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ARTICLE

Is the emergency department used as a substitute or a complement to primary care in Medicaid?

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Abstract
Policies to decrease low-acuity emergency department (ED) use have traditionally assumed that EDs are a substitute for unavailable primary care (PC). However, such policies can exacerbate ED overcrowding, rather than ameliorate it, if patients use EDs to complement, rather than substitute, their PC use. We tested whether Medicaid managed care enrolees visit the ED for nonemergent and PC treatable conditions to substitute for or to complement PC. Based on consumer choice theory, we modelled county-level monthly ED visit rate as a function of PC supply and used 2012–2015 New York Statewide Planning and Research Cooperative System (SPARCS) outpatient data and non-linear least squares method to test substitution vs complementarity. In the post-Medicaid expansion period (2014–2015), ED and PC are substitutes state-wide, but are complements in highly urban and poorer counties during nights and weekends. There is no evidence of complementarity before the expansion (2012–2013). Analyses by PC provider demonstrate that the relationship between ED and PC differs depending on whether PC is provided by physicians or advanced practice providers. Policies to reduce low-acuity ED use via improved PC access in Medicaid are likely to be most effective if they focus on increasing actual appointment availability, ideally by physicians, in areas with low PC provider supply. Different aspects of PC access may be differently related to low-acuity ED use.

Keywords: Medicaid; emergency department; primary care; health economics; substitute; complement

1. Introduction

Policy solutions targeting emergency department (ED) overcrowding are typically based on a widely shared idea that low-acuity ED visits occur when patients substitute the ED for unavailable primary care. Indeed, the steady increase in ED visits in the United States over the last few decades (Tang *et al.*, 2010; The American Hospital Association, 2015), concurrent with exacerbating issues regarding primary care supply and access (Bodenheimer, 2006; Song *et al.*, 2015; Ganguli *et al.*, 2019), points to substitution between the two types of care. The opposite phenomenon – complementarity between the ED and primary care – has not been given as much attention in health policy discussions. To our knowledge, whether the ED is used as a substitute or a complement to primary care has not been empirically tested based on rigorous theory-based hypotheses in prior research; however, answering this question is key to designing effective policies that reduce ED overcrowding as such policies would differ drastically based on this relationship.

ED overcrowding is a widely recognised and long-standing phenomenon (Derlet *et al.*, 2001; Weiss *et al.*, 2004; Burt and McCaig, 2006; United States Government Accountability Office, 2009) and is considered a national epidemic by the Institute of Medicine in the United States (Institute of Medicine, 2007). Overcrowding occurs when ED demand exceeds ED capacity. Both demand for care and its supply contribute to overcrowding (Burt and McCaig, 2006). While ED demand has been steadily increasing over the past few decades, the number of EDs in operation has declined. Nationwide in the US, between 1993 and 2013, ED visit rate increased by 18%, while the number of EDs decreased by 13% (The American Hospital Association, 2015). Between 1997 and 2007, the total annual number of ED visits almost doubled what would be expected from population growth (Tang *et al.*, 2010). Additionally, on the supply side, ED boarding – a practice of keeping a patient in need of a hospital admission in the ED until an inpatient bed becomes available – further aggravates the problem of overcrowding (Institute of Medicine, 2007; United States Government Accountability Office, 2009).

In this paper, we focus on the demand for ED care. Observed ED demand has been outpacing what would be expected based on population growth, leaving many EDs facing severe challenges related to overcrowding. A nontrivial portion of ED demand, particularly for low-acuity conditions, could be met in non-ED care settings (Billings *et al.*, 2000; Uscher-Pines *et al.*, 2013). From the clinical standpoint, ED visits for low-acuity conditions are substitutable at the primary care level. However, since seeking health care is driven primarily by patients themselves, it is important to test whether patients actually substitute the ED for PC. While discussions of substitution and complementarity are common in the literature (Billings *et al.*, 2000; Lowe *et al.*, 2005, 2009; Haltiwanger *et al.*, 2006; Lozano *et al.*, 2015; Weisz *et al.*, 2015; Xin *et al.*, 2015; Sommers and Simon, 2017), there is little empirical evidence establishing whether patients in fact substitute ED care for unavailable primary care. Nevertheless, many policies, including the Affordable Care Act (ACA) in the United States (The White House, 2009*b*, 2013*b*, 2009*a*, 2013*a*), as well as some researchers (Ellis and Esson, 2021), seem to take substitution between ED care and primary care as a given.

