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RESEARCH ARTICLE

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Health center use and hospital-based care among individuals dually enrolled in Medicare and Medicaid, 2012–2018

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Abstract

Objective: To examine the relationship between federally qualified health center (FQHC) use and hospital-based care among individuals dually enrolled in Medicare and Medicaid.

Data Sources: Data were obtained from 2012 to 2018 Medicare claims.

Study Design: We modeled hospital-based care as a function of FQHC use, person-level factors, a Medicare prospective payment system (PPS) indicator, and ZIP code fixed effects. Outcomes included emergency department (ED) visits (overall and non-emergent), observation stays, hospitalizations (overall and for ambulatory care sensitive conditions), and 30-day unplanned returns. We stratified all models on the basis of eligibility and rurality.

Data Extraction Methods: Our sample included individuals dually enrolled in Medicare and Medicaid for at least two full consecutive years, residing in a primary care service area with an FQHC. We excluded individuals without primary care visits, who died, or had end-stage renal disease.

Principal Findings: After the Medicare PPS was introduced, FQHC use in rural counties was associated with fewer ED and nonemergent ED visits per 100 person-years among both age-eligible (−14.8 [−17.5, −12.1]; −6.6 [−7.5, −5.6]) and disability-eligible duals (−11.3 [−14.4, −8.3]; −6 [−7.4, −4.6]) as well as a lower probability of observation stays (−0.8 pp age-eligible; −0.4 pp disability-eligible) and unplanned returns (−2.1 pp age-eligible; −1.9 pp disability-eligible). In urban counties, FQHC use was associated with more ED and nonemergent ED visits per 100 person-years (10.6 [8.4, 12.8]; 4.0 [2.6, 5.4]) among disability-eligible duals (a decrease of more than 60% compared with the pre-PPS period) and increases in the probability of hospitalization (1.1 pp age-eligible; 0.8 pp disability-eligible) and ACS hospitalization (0.5 pp age-eligible; 0.3 pp disability-eligible) (a decrease of roughly 50% compared with the pre-PPS period).

Conclusions: FQHC use is associated with reductions in hospital-based care among dual enrollees after introduction of the Medicare PPS. Further research is needed to understand how FQHCs can tailor care to best serve this complex population.

KEYWORDS
aged, community health centers, disabled persons, hospitalization, Medicaid, Medicare, primary health care

What is known on this topic

- Individuals dually enrolled in Medicare and Medicaid are a high-cost, high-need population.
- Improving access to primary care may reduce the use of costly and potentially avoidable hospital-based care, but prior studies have excluded dual enrollees, used aggregated data, focused on just a few states, and failed to consider the full spectrum of hospital-based care.
- Health centers provide improved access to primary care for certain populations, but there are little data on the use of health centers by dual enrollees.

What this study adds

- Dually-enrolled individuals who use health centers for their primary care had significantly less hospital-based care after implementation of the Medicare prospective payment system.
- Greater reliance on health centers is associated with larger reductions in the use of hospital-based care.
- Many dual enrollees are likely to benefit from receiving care at a health center.

1 | INTRODUCTION

In 2018, over 12 million Medicare beneficiaries were also enrolled in Medicaid.[1] These dual enrollees have disproportionately high medical spending and substantial health needs.[2] Dual enrollees are more likely to visit the emergency department (ED) or be hospitalized for ambulatory care sensitive (ACS) conditions, reflecting underlying disparities in primary care access.[3–16] They are also more likely to be racial and ethnic minorities,[17] suggesting that some of the access barriers they encounter are the result of interpersonal and structural racism.[18,19] While improving primary care access may reduce costly and potentially-preventable hospital-based care and help eliminate inequities, little is known about dual enrollees' primary care use or the ability of different primary care settings to reduce their hospital-based care.

Federally qualified health centers (FQHCs) are federally-funded safety net providers known to improve access to—and reduce disparities in—primary care.[20–22] They offer enabling services (e.g., transportation, case management) designed to improve access that may be especially important for dual enrollees given the significant barriers to care they face.[23,24] Moreover, the nature of these barriers likely differs between rural and urban areas and FQHCs have consumer majority governing boards intended to make them responsive to local needs.[23–26] In 2018, 1362 FQHCs cared for over 28 million patients at nearly 12,000 delivery sites.[27] FQHCs are increasingly important primary care providers for dual enrollees. Only 6% of Medicare enrollees seen by private physicians are dually enrolled versus 39% of those seen in FQHCs,[27] and the number of dual enrollees treated at FQHCs tripled from 2005 to 2018.[27,28] Recognizing this, the Centers for Medicare and Medicaid Services transitioned FQHCs to a Medicare prospective payment system (PPS) beginning in October 2014, which was intended to provide them enhanced reimbursement.[29]

Numerous studies have found that FQHC use is associated with fewer ED visits and ACS hospitalizations.[30–36] However, most of this work has been limited to ecological studies focused on FQHC supply in an area rather than utilization patterns,[30–33] or studies using person-level Medicaid data limited to a few states,[34–36] which may not generalize to dual enrollees given their unique characteristics and care needs.[35] Indeed, prior person-level studies of FQHC use among dual enrollees using national data found that FQHC use increases nonemergent ED visits while only reducing ACS hospitalizations in some cases.[37–39] However, this work did not adjust for all primary care that enrollees receive.[38,39] Furthermore, no studies examined the broader continuum of hospital-based care beyond ED visits and ACS hospitalizations like observation stays and unplanned returns, despite notable shifts in hospitalization from short inpatient admissions to outpatient observation stays over the last decade.[40] Thus, we sought to understand the relationship between FQHC use and several measures of hospital-based care among the nationwide population of dual enrollees using person-level data. We hypothesize that dual enrollees using FQHCs will use less hospital-based care than dual enrollees receiving primary care elsewhere, and that this association will be stronger beginning in 2015 as FQHCs transitioned to the Medicare PPS.[29]

2 | METHODS

2.1 | Data and study sample

For this study, we used Part A (inpatient) and Part B (outpatient and carrier) Medicare claims data and the Master Beneficiary Summary File from 2012 to 2018. These data contain dates of service, diagnoses, services provided, facility codes, place of service codes, revenue center codes, provider specialty codes, and other details allowing us to identify and characterize hospitalizations, observation stays, ED visits, and outpatient evaluation and management (E&M) visits. The Master Beneficiary Summary File contains demographic data that we used to define our sample and adjust our statistical models.

