% lower total expenditures,[16] fewer ED visits (30.4% versus 37.7 percent), and lower rates of unmet medical need among US adults.[17]

The availability of shared communication systems allows practices to contact and remind patients that are due for primary care services. Reminders can come in the form of phone or text or through shared systems such as MyChart. Shared communication systems are a successful strategy to improve patient appointment and medical compliance[18] as well as disease management activities such as laboratory testing and exams.[19, 20] Finally, chronic disease registries—designed to support providers in managing patients with chronic illness through tracking systems, clinician reminders, and checklists—have been shown to improve patient outcomes and support practices in achieving the standard of care for ongoing chronic diseases.[19, 21]

Yet, it is unclear if these structure capabilities are associated with improving care among HNHC patients with behavioral health conditions who experience heightened challenges accessing care and managing their chronic conditions. Therefore, the purpose of this study is to analyze the association between ED utilization and primary care practice structural capabilities (i.e., care coordination, chronic disease registries, shared communication systems, and after-hours care) among HNHC patients with behavioral health conditions.

METHODS

Study Design

We conducted a secondary analysis of linked cross-sectional data. Survey data from primary care NPs in 2018–2019 provided data on primary care practice structural capabilities and was merged with Medicare Part A and Part B claims from 2018 on HNHC patients and ED utilization.

Data Collection

Survey Data. As part of the parent study, researchers sent surveys to 5,689 NPs in six states: Arizona, Washington, New Jersey, Pennsylvania, California, and Texas. These states were selected as they have varying scope of practice laws governing the ability for NPs to practice as primary care providers and independently evaluate, diagnose, interpret tests, and treat patients.[22] NPs were identified through the OneKey database from IQVIA, which includes the most complete information on office-based providers in the US including contact information, practice location, network affiliation, and national provider identifier.[23] Using a modified Dillman method,[24] three rounds of mail and online surveys were sent out with subsequent phone call reminders for NPs who did not complete the survey. Overall, 1,244 NPs completed and returned the surveys (21.9% response rate). A nonresponse analysis was undertaken and determined to have low bias.[25]

Medicare Claims. Demographic, clinical, and utilization data was obtained from 2019 for beneficiaries attributed to primary care practices in our survey. The parent study obtained Medicare Part A and Part B billing claims which includes all claims submitted by inpatient and outpatient institutional providers and individual clinicians. The Medicare Beneficiary Summary File was used to obtain patient-level information including demographic information (e.g., age, sex, and race). We attributed patients to practices by determining their dominant provider and practice (see Appendix).

Patient Sample. The total sample (prior to identifying HNHC patients) was 151,587 Medicare, fee-for-service beneficiaries attributed to 240 practices in Arizona and Washington. These states were selected as they offer full scope of practice regulation allowing NPs to treat patients independently as primary providers (AANP, 2021).

We selected 70,182 HNHC patients from Medicare Claims. HNHC patients were sampled if they had at least two chronic conditions including congestive heart failure, cardiovascular disease, diabetes, hypertension, cerebrovascular disease, and chronic pulmonary disease. HNHC are more likely to be insured by Medicare and thus make up a large portion of the overall sample.[1, 3] We excluded individuals less than 65 years old, those without continuous enrollment in Parts A or B during the study period, and those with dementia and metastatic cancer as these conditions are prone to high costs and there are significant limitations to addressing illness trajectory.[26, 27]

We further subsampled HNHC patients with behavioral health conditions by selecting individuals with at least two chronic conditions plus an additional diagnosis of depression ($n = 12,745$), alcohol use ($n = 1,377$), or substance use disorder ($n = 1,783$). (See Appendix for more details.)

Independent Variable

Our independent variable was the presence of primary care practice structural capabilities measured by the Structural Capability Index (SCI) contained within the NP survey. The SCI is a validated tool measuring structural capabilities and has been used to explore medical home capabilities and the impact of those capabilities on patient outcomes, patient satisfaction, and quality of care.[28–31] We selected four structural capability subscales: (1) *care coordination*: designated staff to support integration of care across the health care spectrum; (2) *chronic disease registries*: lists of patients who are overdue for chronic disease services; (3) *shared communication systems*: reminders for patients who due for primary care services; and (4) *after-hours care*: extended evening or weekend practice hours. The construct of structural capabilities is intended for interpretation at the higher practice-level, though the information is collected at NP-level. Consistent with prior research, for structural capabilities with more than two items, we created an NP-level binary scale (yes/no) by operationalizing the scale as present (i.e., yes) if more than 50% of items were reported as present.[30] The Appendix contains the corresponding survey items.