Importantly, policy implications will differ dramatically, depending on whether the ED and primary care are used as substitutes or complements. If patients substitute ED care for primary care, then expansions of access to the latter should decrease ED use, usually a desired outcome. If, however, patients view primary care and ED care as complements, then expanding access to primary care – via insurance expansions, primary clinic after-hours, or, more recently, telehealth appointments – will instead increase ED use, exacerbating pressures on the ED. If policy makers assume substitution in designing policies to address high ED use and ED overcrowding, an unintended opposite effect may occur.

Whether the ED is used as a substitute or a complement likely depends on the population. This paper tests whether primary care and ED care for primary care treatable conditions (which, from the clinical standpoint, can be addressed at the primary care level) are used as substitutes or complements in the Medicaid population. Medicaid is a public insurance programme for low-income individuals that is jointly funded by the United States federal and state governments and managed by the states. Our choice of population is dictated by two considerations. First, reliance on the ED is particularly common among patients with Medicaid coverage, relative to privately insured and even the uninsured (Zuckerman and Shen, 2004; Amini *et al.*, 2015). In 2009, adult Medicaid recipients had the highest rates of visits deemed 'nonemergent', 515 visits per 1000 people, substantially higher than Medicare beneficiaries (222 visits), the uninsured (189 visits), and privately insured (104 visits) (Gandhi *et al.*, 2014). Second, although economic theory suggests that expanding access to health insurance could either increase or decrease ED use (Sommers and Simon, 2017), multiple studies demonstrate that ED visit rates in Medicaid increase following Medicaid expansions (though the effect on the likelihood of an enrolee visiting the ED can vary) in the first three years. Studies from the Oregon Health Insurance Experiment (OHIE) show that ED visit rates increase by 40–63% among those who enrolled into Medicaid,

compared to the control group (Taubman *et al.*, 2014; Finkelstein *et al.*, 2016) particularly for primary care treatable conditions (Taubman *et al.*, 2014). Several studies on the ACA Medicaid expansion have reported increases in the ED visit rate among patients with Medicaid coverage in the first one to three years, both compared to such rates before the expansion and to those who remained uninsured (Barakat *et al.*, 2017; Dresden *et al.*, 2017; Klein *et al.*, 2017; Nikpay *et al.*, 2017; Giannouchos *et al.*, 2021), with some not finding evidence of changes (Sommers *et al.*, 2016*a*, 2016*b*; Gotanda *et al.*, 2020) (which does not contradict the significant findings above). Even states with the lowest proportional change in Medicaid eligibility thresholds saw increases in the ED visit rate in the first post-expansion year (Nikpay *et al.*, 2017). It is worth noting that after four years of expansion, a recent study found statistically significant decreases in non-emergent, primary care treatable and potentially preventable ED visit rates in the non-elderly adult population (effects specifically by Medicaid status were not estimated) (Giannouchos *et al.*, 2022).

In the context of Medicaid expansions' impact on the ED visit rate and the unyielding ED overcrowding problem, it is particularly important to understand why Medicaid patients seek ED care for low-acuity conditions at high rates. Many researchers and policy makers have stated that people use EDs for low-acuity conditions as a substitute for unavailable primary care (Billings *et al.*, 2000; Haltiwanger *et al.*, 2006; Lozano *et al.*, 2015; Weisz *et al.*, 2015; McMichael *et al.*, 2019), especially in Medicaid where barriers to primary care are common (Asplin *et al.*, 2005; Cheung *et al.*, 2012; Decker, 2012; Rhodes *et al.*, 2014; Hing *et al.*, 2015; Basseyn *et al.*, 2016; Bhandari *et al.*, 2016). Despite long wait times, the ED is generally more accessible than primary care because PC clinics have limited working hours, require appointments, and may not take all insurance plans, while the ED is always open, does not require appointments, and must see and evaluate patients under the Emergency Medical Treatment and Labor Act (EMTALA). Inequitable structures and practices in health care and beyond also contribute to disadvantages in accessing PC for Medicaid enrolees. For example, some PC providers may informally limit appointment availability to patients with Medicaid coverage due to relatively low reimbursement rates in Medicaid. Another example is that EDs tend to be located in inner cities, where lower-income families reside, while PC clinics are often located in the suburbs, which are typically higher-income. The relative ease of accessing the ED, in combination with potentially low confidence in primary care (Coster *et al.*, 2017), may underlie substitution between the ED and PC in Medicaid.