To ensure equal measurement periods, we limited our sample to fee-for-service Medicare enrollees without end-stage renal disease who were dually enrolled in Medicare Parts A and B and Medicaid for 12 months (i.e., full benefit dual enrollees) and did not die in a given calendar year. Because we compare FQHCs to other primary care settings, we excluded individuals without at least one primary care visit during the year, and those residing in a primary care service area (PCSA) without an FQHC. PCSAs are geographic units that "reflect Medicare patient travel to primary care providers."[41] Approximately 76% of dual enrollees with a primary care visit live in a PCSA with an FQHC. Because we lagged our independent variable, we also required individuals to have at least two consecutive years of data. Finally, we excluded observations with missing, invalid, or highly improbable data, as shown in Figure 1.

2.2 | Outcomes

We measured hospital-based care using six outcomes: ED visits (overall and nonemergent), observation stays, inpatient hospitalizations (overall and ACS), and unplanned returns to the hospital within 30 days. Following established procedures, we identified all ED visits using revenue center codes 0450-0459 or 0981 across both inpatient and outpatient

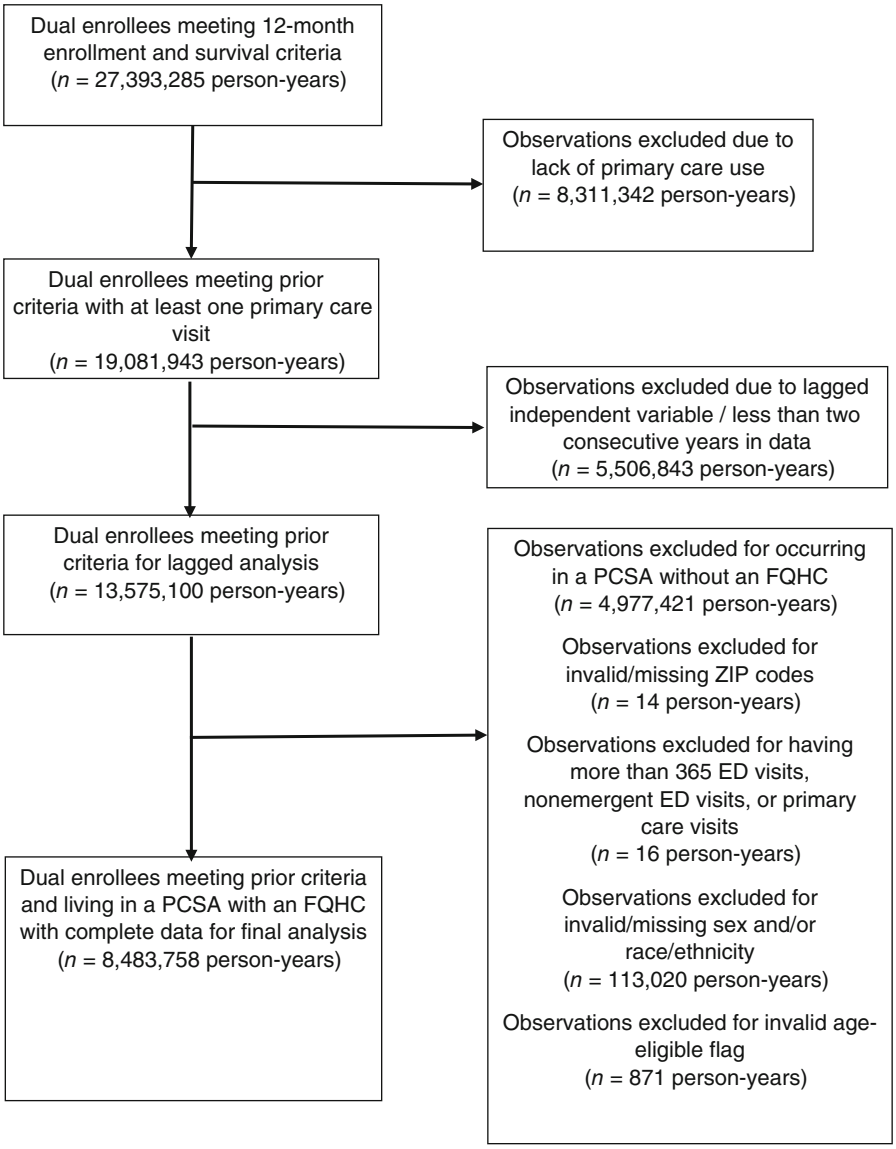

FIGURE 1 Sample selection flowchart

claims.[42] We then classified some ED visits as nonemergent if they had a predicted probability of being nonemergent greater than 50% using the New York University Emergency Department visit severity algorithm.[43,44] Next, we identified observation stays using outpatient revenue center codes 760 or 762 in conjunction with Healthcare Common Procedure Coding System codes G0378 or G0379.[45,46] Then, we identified all inpatient hospitalizations, further classifying some of these as ACS hospitalizations using the Agency for Healthcare Research and Quality's Prevention Quality Indicator software to flag 12 conditions (excluding low birthweight) using ICD-9 codes for claims prior to October 2015 and ICD-10 codes thereafter.[47] Finally, we identified all unplanned returns to the hospital (ED, observation, readmission) within 30 days of discharge.[48] Returns could span calendar years (and were assigned to the year in which they occurred), but index visits could occur no later than December 1, 2018 to ensure a 30-day follow-up period. Given evidence on revisit capture rates,[49] we flagged returns regardless of whether they occurred at the same hospital as the index visit. We measured overall and nonemergent ED visits as counts and all other outcomes as binary indicators of whether the enrollee experienced the outcome at least once during the year, because ED visits occur much more frequently (multiple visits per person) than other hospital-based care.

2.3 | FQHC use

Our key independent variable is a binary measure of whether an FQHC is an enrollee's usual source of primary care. Using the last four digits of the CMS Certification Number, we identified FQHC (1800–1989) and rural health clinic (3800–3999) visits in the outpatient claims, as these providers bill at the facility level. Then, we used specialty and current procedural terminology codes in the outpatient and carrier claims to define other primary care providers as physicians in family practice, general practice, geriatrics, or internal medicine, as well as nurse practitioners, certified clinical nurse specialists, and physician assistants who conducted E&M visits at an office (99,201–99,215), nursing facility (99,304–99,340), or home visit (99,341–99,350). We then assigned these claims to a setting (physician office, outpatient clinic, other primary care) using place of service codes. Following established methods, we assigned enrollees as FQHC users if they received the plurality of their primary care E&M visits at an FQHC.[36,50] To avoid contaminating our nonuser group, we defined individuals as nonusers only if they had zero FQHC visits. In sensitivity analyses guided by prior literature, we used increasingly restrictive thresholds requiring >50%, ≥75%, and 100% of visits to occur at an FQHC to define FQHC users.[51,52]

2.4 | Analytic approach

We conducted descriptive analyses to characterize our sample, stratifying individuals by reason for Medicare eligibility (i.e., age-eligible individuals 65 years and older, and disability-eligible individuals under age 65), residence in an urban or rural county, and FQHC use. In addition to demographic characteristics, we examined the prevalence of 26 chronic conditions (listed in Tables 1 and 2), patterns of E&M visits to primary care providers and specialists, and hospital-based care use.