Outcome Variables

All-cause and preventable ED utilization were the outcome variables defined as the number of ED visits per year. Preventable ED utilization was categorized as an ED visit for an ambulatory care sensitive condition that has any evidence of being avoidable or primary care treatable according to the widely used "NYU ED Algorithm".[32] All other ED visits were categorized as all-caused ED utilization.

Covariates

Models controlled for patient age, sex, race, and ethnicity. Practice characteristics included practice size (i.e., total number of NPs, physicians, and physician assistants within the practice), practice type (e.g., physician practice, hospital-based clinic, community health center, etc.), and practice location (i.e., urban or rural location). Practice location was determined using the ZIP code Version 3.1 of the Rural–Urban Commuting Area codes which classify rural-urban designations based on population density and work commuting patterns.[33]

Statistical Analysis

We used descriptive statistics to compare the demographics, comorbidities, and utilization of HNHC patients to non-HNHC patients. Next, zero-inflated, adjusted Poisson models were used to analyze the association between structural capabilities and ED utilization among the following: (1) HNHC patients; (2) HNHC patients with depression; (3) HNHC patients with alcohol use; and (4) HNHC patients with substance use disorder. Zero-inflated Poisson models effectively estimate count data with excessive zeros.[34]

To assess the direction and strength of the associations, we reported adjusted relative risk (aRR) as the exponentiated Poisson regression coefficient and the associated confidence intervals of the aRR. The intraclass correlation was calculated and demonstrated no need to use models to account for clustering effect (see Appendix for all sensitivity analyses). All statistical analyses were completed in R Version 1.3 with the significance level set at $p < .05$.

RESULTS

Characteristics of HNHC Patients

We identified 70,182 HNHC patients attributed to 240 primary care practices in Arizona and Washington. Patient and practice characteristics differed across HNHC and non-HNHC patients (Table 1). HNHC patients were more likely to be older with a mean age of 76 years compared to 74 and were more likely to be male. HNHC patients had on average

Table 1   Descriptive Statistics of HNHC Patients Compared to Non-HNHC Patients, 2019

	Non-HNHC $n = 81,405$	HNHC $n = 70,182$
Demographic characteristics, *n* (%)		
Mean age (years)	74	76
Female	51,618 (63%)	36,918 (53%)
Race and ethnicity		
Non-Hispanic White	72,183 (91%)	60,627 (88%)
Black	1,097 (1.4%)	1,575 (2.3%)
Asian	2,127 (2.7%)	1,927 (2.8%)
Hispanic	2,638 (3.3%)	3,258 (4.7%)
Other[1]	1,438 (1.8%)	1,830 (2.6%)
Comorbidities, *n* (%)		
Mean number of conditions (SD)	0.62 (0.5)	2.68 (0.9)
CHF	538 (0.7%)	16,298 (23%)
Chronic pulmonary disease	5,572 (6.8%)	26,720 (38%)
Diabetes	3,025 (3.7%)	33,133 (47%)
Cerebrovascular disease	1,379 (1.7%)	16,458 (23%)
HTN	38,642 (47%)	66,461 (95%)
alcohol use	1,054 (1.3%)	1,377 (2.0%)
Substance use	1,223 (1.5%)	1,783 (2.5%)
Depression	11,663 (14%)	12,745 (18%)
Mean utilization per year		
All-cause ED visits (SD)	0.25 (0.7)	0.6 (1.3)
Preventable ED visits (SD)	0.14 (0.5)	0.34 (0.9)
Practice characteristics, *n* (%)		
State		
Arizona	32,945 (39%)	29,935 (44%)
Washington	50,658 (61%)	38,049 (56%)
Practice type		
Physician practice	43,928 (53%)	37,199 (55%)
Hospital-based clinic	20,553 (25%)	15,508 (23%)
Community health center	3,033 (3.7%)	2,562 (3.8%)
All other	15,237 (18%)	12,160 (18%)
Practice size		
Solo provider	227 (0.3%)	146 (0.2%)
2–20 providers	53,833 (72%)	48,573 (76%)
> 20 providers	20,988 (28%)	15,327 (24%)
Practice location		
Rural	6,263 (7.7%)	5,282 (7.5%)
Urban	75,142 (92%)	64,900 (92%)