Patients may indeed substitute ED care for the unavailable primary care. Because evidence shows that ED visits are more commonly made when primary clinics are closed (Pitts *et al.*, 2010), substitution may be particularly relevant during nights and weekends. Conversely, patients may use both ED and primary care in combination to meet their healthcare needs, i.e. in a complementary way. For instance, the rates of PC visits and ED visits were positively associated among patients with Medicaid coverage in New York City (Billings and Raven, 2013). While discussions of substitution and complementarity are common in the literature (Billings *et al.*, 2000; Lowe *et al.*, 2005, 2009; Haltiwanger *et al.*, 2006; Lozano *et al.*, 2015; Weisz *et al.*, 2015; Xin *et al.*, 2015; Sommers and Simon, 2017), to our knowledge, only one study explicitly tested the economic relationship, finding weak evidence of complementarity (Finkelstein *et al.*, 2016). Their framework, however, did not account for the fact that Medicaid enrolees face severe barriers to primary care, which is an established phenomenon (Asplin *et al.*, 2005; Cheung *et al.*, 2012; Decker, 2012; Rhodes *et al.*, 2014; Hing *et al.*, 2015; Basseyn *et al.*, 2016; Bhandari *et al.*, 2016).

Unlike previous research, this study tests whether the ED is used as a substitute or a complement to primary care using a theoretical framework that explicitly results in empirically testable hypotheses. Our first objective was to empirically test whether ED care and primary care are used as substitutes or complements for primary care treatable conditions in the Medicaid population following Medicaid expansion. We repeated the test in county subgroups on the urban-rural continuum and by county poverty level. We then repeated these analyses in the period preceding

Medicaid expansion (2012–2013), and compared these findings to the post-expansion period, to understand how use of the ED in relation to primary care changed. Our second objective was to examine the relationship between ED use and primary care availability by type of provider in Medicaid, since policies aimed at decreasing ED use by channelling patients into primary care often target primary care delivery (Bradley *et al.*, 2012; Pourat *et al.*, 2015; Capp *et al.*, 2017).

2. Materials and methods

2.1 Theoretical framework

Drawing on conceptual definitions from the economics literature (described in the Appendix), we define medical services substitutes as medical services such that one can be used in place of another in order to satisfy a perceived medical care need to a similar extent. We define medical services complements as medical services that either satisfy a perceived medical care need when consumed in combination, or because use of one results in the use of another. As shown in the Appendix, substitutes and complements are formally defined in terms of cross-price elasticity (where price can be non-monetary, e.g. time spent). However, cross-price elasticity, or knowing the price in the first place, is not required to identify substitution vs complementary, as described below.

The joint demand for ED care and PC is graphically represented in consumer choice theory. In the case of substitutes, the joint demand is represented by a plane of smooth convex indifference curves (Santerre and Neun, 2010). Each indifference curve represents possible bundles of equal utility. These possibilities are constrained by the budget, or time, that one has, which is typically represented by a downward-sloping straight line. As shown in Figure 1a, the optimal bundle of demanded health services within a given budget or amount of available time is determined by the point of tangency between an indifference curve (I) and the budget or time constraint line (C), at PC* and ED*. With sufficient PC supply (PC supply right of PC*, e.g. PC_1), these services are demanded at the optimal bundle levels. When PC supply is not sufficient (PC supply left of PC*, e.g. PC_2), the levels of services demanded are determined by the intersection of the constraint line and the PC supply (at PC_2 and ED_2), providing the largest utility given the budget or time constraint and the restricted supply.

In the case of complements, the joint demand for ED care and PC is represented by a plane of L-shaped curves (Santerre and Neun, 2010). As shown in Figure 1b, the optimal bundle of demanded health services is at the intersection of the corner of an L-shaped curve and the constraint line, at PC* and ED*. With sufficient PC supply (PC supply right of PC*), the services are demanded at the optimal bundle levels. When PC supply is not sufficient (PC supply left of PC*), the demand shifts to the corner of a lower L-shaped curve (L_2), whose vertical line coincides with the PC supply.

Demand for ED care is therefore a function (F) of PC supply in both cases. When PC supply is sufficient, ED care demand remains constant regardless of the amount of supply. When PC supply is insufficient, ED care demand increases in the case of substitutes and decreases in the case of complements. The function of ED care on PC supply is therefore a two-spline function, with a horizontal right spline and the left spline being negatively sloped (indicating substitution; Figure 1a) or positively sloped (indicating complementarity; Figure 1b). Note that using graphical representations of indifference curves based on consumer choice theory and variation in PC supply allows us to differentiate between substitutes and complements without investigating the sign of the cross-price elasticity. Two examples of empirical fit are given in Figure 1c (substitution) and Figure 1d (complementarity).