We used regression analysis to estimate each of our outcomes as a function of FQHC use and other factors. We used negative binomial models for our count outcomes and linear probability models for our binary outcomes to estimate the following equation:

$$\text{Outcome}_{ijt} = \alpha_0 + \beta_1 \text{FQHC}_{ijt-1} + \beta_2 \text{Post}_{t-1} + \beta_3 \text{FQHC}_{ijt-1} * \text{Post}_{t-1} + \beta_4 \text{ZIP}_j + \beta_5 X_{it} + \varepsilon_{ijt},$$

where Outcome_{ijt} is one of our hospital-based outcomes for enrollee i living in ZIP code j in year t and FQHC_{ijt-1} indicates whether enrollee i living in ZIP code j was an FQHC user in year $t-1$. We used the 1-year lag to ensure that FQHC use preceded hospital-based care since we use person-year data. Post_{t-1} indicates the post-PPS period. To determine whether this change in payment policy moderates the relationship between FQHC use and our outcomes, we also include an interaction term. X_{it} is a vector of enrollee characteristics including age, sex, race/ethnicity, a categorical measure of 26 different chronic conditions, an indicator of disability among older adults (derived from the original reason for Medicare eligibility), and volume of annual primary care visits. ZIP_j is a ZIP code-level fixed effect accounting for both state-level Medicaid payment policy differences that might influence access to care through supply-side constraints[53] and unobserved time-invariant factors (e.g., local health care infrastructure, practice patterns, socioeconomic status) potentially associated with our outcomes. We used RTI race codes, which better identify Hispanic and Asian/Pacific Islanders compared with the standard race variable.[54] Given the heterogeneity among dual enrollees and the potential for FQHCs to operate differently in rural areas, we also stratified all models by current reason for eligibility and rurality. To account for repeated observations of individuals over time, we clustered standard errors at the enrollee level, and to account for multiple comparisons across our 4 FQHC user thresholds, we implemented a Bonferroni correction that reduced our alpha level to 0.01. The University of North Carolina at Chapel Hill Institutional Review Board approved this study.

3 | RESULTS

3.1 | Summary statistics

Our overall sample included 8,483,758 person-year observations, representing over 2.9 million unique dual enrollees. Of these observations, 54% were Medicare eligible based on age, and 46% were eligible based on disability. Additionally, 84% lived in urban counties, 16% lived in rural counties, 17.6% were FQHC users, and 82.4% were nonusers. We provide further characteristics of our age- and disability-eligible duals in Tables 1 and 2, stratified by rurality and FQHC use.

TABLE 1 Summary statistics of age-eligible dual enrollees, by FQHC use and rurality

	Rural		Urban	
Variable	**User**	**Nonuser**	**User**	**Nonuser**
N (person-years)	145,468	521,062	553,887	3,362,660
Mean age	75.1*** [IQR: 69, 80]	76.5 [IQR: 70, 82]	74.2*** [IQR: 69, 78]	77.4 [IQR: 71, 83]
% Male	31.7*** [31.4, 31.9]	28.5 [28.4, 28.6]	36.3*** [36.1, 36.4]	30.5 [30.5, 30.6]
Race/ethnicity				
% White	63.2*** [62.9, 63.4]	65.6 [65.5, 65.7]	32.1*** [32.0, 32.2]	40.2 [40.1, 40.2]
% Black	18.5*** [18.3, 18.7]	20.2 [20.1, 20.3]	17.0*** [16.9, 17.1]	14.9 [14.9, 14.9]
% Asian/Pacific Islander	0.8 [0.8, 0.8]	0.8 [0.8, 0.8]	15.2*** [15.1, 15.3]	19.3 [19.2, 19.3]
% American Indian/Alaskan Native	3.5*** [3.4, 3.5]	2.7 [2.7, 2.8]	0.9*** [0.9, 0.9]	0.4 [0.4, 0.4]
% Hispanic	13.6*** [13.4, 13.8]	10.2 [10.1, 10.2]	34.0*** [33.9, 34.1]	23.8 [23.7, 23.8]
% Other	0.5* [0.5, 0.6]	0.5 [0.5, 0.5]	0.8*** [0.8, 0.8]	1.5 [1.5, 1.6]
Eligibility status				
% Older adults with disabilities	33.8*** [33.5, 34.0]	36 [35.8, 36.1]	25.2* [25.1, 25.3]	24.1 [24.1, 24.2]
Health status				
Mean number of chronic conditions[a]	4.8*** [IQR: 3, 7]	5.6 [IQR: 3, 7]	4.3*** [IQR: 2, 6]	5.8 [IQR: 4, 8]
Health care utilization				
Mean E&M visits to primary care provider	10.0*** [IQR: 4, 13]	7 [IQR: 3, 9]	9.5*** [IQR: 4, 12]	7.4 [IQR: 3, 10]
Mean E&M visits to specialist	3.6*** [IQR: 0, 5]	4.7 [IQR: 1, 6]	4.2*** [IQR: 0, 6]	6.6 [IQR: 1, 9]
Hospital-based care				
Mean total overall ED visits	1.2*** [IQR: 0, 2]	1.3 [IQR: 0, 2]	1.0*** [IQR: 0, 1]	1.0 [IQR: 0, 1]
Mean total nonemergent ED visits	0.4*** [IQR: 0, 0]	0.4 [IQR: 0, 1]	0.3*** [IQR: 0, 0]	0.3 [IQR: 0, 0]
% with at least one inpatient stay	21.7*** [21.5, 21.9]	26.7 [26.6, 26.8]	18.4*** [18.3, 18.5]	23.5 [23.4, 23.5]
% with at least one observation stay	9.5*** [9.3, 9.6]	12 [12, 12.1]	7.8*** [7.7, 7.9]	9.7 [9.7, 9.8]
% with at least one ACS hospitalization	6.6*** [6.4, 6.7]	8.8 [8.8, 8.9]	4.7*** [4.6, 4.7]	6.7 [6.6, 6.7]
% with at least one unplanned return	31.3*** [31.0, 31.7]	32.7 [32.5, 32.9]	28.1*** [27.9, 28.3]	28.2 [28.1, 28.2]