Source. Author's calculations based on data from nurse practitioner survey and Medicare claims 2019. Note. HNHC high-need high-cost, CHF congestive heart failure, CVD cardiovascular disease, HTN hypertension. Chronic pulmonary disease includes chronic obstructive pulmonary disease and asthma. [1]Other includes American Indian Alaskan Native

higher rates of both all-cause (0.59 versus 0.27) and preventable ED utilization (0.34 versus 0.14). Practices caring for both HNHC and non-HNHC patients were predominantly physician-run practices (55%) and based in urban settings (92%).

HNHC patients with behavioral health conditions were also significantly different from the overall HNHC population (Table 2). HNHC patients with behavioral health conditions were more likely to be younger and had significantly higher averages of all-cause and preventable ED utilization per year compared to the overall HNHC population ($p < .001$). Specifically, HNHC patients with substance use disorders had the highest average rate of ED utilization for both all-cause ED visits (1.45 versus 0.6, $p < .001$) and preventable ED visits (0.84 versus 0.34, $p < .001$) compared to the overall HNHC population, but also compared to HNHC patients with depression or alcohol use disorder. Care coordination was significantly more likely to be delivered in practices serving HNHC patients with depression, alcohol use, and substance use disorder compared to the overall HNHC population ($p < .05$).

Relationship Between Structural Capabilities and ED Utilization

Table 3 presents the results of the exponentiated, zero-inflated Poisson models. There were significant negative associations between shared communication systems and care coordination and rates of ED utilization. Among HNHC patients with alcohol use, shared communication systems were associated with a 28% lower rate of all-cause ED utilization (aRR 0.72,

95% CI: 0.62, 0.84) and a 50% lower rate of preventable ED utilization (aRR 0.5, 95% CI: 0.40, 0.64)). For HNHC patients with substance use disorders, shared communication systems were associated with a 24% lower rate of all-cause ED utilization (aRR 0.76, 95% CI: 0.68, 0.85) and a 39% lower rate of preventable ED utilization (aRR 0.61, 95% CI: 0.52, 0.71). Care coordination was associated with a 24% lower rate of all-cause ED utilization among HNHC patients with alcohol use (aRR 0.76; 95% CI: 0.64, 0.90) and a 4% lower rate of all-cause ED utilization among the overall HNHC population (aRR 0.96; 95% CI: 0.93, 0.99). Care coordination was not significantly associated with differences in ED utilization among HNHC patients with depression or substance use disorder.

Two structural capabilities (chronic disease registries and after-hours care) were positively associated with ED utilization. Chronic disease registries were associated with higher rates of preventable ED utilization among HNHC patients with behavioral health conditions, but not among the overall HNHC population. After-hours care was also associated with higher rates of all-cause ED utilization among HNHC patients with depression (aRR: 1.09, 95% CI: 1.03, 1.15) and among the overall HNHC population (aRR: 1.07, 95 percent CI: 1.03, 1.11).

DISCUSSION

This is the first study to investigate structural capabilities in primary care practices serving HNHC patients with

Table 2 Demographics, ED Utilization, and Structural Capabilities of HNHC Patients, 2019