2.2 Data sources

We obtained 2012–2015 ED visit data from New York's Statewide Planning and Research Cooperative System (SPARCS) Outpatient File. This file contains encounter-level data for all
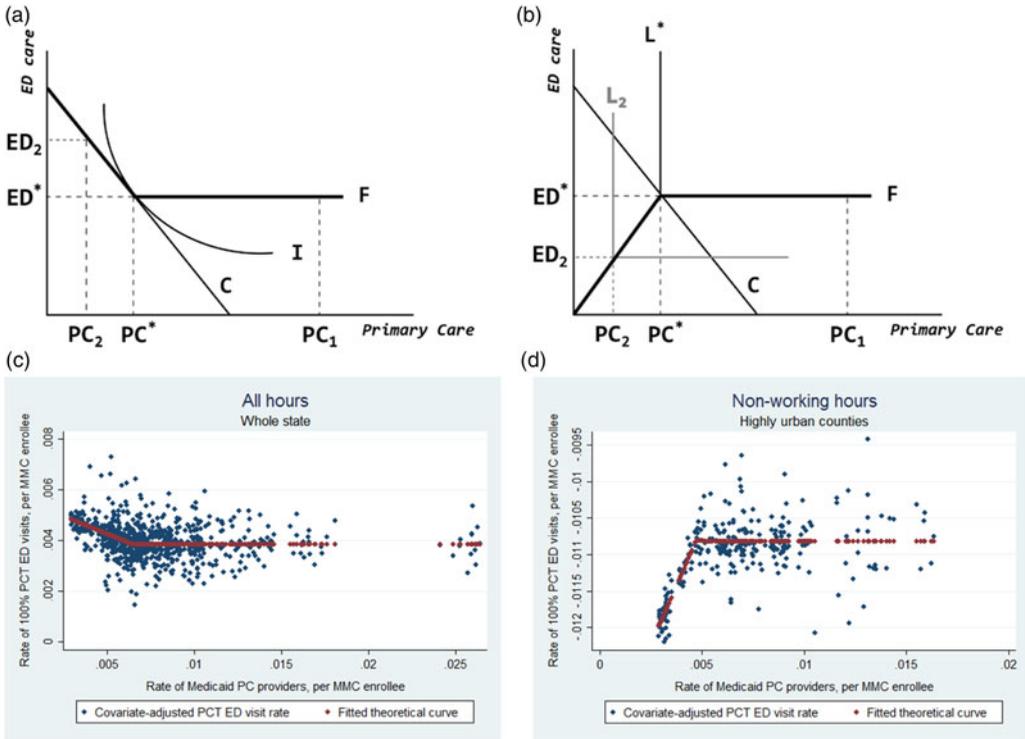
Figure 1. Theoretical curves for substitutes vs complements and examples from the data. (a) Substitutes: theoretical curve. (b) Complements: theoretical curve. (c) Substitutes: example from data. (d) Complements: example from data. MMC, Medicaid Managed Care.

The *Y*-axis range in Figure 1d is negative numbers because ED visit rate is covariate adjusted. Covariate adjusted data points facilitate graphical representation of the evidence. The range of ED visit rates before covariate adjustment is from approximately 0.0003 to 0.0035 ED visits per MMC enrolee per month.

outpatient ED visits, ambulatory surgery, and certain outpatient visits. The ED visit data contain basic patient demographic information and visit information.

We obtained primary care provider data from Managed Care Individual Provider Network Data files. These data are collected on a quarterly basis from the providers contracting with managed care plans. The files contain provider information such as name, national provider identification, type of provider (MD, DO, nurse practitioner (NP), physician assistant (PA)), specialty (PC, specialist, or both), location of practice, whether they are a Medicaid provider, and whether they currently accept patients with Medicaid coverage on their panel.

For the denominator of the ED visit rate and provider supply rate, we used county-level monthly Medicaid Managed Care Enrolment Reports available from New York State Department of Health website. We only included counties and months in which managed care was mandatory (most counties in 2012 and all counties by 2013), so that the enrolment counts used in the study include all nonelderly adults and children in Medicaid managed care. Managed care is a health care delivery system in which state Medicaid programmes contract with private organisations (called managed care organisations) that provide for the delivery of Medicaid health benefits, typically for a set capitation payment.

We obtained poverty rate data from Small Area Income and Poverty Estimates (SAIPE) Program, unemployment rate data from the Bureau of Labor Statistics, urban-rural classification data from the National Center for Health Statistics (NCHS), and county population data (to calculate per cent population in Medicaid managed care) from Surveillance, Epidemiology, and End Results (SEER) Program.