Note: Tests of significance compare users versus nonusers within rural and urban groups, respectively. Values in brackets are 95% confidence intervals unless indicated to be the interquartile range (IQR).
Abbreviations: ACS, ambulatory care sensitive; E&M, evaluation and management; ED, emergency department; FQHC, federally qualified health center.
[a]Chronic conditions included: Alzheimer's and related dementias, acute myocardial infarction, anemia, asthma, atrial fibrillation, breast cancer, colorectal cancer, endometrial cancer, lung cancer, prostate cancer, cataracts, congestive heart failure, chronic kidney disease, chronic obstructive pulmonary disease, depression, diabetes, glaucoma, hip fracture, hyperlipidemia, hyperplasia, hypertension, hyperthyroidism, ischemic heart disease, osteoporosis, rheumatoid/osteoarthritis, stroke/transient ischemic attack.
*$p < 0.01$; ***$p < 0.0001$.

Age-eligible duals are more likely to be female, less likely to be White, had more chronic conditions, and were more likely to be hospitalized than disability-eligible duals (Tables 1 and 2). Looking within each table at rural–urban differences, duals in rural counties were more likely to be White and less likely to be Asian or Hispanic than duals in urban counties. Among age-eligible duals, those in rural counties used more hospital-based care than those in urban counties, while among disability-eligible duals, those in rural counties used less hospital-based care than those in urban counties. On average, rural duals were more likely than urban duals to be FQHC users. Regardless of their basis for eligibility or their rurality of residence, FQHC users tended to be younger, more likely to be male, less likely to be White, have fewer chronic conditions (FQHC users had equal or lower rates than nonusers for each of the 26 conditions in our data when examined individually), use more primary care and less specialty and hospital-based care. Additional characteristics for FQHC users as defined at various thresholds and individuals with some FQHC use who did not meet our plurality definition are shown in Appendix Tables 1–3 of Supporting information.

3.2 | ED visits

Table 3 presents the marginal effects of FQHC use on the number of ED visits and nonemergent ED visits per 100 person-years among dual enrollees, stratified before and after the Medicare PPS was introduced (full results in Appendix Tables 4 and 5 of Supporting information). Prior to the Medicare PPS, FQHC use is associated with increased use of both ED and nonemergent ED visits in all groups except rural age-eligible duals. For example, among disability-eligible

TABLE 2 Summary statistics of disability-eligible dual enrollees, by FQHC use and rurality

	Rural		Urban	
Variable	**User**	**Nonuser**	**User**	**Nonuser**
N [person-years]	167,409	537,270	629,220	2,566,782
Mean age	49.4*** [IQR: 42, 58]	49.4 [IQR: 42, 58]	49.3*** [IQR: 42, 58]	49.5 [IQR: 42, 58]
% Male	44.3*** [44.1, 44.6]	44 [43.9, 44.2]	45.6*** [45.5, 45.7]	44.5 [44.4, 44.6]
Race/ethnicity				
% White	73.8*** [73.6, 74]	74.7 [74.6, 74.8]	51.0*** [50.8, 51.1]	61.3 [61.3, 61.4]
% Black	15.7*** [15.5, 15.9]	17.3 [17.2, 17.4]	25.7*** [25.6, 25.8]	22.6 [22.6, 22.7]
% Asian/Pacific Islander	0.6*** [0.6, 0.7]	0.4 [0.4, 0.4]	2.7*** [2.7, 2.8]	2.4 [2.3, 2.4]
% American Indian/Alaskan Native	3.1*** [3, 3.2]	2.4 [2.4, 2.5]	1.2*** [1.2, 1.3]	0.7 [0.7, 0.8]
% Hispanic	6.4*** [6.3, 6.5]	4.7 [4.6, 4.8]	18.8*** [18.7, 18.9]	12.3 [12.2, 12.3]
% Other	0.4 [0.4, 0.5]	0.4 [0.4, 0.4]	0.6*** [0.6, 0.6]	0.7 [0.7, 0.7]
Health status				
Number of chronic conditions[a]	3.0*** [IQR: 1, 4]	3.3 [IQR: 1, 5]	2.9*** [IQR: 1, 4]	3.4 [IQR: 1, 5]
Health care utilization				
Mean E&M visits to primary care provider	10.0*** [IQR: 4, 13]	6.8 [IQR: 3, 9]	9.5*** [IQR: 4, 12]	6.4 [IQR: 3, 8]
Mean E&M visits to specialist	3.8*** [IQR: 0, 5]	4.4 [IQR: 0, 6]	4.5*** [IQR: 0, 6]	6.2 [IQR: 1, 9]
Hospital-based care				
Mean total overall ED visits	1.5*** [IQR: 0, 2]	1.5 [IQR: 0, 2]	1.7*** [IQR: 0, 2]	1.5 [IQR: 0, 2]
Mean total nonemergent ED visits	0.6*** [IQR: 0, 1]	0.6 [IQR: 0, 1]	0.7*** [IQR: 0, 1]	0.6 [IQR: 0, 1]
% with at least one inpatient stay	17.1*** [16.9, 17.3]	18.9 [18.7, 19]	18.7*** [18.6, 18.8]	20.8 [20.8, 20.9]
% with at least one observation stay	6.6*** [6.4, 6.7]	7.7 [7.7, 7.8]	7.3*** [7.2, 7.3]	8.5 [8.5, 8.5]
% with at least one ACS hospitalization	3.2*** [3.1, 3.3]	3.9 [3.9, 4]	3.0*** [3.0, 3.1]	3.8 [3.8, 3.9]
% with at least one unplanned return	34.7*** [34.4, 35]	35 [34.8, 35.2]	36.2*** [36, 36.4]	35.2 [35.1, 35.3]

Note: Tests of significance compare users versus nonusers within rural and urban groups, respectively. Values in brackets are 95% confidence intervals unless indicated to be the interquartile range (IQR).

Abbreviations: ACS, ambulatory care sensitive; E&M, evaluation and management; ED, emergency department; FQHC, federally qualified health center.

[a]Chronic conditions included: Alzheimer's and related dementias, acute myocardial infarction, anemia, asthma, atrial fibrillation, breast cancer, colorectal cancer, endometrial cancer, lung cancer, prostate cancer, cataracts, congestive heart failure, chronic kidney disease, chronic obstructive pulmonary disease, depression, diabetes, glaucoma, hip fracture, hyperlipidemia, hyperplasia, hypertension, hyperthyroidism, ischemic heart disease, osteoporosis, rheumatoid/osteoarthritis, stroke/transient ischemic attack.