	HNHC: ref (*n* = 70,182)	HNHC and depression (*n* = 12,745)	HNHC and alcohol use (*n* = 1,377)	HNHC and substance use (*n* = 1,783)
Demographic characteristics				
Mean age (years)	76	75***	74***	74***
Female (%)	53	67***	33***	61***
Non-Hispanic White (%)	88	91***	90***	87***
Comorbidities (%)				
CHF	23	25**	31***	31***
Chronic pulmonary disease	38	46***	46***	51***
Diabetes	47	47	37***	43***
Cerebrovascular disease	23	28***	31***	29***
CVD	41	40*	42	43
HTN	95	95	93**	95
Alcohol use disorder	2.0	3.5***	–	7.8***
Substance use disorder	2.5	6.1***	10***	–
Depression	18	–	32***	44***
Utilization per year, mean (range)				
ED visits	0.6	0.86***	1.01***	1.45***
	(0, 108)	(0, 35)	(0, 108)	(0, 108)
Preventable ED visits	0.34	0.49***	0.49*	0.84***
	(0, 72)	(0, 25)	(0, 72)	(0, 72)
Structural capabilities (%)				
Care coordination	32	34*	36*	35*
Chronic disease registries	54	55	54	57*
Shared communication systems	52	48	51	49*
After-hours care	26	26	26	28**

Source. Author's calculations based on data from nurse practitioner survey and Medicare claims 2019. Note. HNHC high-need high-cost, CHF congestive heart failure, CVD cardiovascular disease, ED emergency department. Chronic pulmonary disease includes chronic obstructive pulmonary disease and asthma. Chi-squared tests were used to analyze the relationship between HNHC patient subgroups and the overall HNHC patient population. Significance is compared to the reference group: HNHC patients.
*$p < .05$, **$p < .01$, ***$p < .001$.

Table 3 Association Between Structural Capabilities and ED Utilization Among HNHC Patients with Behavioral Health Conditions, 2019

	Care coordination	Chronic disease registries	Shared communication systems	After-hours care
	aRR (95% CI)			
HNHC (*n* = 68,648)				
All-cause ED utilization	0.96**	1	1.01	1.07***
	(0.93, 0.99)	(0.97, 1.03)	(0.97, 1.04)	(1.03, 1.11)
Preventable ED utilization	0.96	1.04	1	1.05
	(0.91, 1.01)	(0.99, 1.09)	(0.95, 1.05)	(1, 1.09)
HNHC and depression (*n* = 12,500)				
All-cause ED utilization	0.95	1.02	1	1.09**
	(0.90, 1.01)	(0.96, 1.08)	(0.94, 1.06)	(1.03, 1.15)
Preventable ED utilization	0.97	1.09*	0.96	1.06
	(0.89, 1.05)	(1, 1.19)	(0.88, 1.04)	(0.97, 1.15)
HNHC and alcohol use (*n* = 1,344)				
All-cause ED utilization	0.76**	1.59***	0.72***	1.04
	(0.64, 0.90)	(1.38, 1.84)	(0.62, 0.84)	(0.89, 1.21)
Preventable ED utilization	0.78	1.96***	0.5***	0.89
	(0.58, 1.04)	(1.55, 2.48)	(0.40, 0.64)	(0.70, 1.15)
HNHC and substance use disorder (*n* = 1,751)				
All-cause ED utilization	0.95	1.38***	0.76***	1.1
	(0.85, 1.05)	(1.23, 1.54)	(0.68, 0.85)	(0.99, 1.21)
Preventable ED utilization	0.96	1.63***	0.61***	1.03
	(0.82, 1.12)	(1.39, 1.90)	(0.52, 0.71)	(0.89, 1.20)

Source. Author's calculations based on data from NP survey and Medicare claims 2019. Note. ED emergency department, HNHC high-need high-cost, aRR adjusted relative risk. Exponentiated aRR estimates and exponentiated confidence intervals are from zero-inflated adjusted Poisson models, one for each dependent variable (i.e., ED use and preventable ED use) and for each HNHC subgroup. Models adjusted for age, sex, race, practice size, practice type (e.g., hospital clinic, physician practice, etc.), and practice setting (rural or urban).
For the full output from each of the regression models, see the Appendix.
*p < .05, **p < .01, ***p < .001.

behavioral health conditions. Despite HNHC Medicare beneficiaries being more likely to have a behavioral health diagnosis,[9] the literature base is limited on best practices to care for HNHC patients with behavioral health conditions in primary care. Our results demonstrate differences in demographics and utilization patterns in HNHC patients with behavioral health conditions compared to the overall HNHC population. In addition, we found variability in the association between structural capabilities and ED utilization across the HNHC population even after adjusting for patient and practice characteristics. These findings suggest that targeting HNHC patients with specific needs can more effectively improve chronic care and increase savings.