2.3 Measures

Our outcome of interest was the ED visit rate for primary care treatable (PCT) conditions per nonelderly Medicaid managed care enrolee (ages 0–64). To identify ED visits for PCT conditions, we used the New York University (NYU) algorithm. This algorithm classifies ED visits into (a) nonemergent, (b) emergent PCT, (c) emergent / ED care needed but PC preventable, (d) emergent / ED care needed and not PC preventable, and (e) other (including mental health, alcohol and substance use related, injury, and unclassified) (Billings *et al.*, 2000). The algorithm assigns each diagnostic code a probability of being in one of the categories. For our analyses, we define a PCT condition as a condition whose probabilities in categories (a) and (b) sum to 1, i.e. that are 100% emergent primary care treatable or nonemergent. Together with excluding ED visits that result in hospital admission, this conservative approach ensures that ED visits of greater severity are not included and is consistent with previous research (Raven *et al.*, 2013). Additionally, because of the limited concordance between presenting complaints and discharge diagnoses (Raven *et al.*, 2013), we defined a 100% PCT ED visit if both the admitting diagnosis and the discharge diagnosis are 100% PCT. This approach ensures that the condition could in fact be addressed at the PC level both based on the presenting complaints and the diagnosis after an objective medical assessment. Our definition of a PCT condition is thus most conservative, which is particularly important since our economic framework views substitution and complementarity bi-directionally (i.e. ED substitutes for PC and PC substitutes for ED; ED complements PC and PC complements ED). Only ED visits paid by Medicaid managed care were included. Of note, managed care is mandatory in New York state.

We further categorised ED visits by the hours during which PC offices are likely to be open (weekdays, 9am-5pm, or 'during the day') and closed (weekdays, 5pm–9am, and weekends, or 'during nights and weekends'). This categorisation was done because the economic relationship between ED care for PCT conditions and PC may vary depending on whether PC is available at the time of ED visit.

We measure the PC supply by the ratio of the number of PC providers to the number of nonelderly Medicaid managed care enrolees. We defined Medicaid PC providers as MDs, DOs, NPs, and PAs that are Medicaid certified and report accepting patients with Medicaid coverage on their panel.

2.4 Statistical analysis

We modelled the county-month level PCT ED visit rate as a spline function of county-month PC provider rate (both rates per nonelderly Medicaid managed care enrolee), estimating it with non-linear least squares regression,. This method estimates both the slope of the left spline and the location of the knot between the splines. The precise estimating equation is given in the Appendix. The visit-level SPARCS data were aggregated to the county-month level. For our main analyses, we used a period of thirteen months, from September 2014 to September 2015. We omitted the first eight months of 2014 because Medicaid managed care enrolment reports did not include those enrolled through the state marketplace website. We did not include years beyond 2015 because Delivery System Reform Incentive Payment (DSRIP) programme in New York started to provide financial incentives for providers to improve care and avoid unnecessary hospitalisations and ED visits in 2016. The last three months of 2015 were omitted because the frequency of 100% PCT conditions decreased nontrivially in our data with the implementation of ICD-10-CM codes. We excluded Hamilton County from our analyses because of outlying values of PC supply. The analytical dataset contains 793 observations (61 counties × 13 months). For the 2012–2013 additional analyses, the analytical dataset has 1261 observations: 61 counties were included, 48 counties observed over 24 months and 13 counties, in which managed care became mandatory during this study period, observed over 2–20 months, depending on mandatory managed care implementation timing.

The best-fitting model specification includes county fixed effects and three time-varying covariates: poverty rate, unemployment rate, and per cent population in Medicaid managed care. Other considered covariates, which could be potential confounders (county-level rate of high school graduates, per cent population with vehicles, supply of emergency department and urgent clinics), vary minimally within counties and are therefore subsumed within county fixed effects. We calculated standard errors and corresponding p-values using a bootstrapping approach described in the Appendix.

We repeated the analysis on subsets of highly urban counties (large metropolitan in NCHS classification), moderately urban counties (medium metropolitan), and rural counties (not metropolitan). Further, to examine whether the economic relationship changes by poverty rate, we estimated models in which the slope coefficient is a quadratic function of county poverty rate. When the economic relationship changes, i.e. when this function crosses zero, we calculated 95% confidence intervals based on bootstrap standard errors from 100 bootstrap samples.

Further, we conducted the same statistical analyses, but examined PC supply separately by physicians (MDs, DOs) and advanced practice providers (APPs; includes NPs and PAs). To account for APP supply in physician models, we used residuals from a linear regression of physician supply on APP supply as the physician supply measure, and vice versa for the APP supply measure. Importantly, in these analyses, we interpret the slope estimate as a negative or positive relationship rather than substitutes or complements, because the supply of one provider type – physicians or APPs – does not represent the total PC supply, and the concept of PC sufficiency, which is key to our economic framework, does not apply.

Sensitivity analyses are described in the Appendix.