***$p < 0.0001$.

duals, FQHC use is associated with 5.1 more ED visits (95% CI: 2.3, 7.8) per 100 person-years among rural residents and 28.1 more ED visits per 100 person-years (95% CI: 26.0, 30.2) among urban residents. Relative to their baseline volume of ED visits, these represent increases of 3.4% and 16.5%, respectively. Similarly, among disability-eligible duals, FQHC use is associated with 2.4 more nonemergent ED visits (95% CI: 1.1, 3.7) per 100 person-years among rural residents and 13 more nonemergent ED visits (95% CI: 12.3, 13.7) per 100 person-years among urban residents, representing relative increases of 4% and 18.6%, respectively. Among age-eligible urban duals, FQHC use is associated with 12.7 more ED visits (95% CI: 11.4, 13.9) and 4.6 more nonemergent ED visits (95% CI: 3.9, 5.3) per 100 person-years. These represent increases of 12.7% and 15.3%, relative to baseline.

However, following the introduction of the Medicare PPS, the relationship between FQHC use and both ED and nonemergent ED visits changed. In urban areas, FQHC use was no longer significantly associated with ED or nonemergent ED use among age-eligible duals, and among disability-eligible duals, FQHC use remained associated with an increase in ED and nonemergent ED visits, but the effect sizes decreased by 62% and 69%, respectively. Meanwhile, in rural areas, post-PPS FQHC use is associated with 14.8 fewer ED visits (95% CI: −17.5, −12.1) and 6.6 fewer nonemergent ED visits (95% CI: −7.5, −5.6) per 100 person-years among age-eligible duals and 11.3 fewer ED visits (95% CI: −14.4, −8.3) and 6 fewer nonemergent ED visits (95% CI: −7.4, −4.6) per 100 person-years among disability-eligible duals. Relative to baseline, these represent decreases of 12.3% and 16.5% among the age-eligible and 7.5% and 10% among the disability-eligible duals.

3.3 | Other hospital-based care outcomes

Table 3 also presents the marginal effects from our four linear probability models of duals having an observation stay, inpatient hospitalization, ACS hospitalization, or 30-day unplanned return as a function

TABLE 3 Marginal effects from main model of count and binary outcomes for dual enrollees, by reason for eligibility, rurality, and pre- versus post-prospective payment system transition

	Age-eligible				Disability-eligible			
	Rural		Urban		Rural		Urban	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Count outcomes[a]								
N [person-years]	666,530		3,916,547		704,679		3,196,002	
Total ED visits per 100 person-years	−0.0 [−2.4, 2.3]	−14.8* [−17.5, −12.1]	12.7* [11.4, 13.9]	0.6 [−0.4, 1.6]	5.1* [2.3, 7.8]	−11.3* [−14.4, −8.3]	28.1* [26.0, 30.2]	10.6* [8.4, 12.8]
Total nonemergent ED Visits per 100 person-years	−0.9 [−1.9, 0.1]	−6.6* [−7.5, −5.6]	4.6* [3.9, 5.3]	0.1 [−0.2, 0.4]	2.4* [1.1, 3.7]	−6.0* [−7.4, −4.6]	13.0* [12.3, 13.7]	4.0* [2.6, 5.4]
Binary outcomes[b]								
Inpatient stay	−0.2 [−0.7, 0.2]	−0.9 [−1.7, −0.1]	2.1* [1.9, 2.3]	1.1* [0.7, 1.5]	−0.4 [−0.8, 0.1]	−0.2 [−0.7, 0.2]	1.5* [1.3, 1.7]	0.8* [0.7, 1.0]
Observation stay	0.5 [−0.0, 1.0]	−0.8* [−1.2, −0.3]	1.1* [0.9, 1.2]	0.1 [−0.1, 0.3]	−0.1 [−0.4, 0.3]	−0.4* [−0.5, −0.2]	0.7* [0.6, 0.8]	0.1 [0.0, 0.2]
ACS hospitalization	−0.1 [−0.3, 0.1]	−0.4 [−0.7, −0.0]	0.9* [0.7, 1.0]	0.5* [0.3, 0.8]	−0.2 [−0.4, 0.0]	−0.1 [−0.2, 0.0]	0.2* [0.2, 0.3]	0.3* [0.2, 0.4]
Unplanned return[c]	−0.4 [−1.1, 0.3]	−2.1* [−2.7, −1.5]	2.1* [1.8, 2.4]	0.1 [−0.5, 0.6]	0.2 [−0.4, 0.8]	−1.9* [−2.4, −1.5]	2.9* [2.8, 3.1]	0.7* [0.4, 1.1]
N [person-years]	345,618		1,704,960		364,394		1,633,311	

Note: Values in brackets are 95% confidence intervals.

Abbreviations: ACS, ambulatory care sensitive; ED, emergency department.

[a]Count outcomes are reported as the change in the number of visits per 100 person-years.

[b]Binary outcomes are reported as percentage point changes.

[c]The unplanned return analysis is limited to the subsample of enrollees with at least one index ED visit, observation stay, or inpatient hospitalization.

*$p < 0.01$.

TABLE 4 Marginal effects of main modes at varying levels of FQHC use among dual enrollees, pre and post transition to the prospective payment system [reported as percentage point changes]