Shared systems for communication can support a proactive approach to primary care delivery through reminders for patients who are due for preventive or chronic care. We found that among HNHC patients with alcohol use and substance use disorders, shared systems for communication were associated with decreased rates of both all-cause and preventable ED utilization. Reminders are particularly helpful for providers caring for patients with alcohol and substance use disorders as they can support screening, identification of unhealthy behaviors, and early intervention.[35] Use of alcohol counseling reminders among adults is associated with a decrease in unhealthy alcohol use at follow-up screenings[36] and a decrease in non-attendance for mental health care appointments for patients with substance use disorders.[37] Our findings suggest that the use of reminders has potential for providers to improve care for HNHC patients with alcohol and substance abuse at low cost to practices.

There is longstanding interest in implementing care coordination models in practices caring for HNHC patients with complex and chronic medical, behavioral health, and social needs.[1, 38] Yet, the effectiveness of care coordination differs among the HNHC population and may be more sustainable if tailored to specific subgroups.[39] For example, Brown et al. found care coordination reduced hospitalizations only when directed at HNHC patients with a higher risk of being hospitalized.[40] Duru et al. demonstrated that care coordination decreased ED utilization only among HNHC patients with diabetes plus additional behavioral health and social needs.[13] Similarly, in our study, we found that care coordination made significant differences in the overall HNHC population and those with alcohol use, but not among HNHC patients with depression and substance use disorder.

Barriers to effective care coordination are exacerbated among patients with mental health issues or substance abuse. In a recent survey of insured, nonelderly adults with a mental health issue, more than half reported experiencing adverse consequences of ineffective care coordination including duplicated tests, having test results not ready at the time of appointment, or receiving conflicting information from providers.[41] Inadequate care coordination can occur due to poor screening of mental or behavioral health conditions in the primary care setting or due to poor integration of care between primary care and rehabilitation facilities.[42, 43] In addition to poor patient outcomes, ineffective care coordination is estimated to be responsible for up to $78.2 billion in annual health care waste.[44] Thus, tailoring traditional care coordination models has the potential to improve patient outcomes and produce substantive savings.

Inversely, we found that after-hours care and chronic disease registries were associated with increased rates of ED utilization among HNHC patients with behavioral health conditions. However, we were unable to explore whether an ED visit was made due to a patient's behavioral health condition, due to an exacerbation of an underlying medical condition, or if a patient was explicitly referred to the ED by their primary provider upon seeking after-hours care. We were also unable to control for variability in disease severity across practices or determine if the use of disease registries was in response to a sicker patient population. Sicker patients are more likely to be over-represented in disease registries as they are used to track the longitudinal impact of therapies used for patients with more severe illness[45] and they pull data from electronic medical records which collect more data on sicker patients.[46] Future research should incorporate qualitative investigation to capture real-time physical, emotional, and socioeconomic factors which immediately precede an ED visit.

There are inherent limitations in analyzing administrative claims data including the potential to miss patients who are undiagnosed or underreported. Administrative claims do not include information on social determinants of health such as education level, income, housing, or social isolation which impact utilization and health status of HNHC patients.[3, 47] Our survey data only provided information on the presence or absence of shared communication systems rather than describing their specific components such as how practices screen patients who are overdue or how frequently patients receive reminders. Lastly, cross-sectional data limited our ability to infer causal relationships or assess long-term patient outcomes.

CONCLUSION

Targeting structural capabilities to specific HNHC patients may be a useful strategy to improve primary care delivery and chronic care disease management. Among HNHC patients with alcohol use and substance use disorders, shared communication systems were associated with decreased rates of ED utilization and show promise for improving primary care delivery and chronic disease management. Care coordination was associated with decreased rates of ED utilization across some, but not all HNHC patients. Future research is needed to determine the essential components of shared communication systems and care coordination which may be tailored to effectively manage HNHC patients with wide-ranging behavioral health conditions.

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