3. Results

3.1 Overall ED visit rates and PC supply

Summary statistics for 2014–2015 are provided in Table 1. The rate of ED visits for PCT conditions among Medicaid enrolees is higher in moderately urban and rural counties and in counties with above-median poverty rates. The total supply of PC providers in Medicaid is higher in moderately urban and rural counties and in counties with below-median poverty rates. The supply of PC providers by type (physicians vs APPs) varies across types of counties (Table 1). Summary statistics for 2012–2013 are shown in Table A1 of the Appendix.

3.2 ED visits and PC: substitution vs complementarity after Medicaid expansion

Table 2 presents our main results for the post-expansion (2014–2015) period. Negative slope coefficients indicate substitution and positive slope coefficients indicate complementarity. In analyses by poverty rate, we descriptively indicate substitution and complementarity and include ranges of poverty that incorporate statistical uncertainty. In several analyses, we considered our findings to be undetermined, i.e., the left spline (where slope is estimated) was fit using relatively few data points. Although these estimates may have been statistically significant, we do not have confidence in these results, based on our visual assessment of the regression fit.

We found that in the state overall, the two types of care are used as substitutes. Subgroup analyses reveal that this is also true for moderately urban and rural counties regardless of the time of day and week, but in highly urban counties, the two types of care are used as complements during nights and weekends. Our analyses by poverty level show that during nights and weekends, ED and primary care are used as substitutes in wealthier counties (6.0–12.7% of population in poverty) and as complements in poorer counties (21.7–31.5% in poverty).

Table 1. Summary statistics, 2014–2015

	All counties (61 counties) (N = 793)	Highly urban (20 counties) (N = 260)	Moderately urban (18 counties) (N = 234)	Rural (23 counties) (N = 299)	Below median % in poverty (N = 410)	At or above median % in poverty (N = 383)
Medicaid managed care enrolment count	73,515 (172,027)	191,581 (263,131)	23,728 (18,403)	9811 (5362)	51,533 (116,950)	97,046 (213,630)
100% PCT ED visit rate, per 100 enrolees/month	0.323 (0.180)	0.259 (0.093)	0.354 (0.217)	0.355 (0.191)	0.302 (0.177)	0.346 (0.181)
100% PCT ED visit rate, working hours, per 100 enrolees/month	0.107 (0.070)	0.092 (0.042)	0.110 (0.082)	0.119 (0.077)	0.096 (0.067)	0.120 (0.071)
100% PCT ED visit rate, non-working hours, per 100 enrolees/month	0.216 (0.120)	0.167 (0.060)	0.244 (0.144)	0.236 (0.125)	0.206 (0.121)	0.226 (0.117)
PC providers accepting Medicaid patients, per 100 enrolees	0.776 (0.367)	0.713 (0.310)	0.868 (0.479)	0.760 (0.291)	0.870 (0.419)	0.676 (0.269)
PC physicians accepting Medicaid patients, per 100 enrolees	0.559 (0.232)	0.582 (0.241)	0.587 (0.265)	0.517 (0.186)	0.625 (0.253)	0.489 (0.183)
PC APPs accepting Medicaid, per 100 enrolees	0.217 (0.184)	0.131 (0.111)	0.281 (0.250)	0.243 (0.140)	0.245 (0.220)	0.188 (0.127)

PCT, primary care treatable; ED, emergency department; PC, primary care; APP, advanced practice providers.

Notes: The table presents means, and standard deviations in parentheses. To obtain annual ED visit rates, the reported monthly ED visit rates should be multiplied by 12.
Physicians include MDs and DOs. APPs include NPs and PAs. Median % poverty is 14.2%.

Table 2. Economic relationship between ED care for PCT conditions and PC in Medicaid, 2014–2015

	State overall	Highly urban	Moderately urban	Rural	Wealthier	Poorer
All hours	−0.28 **	−0.27 **	−1.26 ***	−0.58 **	subst (6.0–13.5% poverty)	comp (25.6–31.5% poverty)
During the day on weekdays	−0.15 **	−0.36 **	−0.10 ***	−0.23	–	–
During nights and weekends	−0.29 *	0.63 ***	−0.90 ***	−0.38*	subst (6.0–12.7% poverty)	comp (21.7–31.5% poverty)

PCT, primary care treatable; ED, emergency department; PC, primary care; subst, substitution; comp, complementarity.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Negative coefficients indicate substitution, positive coefficients indicate complementarity. Dash (–) indicates undetermined results. The % poverty cutoff between wealthier and poorer counties was determined empirically; the higher bound of wealthier represents the lower bound of 95% CI for this cutoff, the lower bound of poorer represents the upper bound of 95% CI for this cutoff. E.g. the cutoff for the first model was estimated at 19.6% (95% CI 13.5, 25.6). Statistical precision is not indicated next to 'subst' and 'comp' in analyses by poverty because statistical uncertainty is indicated by the 95% CI of the estimated cutoff. Lists of county-years in the poverty ranges are provided in the Appendix.