	Plurality		> 50%		≥ 75%		100%	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Rural age-eligible dual enrollees								
Total ED visits	−0.0 [−2.4, 2.3]	−14.8* [−17.5, −12.1]	−0.5 [−2.9, 1.8]	−15.2* [−18.1, −12.3]	−1.6 [−3.4, 0.3]	−16.6* [−19.2, −14.0]	−3.2* [−5.2, −1.2]	−18.0* [−19.7, −16.3]
Nonemergent ED visits	−0.9 [−1.9, 0.1]	−6.6* [−7.5, −5.6]	−1.1 [−2.2, 0.0]	−6.7* [−7.7, −5.8]	−2.0* [−2.9, −1.0]	−7.8* [−8.4, −7.1]	−3.3* [−4.4, −2.2]	−9.3* [−10.3, −8.3]
Inpatient stay	−0.2 [−0.7, 0.2]	−0.9 [−1.7, −0.1]	−0.2 [−0.7, 0.2]	−0.9 [−1.7, −0.1]	−0.1 [−0.6, 0.4]	−0.8 [−1.5, 0.0]	0.3 [−0.2, 0.8]	0.0 [−0.9, 0.9]
Observation stay	0.5 [−0.0, 1.0]	−0.8* [−1.2, −0.3]	0.5 [−0.0, 1.0]	−0.7* [−1.1, −0.4]	0.5 [−0.0, 1.1]	−0.7* [−1.1, −0.4]	0.5 [0.0, 0.9]	−0.6* [−0.9, −0.3]
ACS hospitalization	−0.1 [−0.3, 0.1]	−0.4 [−0.7, −0.0]	−0.1 [−0.4, 0.1]	−0.4 [−0.7, −0.0]	−0.1 [−0.3, 0.1]	−0.3 [−0.7, 0.1]	0.1 [−0.1, 0.3]	0.1 [−0.3, 0.5]
Unplanned return	−0.4 [−1.1, 0.3]	−2.1* [−2.7, −1.5]	−0.5 [−1.2, 0.2]	−2.1* [−2.7, −1.6]	−0.6 [−1.3, 0.1]	−2.3* [−2.9, −1.8]	−0.8 [−1.6, −0.0]	−2.7* [−3.5, −1.9]
Urban age-eligible dual enrollees								
Total ED visits	12.7* [11.4, 13.9]	0.6 [−0.4, 1.6]	12.3* [11.1, 13.5]	0.4 [−0.7, 1.4]	11.7* [10.6, 12.7]	−0.8 [−1.9, 0.3]	10.2* [9.4, 11.1]	−1.9* [−3.0, −0.8]
Nonemergent ED visits	4.6* [3.9, 5.3]	0.1 [−0.2, 0.4]	4.5* [3.8, 5.2]	0.0 [−0.3, 0.3]	3.9* [3.3, 4.4]	−0.6* [−0.9, −0.3]	2.6* [2.1, 3.1]	−2.0* [−2.2, −1.7]
Inpatient stay	2.1* [1.9, 2.3]	1.1* [0.7, 1.5]	2.1* [1.9, 2.2]	1.0* [0.7, 1.4]	2.2* [2.0, 2.4]	1.1* [0.7, 1.5]	2.4* [2.2, 2.6]	1.7* [1.3, 2.1]
Observation stay	1.1* [0.9, 1.2]	0.1 [−0.1, 0.3]	1.0* [0.9, 1.2]	0.1 [−0.1, 0.3]	1.1* [0.9, 1.2]	0.1 [−0.1, 0.3]	1.1* [0.9, 1.3]	0.2 [0.0, 0.4]
ACS hospitalization	0.9* [0.7, 1.0]	0.5* [0.3, 0.8]	0.9* [0.7, 1.0]	0.5* [0.2, 0.8]	0.9* [0.8, 1.1]	0.6* [0.3, 0.9]	1.1* [0.9, 1.2]	0.9* [0.5, 1.2]
Unplanned return	2.1* [1.8, 2.4]	0.1 [−0.5, 0.6]	2.1* [1.8, 2.4]	0.0 [−0.5, 0.6]	2.0* [1.7, 2.4]	−0.1 [−0.7, 0.5]	1.9* [1.5, 2.3]	−0.1 [−0.7, 0.6]
Rural disability-eligible dual enrollees								
Total ED visits	5.1* [2.3, 7.8]	−11.3* [−14.4, −8.3]	3.6 [1.2, 5.9]	−12.8* [−16.1, −9.6]	−0.5 [−2.7, 1.7]	−16.1* [−19.5, −12.7]	−6.2* [−8.6, −3.8]	−19.6* [−22.0, −17.1]
Nonemergent ED visits	2.4* [1.1, 3.7]	−6.0* [−7.4, −4.6]	1.9 [0.5, 3.2]	−6.7* [−8.0, −5.3]	−0.2 [−1.5, 1.2]	−8.2* [−9.5, −7.0]	−3.5* [−5.1, −2.0]	−10.1* [−11.5, −8.6]
Inpatient stay	−0.4 [−0.8, 0.1]	−0.2 [−0.7, 0.2]	−0.5 [−0.8, −0.1]	−0.3 [−0.8, 0.2]	−0.6* [−1.0, −0.3]	−0.4 [−0.9, 0.0]	−0.6* [−1.0, −0.2]	−0.0 [−0.4, 0.3]
Observation stay	−0.1 [−0.4, 0.3]	−0.4* [−0.5, −0.2]	−0.1 [−0.5, 0.3]	−0.4* [−0.6, −0.3]	−0.2 [−0.5, 0.2]	−0.5* [−0.6, −0.4]	−0.3 [−0.7, 0.2]	−0.3* [−0.5, −0.2]
ACS hospitalization	−0.2 [−0.4, 0.0]	−0.1 [−0.2, 0.0]	−0.2 [−0.4, −0.0]	−0.1 [−0.2, 0.0]	−0.2 [−0.4, −0.0]	−0.0 [−0.1, 0.0]	−0.0 [−0.2, 0.1]	0.3* [0.1, 0.4]
Unplanned return	0.2 [−0.4, 0.8]	−1.9* [−2.4, −1.5]	0.0 [−0.6, 0.7]	−2.0* [−2.4, −1.6]	−0.4 [−1.1, 0.3]	−2.5* [−3.0, −1.9]	−1.0* [−1.5, −0.5]	−3.0* [−3.4, −2.5]
Urban disability-eligible dual enrollees								
Total ED visits	28.1* [26.0, 30.2]	10.6* [8.4, 12.8]	26.6* [24.4, 28.9]	9.3* [6.9, 11.7]	23.4* [21.3, 25.5]	6.4* [4.6, 8.3]	17.8* [15.6, 20.1]	1.2 [−0.6, 3.0]
Nonemergent ED visits	13.0* [12.3, 13.7]	4.0* [2.6, 5.4]	12.4* [11.6, 13.3]	3.5* [2.1, 5.0]	10.6* [9.5, 11.6]	2.3* [1.1, 3.5]	7.1* [6.1, 8.2]	−0.6 [−2.1, 0.9]
Inpatient stay	1.5* [1.3, 1.7]	0.8* [0.7, 1.0]	1.5* [1.3, 1.7]	0.8* [0.6, 0.9]	1.5* [1.2, 1.7]	0.8* [0.6, 0.9]	1.4* [1.2, 1.7]	0.9* [0.7, 1.1]
Observation stay	0.7* [0.6, 0.8]	0.1 [0.0, 0.2]	0.7* [0.6, 0.8]	0.1 [−0.0, 0.2]	0.7* [0.6, 0.8]	0.1 [−0.0, 0.2]	0.6* [0.5, 0.8]	0.2 [0.0, 0.3]
ACS hospitalization	0.2* [0.2, 0.3]	0.3* [0.2, 0.4]	0.2* [0.2, 0.3]	0.3* [0.2, 0.3]	0.3* [0.2, 0.4]	0.4* [0.3, 0.4]	0.4* [0.3, 0.4]	0.5* [0.4, 0.7]
Unplanned return	2.9* [2.8, 3.1]	0.7* [0.4, 1.1]	2.8* [2.6, 3.0]	0.6* [0.3, 1.0]	2.4* [2.1, 2.7]	0.3 [0.0, 0.7]	2.0* [1.7, 2.3]	0.0 [−0.4, 0.4]

Note: Values in brackets are 95% confidence intervals.