Table 3. Economic relationship between ED care for PCT conditions and PC in Medicaid, 2012–2013

	State overall	Highly urban	Moderately urban	Rural	Wealthier	Poorer
All hours	−0.27 ***	−0.08 *	−0.30 ***	−0.30 ***	substitutes (5.8–30.8% poverty)	
During the day on weekdays	−0.09 ***	–	0.03	−0.14 ***	–	–
During nights and weekends	−0.10 ***	−0.09 **	−0.32 ***	−0.13 ***	substitutes (5.8–30.8% poverty)	

PCT, primary care treatable; ED, emergency department; PC, primary care; subst, substitution; comp, complementarity.
* p < 0.1, ** p < 0.05, *** p < 0.01. Negative coefficients indicate substitution, positive coefficients indicate complementarity. Dash (–) indicates undetermined results. The % poverty cutoff between wealthier and poorer counties was determined empirically; the higher bound of wealthier represents the lower bound of 95% CI for this cutoff, the lower bound of poorer represents the upper bound of 95% CI for this cutoff. Example is provided in Notes to Table 2. Statistical precision is not indicated next to 'substitutes' in analyses by poverty because statistical uncertainty is indicated by the 95% CI of the estimated cutoff (5.8–30.8% represents the whole range, i.e. all county-years in the analysis).

3.3 ED visits and PC: substitution vs complementarity before Medicaid expansion

Table 3 shows our findings for the pre-expansion period (2012–2013). There is strong evidence of substitution in the state overall as well as across most county types. Note that in contrast with the post-expansion period, there is no evidence of complementarity in any of the subgroups.

3.4 ED visits and PC: analyses by provider type

Table 4 shows our findings from analyses by provider type. When PC is provided by physicians, the relationship between PC supply and ED visits is decreasing during the day. During nights and weekends, a higher supply of PC physicians is associated with more ED visits in highly urban and wealthier counties (6.0–9.0% in poverty) but with fewer ED visits in poorer counties (16.0–31.5% in poverty). When PC is provided by APPs, the relationships reverse. The relationship between PC APP supply and ED visits is increasing during the day, across all counties. During nights and weekends, a higher supply of PC APPs is associated with fewer ED visits in highly urban and wealthier counties (6.0–11.3% in poverty) but with more ED visits in poorer counties (17.0–31.5% in poverty).

Results of the sensitivity analyses are described in the Appendix.

4. Discussion

4.1 ED visits and PC: substitution vs complementarity

We found that among Medicaid beneficiaries in New York state overall, ED care for primary care treatable conditions and primary care are used as substitutes. This finding confirms the conventional understanding that has prevailed in health services research and policy (Cunningham *et al.*, 1995; Pitts *et al.*, 2010; Tang *et al.*, 2010; Uscher-Pines *et al.*, 2013; Gandhi, Grant, and Sabik, 2014; Pukurdpol *et al.*, 2014; Xin *et al.*, 2015; Lines *et al.*, 2019; Ladhania *et al.*, 2021) as well as recent research that indirectly points to substitution between ED use and private PC clinics (Ellis and Esson, 2021). Our finding is also consistent with the evidence of barriers in access to PC in Medicaid (Asplin *et al.*, 2005; Cheung *et al.*, 2012; Decker, 2012; Rhodes *et al.*, 2014; Hing *et al.*, 2015; Basseyn *et al.*, 2016; Bhandari *et al.*, 2016; Ludomirsky *et al.*, 2022) and most likely indicates that Medicaid enrolees continue to experience barriers to primary care and resort to ED care instead.

We found that the two types of care are used as complements in highly urban and poorer areas during nights and weekends. Complementarity between ED care and primary care is a relatively

Table 4. Relationship between ED visits for PCT conditions and PC in Medicaid, by PC provider type, 2014–2015

	State overall	Highly urban	Moderately urban	Rural	Wealthier	Poorer
Panel A. PC physicians (PCPs)						
All hours	−1.61 **	0.29 ***	–	–	positive (6.0–10.4% poverty)	negative (15.9–31.5% poverty)
During the day on weekdays	–	–	–	−0.11 *	negative (5.8–30.8% poverty)	
During nights and weekends	–	0.23 ***	–	–	positive (6.0–9.0% poverty)	negative (16.0–31.5% poverty)
Panel B. PC advance practice providers (APPs)						
All hours	−0.39 *	−0.24 **	–	0.21 *	negative (6.0–9.5% poverty)	positive (14.4–31.5% poverty)
During the day on weekdays	0.19 **	0.52 ***	0.93 ***	0.23 **	positive (11.3–30.8% poverty)	
During nights and weekends	−0.38 **	−0.24 ***	–	–	negative (6.0–11.3% poverty)	positive (17.0–31.5% poverty)