Abbreviations: ACS, ambulatory care sensitive; ED, emergency department; FQHC, federally qualified health center.

*$p < 0.01$.

of FQHC use before and after the Medicare PPS transition (full results in Appendix Tables 6 and 7 of Supporting information). Prior to the Medicare PPS, there is no statistically significant relationship between FQHC use and our outcomes among rural duals, regardless of reason for eligibility. However, among both age- and disability-eligible duals in urban counties, FQHC use in the pre-PPS period was associated with an increase in the probability of each of our binary outcomes of hospital-based care. Among age-eligible duals in urban counties, FQHC use is associated with increases in the probability of observation (1.1 percentage points [95% CI: 0.9, 1.2]), inpatient hospitalization (2.1 percentage points [95% CI: 1.9, 2.3]), ACS hospitalization (0.9 percentage points [95% CI: 0.7, 1.0]), and unplanned returns (2.1 percentage points [95% CI: 1.8, 2.4]). Relative to baseline, these represent respective increases of 14.1%, 11.4%, 19.1%, and 7.5%. Among disability-eligible duals in urban counties, FQHC use is associated with increases in the probability of observation stays (0.7 percentage points [95% CI: 0.6, 0.8]), inpatient hospitalization (1.5 percentage points [95% CI: 1.3, 1.7]), ACS hospitalization (0.2 percentage points [95% CI: 0.2, 0.3]), and unplanned returns (2.9 percentage points [95% CI: 2.8, 3.1]). Relative to baseline, these represent respective increases of 9.6%, 8%, 6.7%, and 8%.

As with ED visits, the relationship between FQHC use and other hospital-based care also changed markedly following the introduction of the Medicare PPS. In rural areas, FQHC use becomes associated with significant reductions in both observation stays and unplanned returns, regardless of the reason for eligibility. Specifically, FQHC use is associated with a 0.8 percentage point decrease in the probability of experiencing an observation stay (95% CI: −1.2, −0.3) among age-eligible duals and a 0.4 percentage point decrease (95% CI: −0.5, −0.2) among disability-eligible duals. Relative to baseline, these represent decreases of 8.4% and 6.1%, respectively. Similarly, FQHC use is associated with a 2.1 percentage point decrease in the probability of experiencing an unplanned return (95% CI: −2.7, −1.5) among age-eligible duals and a 1.9 percentage point decrease (95% CI: −2.4, −1.5) among disability-eligible duals. Relative to baseline, these represent decreases of 6.7% and 5.5%, respectively. In urban counties post-PPS, FQHC use remained associated with an increased probability of inpatient and ACS hospitalizations among both age- and disability-eligible duals, despite decreasing in magnitude by roughly 50%. FQHC use also continued to be associated with an increased probability of experiencing an unplanned return, but only among disability-eligible duals.

3.4 | Examining increasingly restrictive definitions of FQHC use

To evaluate the robustness of our findings to differing thresholds for defining FQHC user, we conducted sensitivity analyses in which FQHC users were defined based on receiving a majority (>50%), supermajority (75% or more), or all (100%) of their primary care at an FQHC. Overall, we found consistent evidence that higher levels of FQHC use were associated with reductions in the amount of ED and nonemergent ED visits and the probability of observation stays, inpatient hospitalizations, and ACS hospitalizations as shown in Table 4. The relationships between FQHC use and hospital-based care were strengthened monotonically with increasingly restrictive measures of FQHC use. In cases where FQHC use was associated with reductions in hospital-based care, the magnitude of those reductions increased, and in many cases where we identified FQHC use as associated with increases in hospital-based care, it became associated with smaller increases or even reductions in hospital-based care at higher levels of FQHC use. For duals receiving 100% of their primary care at FQHCs, the only outcomes positively associated with FQHC use following the Medicare PPS transition were inpatient and ACS hospitalization among age- and disability-eligible duals in urban counties and ACS hospitalization among disability-eligible duals in rural counties.

3.5 | Additional sensitivity analyses

We also conducted several additional sensitivity analyses. First, because FQHC user thresholds might be sensitive to an individual's volume of primary care visits, we repeated our analyses, excluding individuals with only one primary care visit. Our results (Appendix Tables 8 and 9 of Supporting information) remained consistent. Second, because individuals residing in nursing facilities have higher rates of hospital-based care,[55] we repeated our analyses, excluding individuals who received primary care in a nursing facility. Our results (Appendix Tables 10 and 11 of Supporting information) remained consistent with some slight increases in the magnitude of the marginal effects. Third, we conducted a sub-analysis among individuals with a diabetes or congestive heart failure (CHF) diagnosis, because several ACS hospitalization indicators require these diagnoses, and differences in the underlying distribution of duals with these diagnoses between FQHC users and nonusers might lead to spurious correlations. Our results (Appendix Table 12 of Supporting information) suggest that FQHC use is associated with a reduction in ACS hospitalization among patients with diabetes and CHF, particularly under the Medicare PPS. Finally, to account for potential selection bias, we estimated our main models using a propensity score matched sample. We modeled the likelihood of FQHC use as a function of age, sex, race/ethnicity, total E&M visits, and indicators for specific chronic conditions. Then, we matched five nonusers to each FQHC user using a caliper of 0.25. While 42.9% of our sample went unmatched, our marginal effects (Appendix Table 13 of Supporting information) remained consistent with only small changes in effect size or significance (full results in Appendix Tables 14–17 of Supporting information).

4 | DISCUSSION

In this nationwide study of dually-enrolled individuals living in areas with access to an FQHC, we sought to understand the relationship between FQHC use and the broader continuum of hospital-based care. Overall, we found that this relationship varied significantly

across rural and urban areas and was dramatically influenced by reimbursement changes when FQHCs transitioned to the Medicare PPS in late 2014. Prior to the Medicare PPS, we found that FQHC use was not associated with hospital-based care in rural areas but was associated with increased hospital-based care in urban areas. Following the Medicare PPS, FQHC use was associated with less hospital-based care. This took the form of actual decreases (e.g., fewer ED visits among rural FQHC users) or the attenuation of increases seen in the pre-PPS period, such that FQHC use was no longer associated with hospital-based care or was associated with smaller increases in our outcomes. We also found that the relationship was sensitive to the threshold used to define individuals as FQHC users. As we relied on an increasingly restrictive measure of FQHC use, we found that duals receiving care from FQHCs were generally less likely to use hospital-based care regardless of their reason for eligibility or whether they were urban or rural residents. This suggests that—particularly in urban counties with an ample supply of other primary care providers—defining FQHC use based on a plurality of visits may result in defining some individuals as FQHC users who only receive 20%–30% of their visits in an FQHC, which may be insufficient to accrue the benefits of FQHC-based primary care. Alternatively, FQHC use may appear more beneficial when using a more restrictive threshold if individuals who receive nearly all their primary care at an FQHC do so because they lack accessible alternatives. In this case, FQHCs are serving the population at the greatest risk of forgoing care. In either case, our findings suggest that receiving a higher proportion of primary care in FQHCs is associated with reductions in the use of hospital-based care among dual enrollees.

While the receipt of primary care in general—and at FQHCs specifically—has been previously associated with a reduction in ED visits, nonemergent ED visits, and potentially avoidable hospitalizations, few of these studies have included dual enrollees, fewer still have been national in scope, and most have used aggregated—rather than person-level—data.[30–36,56] This limits the ability to examine the relationship between FQHC use and hospital-based care. By contrast, we used person-level data to capture actual patterns of utilization and fixed effects at the ZIP code level to ensure that we compared individuals who lived near one another and had similar access to health care and other resources—particularly since FQHCs must be in medically underserved areas or serve medically underserved populations. Prior work has found FQHC use to be associated with more ED visits,[37–39,57] which we also found under certain circumstances. Yet we also found that post-PPS, FQHC use was associated with reductions in ED visits in rural areas, had no effect on ED visits among urban age-eligible duals, and was associated with much smaller increases in ED visits than before the Medicare PPS among urban disability-eligible duals. We also found even larger reductions in ED visits among individuals receiving higher proportions of primary care in FQHCs.

The ED is the most common pathway by which patients are hospitalized.[58–60] Thus, our finding that the direction and magnitude of the relationship between FQHC use and hospitalization generally tracks the relationship between FQHC use and ED visits is not surprising. It suggests that the more (or less) often duals visit the ED, the more (or less) opportunities they have to be hospitalized. Again, we observed stark differences in the relationship between FQHC use and hospitalization before and after the Medicare PPS. In rural areas, FQHC use went from being unassociated with hospitalization pre-PPS to being associated with reductions in observation and unplanned returns post-PPS. In urban areas, FQHC use went from being associated with increases in the probability of all our hospitalization measures pre-PPS to being associated with much smaller increases in the probability of only some of our hospitalization measures post-PPS. Moreover, in stratified analyses of patients with diabetes and CHF, FQHC use is consistently associated with fewer ACS hospitalizations, particularly post-PPS. This suggests that FQHCs are providing primary care to a disproportionate share of patients with diabetes and CHF.

The marked change in results following the introduction of the Medicare PPS suggests two related explanations. The first is the Medicare PPS itself, which was projected to increase Medicare revenues at FQHCs by 30%.[29] These additional resources may have better equipped FQHCs to provide high-quality primary care, expand primary care access, and keep duals from using hospital-based care. Second, our Medicare PPS indicator coincides closely with the Medicaid expansion and the creation of the Community Health Center Fund under the ACA.[61] Together, these policy changes led to increased revenue for FQHCs, enabling them to increase their service capacity and expand access to care.[62,63] Similar to the PPS, it is reasonable to expect that increased revenues would enhance FQHCs' ability to provide high-quality primary care. Our analysis does not delineate these policies, but FQHCs in Medicaid expansion states experienced improvements in quality outcomes,[64–67] and it is reasonable to expect positive spillover effects among duals at these FQHCs, even though Medicare is the primary payer for duals.

This study has several limitations. First, we exclude Medicare Advantage enrollees. Therefore, our results may not generalize to duals enrolled in managed care. Second, to ensure equal measurement periods, we excluded those who died during the year, which reduces generalizability as our sample is likely healthier. Third, our definition of primary care excludes instances in which enrollees rely on specialists for their primary care. Fourth, while we use nonemergent ED visits as an outcome, there has been well-justified criticism of the limitations inherent in the post hoc classification of ED visits as nonemergent.[68–70] Fortunately, we find that the relationship between FQHC use and ED visits does not depend on whether those visits are classified as nonemergent. Fifth, while we use a granular level of geography—ZIP code fixed effects—to compare similarly situated FQHC users and nonusers, individual patient decisions regarding whether to seek care at an FQHC may introduce selection bias. While we found similar results using propensity score matching, this method cannot account for unobserved confounders. Sixth, while partially captured by our FQHC use measure, we do not explicitly account for provider or organizational continuity of care, which may play an important role in reducing hospital-based care. Finally, while we interpret reductions in hospital-based care as desirable, they may reflect underuse. Claims data cannot be used to identify needed care that was not received. However, we selected several outcomes typically

deemed to be potentially avoidable and are reassured that the relationship between FQHC use and those outcomes parallels that of our other measures of hospital-based care.

Overall, our findings suggest that FQHC use is generally associated with reductions in hospital-based care among duals, particularly after 2014 when major provisions of the Affordable Care Act—including the Medicare PPS and Medicaid expansion went into effect. A large body of evidence supports that FQHCs are high-quality, cost-effective providers that increase access to primary care for marginalized and underserved populations. While our findings add to this literature and are supportive of the value of FQHCs in caring for dual enrollees, they are unlikely to represent a one-size-fits-all solution. Duals are a heterogenous population by virtue of their pathway to eligibility, which varies from state to state, the nature of the communities in which they live, and their own personal contexts including social supports. In short, some duals likely face more barriers to care than others, and our findings suggest they may benefit from receiving care at an FQHC. Our findings also suggest—albeit crudely—that investing additional resources into FQHCs may enhance their ability to provide this care. Further research is needed to better understand the nature of the heterogeneity among duals, which characteristics may enable some FQHCs to serve duals better than other settings (including lower-performing FQHCs), and how best to utilize FQHCs to meet the needs of this population in ways that most effectively reduce hospital-based care.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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