PCT, primary care treatable; ED, emergency department; PC, primary care.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Dash (–) indicates undetermined results. The % poverty cutoff between wealthier and poorer counties was determined empirically; the higher bound of wealthier represents the lower bound of 95% CI for this cutoff, the lower bound of poorer represents the upper bound of 95% CI for this cutoff. E.g. the cutoff for the first model (all PCPs in Medicaid, all hours) was estimated at 13.2% (95% CI 10.4, 15.9). Statistical precision is not indicated next to 'negative' and 'positive' in analyses by poverty because statistical uncertainty is indicated by the 95% CI of the estimated cutoff.

recent idea in health policy discussion. A complementary relationship may reflect (1) the combined use of the ED and primary care to satisfy patients' demand for low-acuity care (due to their self-perceived need, preferences for a combination of care, or relative ease of obtaining diagnostic procedures or specialist consultations through the ED after a PC visit), and/or (2) referrals from PC providers to the ED for PC treatable conditions.

Our finding that complementarity prevails specifically in highly urban areas, at least during nights and weekends, is consistent with some of the prior research. A study on the Oregon Health Insurance Experiment that examined data from Portland, Oregon, a highly urban area, found evidence of complementarity (Finkelstein *et al.*, 2016). Our finding may also explain the positive relationship found between ED visits and primary care visits found among Medicaid patients in New York City (Billings and Raven, 2013). Another study, done on adults with various health insurance within the Geisinger system, concludes that multiple ED visits (i.e. two or more) appear to be complementary to primary care visits (Maeng *et al.*, 2017). Given that highly urban areas are more likely to have relatively large populations of those with multiple ED visits, including frequent ED users, such populations might be driving our findings on complementarity in highly urban areas.

While, to our knowledge, there are no studies pointing to complementarity specifically in poor areas, there are several potential explanations. First, counties with large populations in poverty are likely to have larger populations of more complex, ill patients, who have a higher demand for care. It is possible that these patients choose to use both PC and the ED in combination, or that by using PC more, they are also referred to the ED more. This is plausible as prior research has shown that outpatient provider referrals to the ED are common (Raven and Steiner, 2018). Provider reimbursement rates in Medicaid may also play a role. In counties with a larger low-income population and thus a higher share of the population on Medicaid (the correlation in our data is 0.69), Medicaid PC providers may have higher concentrations of patients with Medicaid coverage and thus lower total revenues, compared to those in counties with a smaller low-income population. Lower revenues from the Medicaid patients could incentivise some providers to refer patients to the ED more often, assuming they can draw revenue from other patients. Of note, the estimated poverty range for the areas with complementarity (21.7–30.8% population in poverty) correlates with highly urban status: the counties in this range are all highly urban and represent 10% of all highly urban counties. Finally, patients in poorer areas might be more likely to delay seeking PC, potentially leading to a higher likelihood of being referred to the ED if their condition exacerbates, while still being a PC treatable one, according to the NYU algorithm.

Another explanation for complementarity during nights and weekends lies in different aspects of health care that underlie substitution or complementarity. Given that during the day on weekdays, people can, at least in theory, access primary care, the economic relationship between PC and ED care during this time reflects how realised access to PC (i.e. obtaining an appointment) and PC provision factor in patients' decision to use health care. At night and on weekends, when PC clinics are typically closed, this relationship reflects how PC practice characteristics, especially relating to after-hours care, influence this decision. This is elaborated below, in relation to our findings on the relationship between ED care and primary care by PC providers.

4.2 ED visits and PC: differences in relationship by provider type

The negative relationship between the supply of PC physicians and ED visits during the day indicates that in areas with fewer PC physicians, daytime ED visit rates in Medicaid are higher, compared to areas with more PC physicians. This finding suggests that barriers in access to PC physicians drive Medicaid enrolees to the ED. This is in alignment with the abundant literature on barriers to PC in Medicaid (Asplin *et al.*, 2005; Cheung *et al.*, 2012; Decker, 2012; Rhodes *et al.*, 2014; Hing *et al.*, 2015; Basseyn *et al.*, 2016; Bhandari *et al.*, 2016).

The positive association of PC APP supply with ED visits during the day is consistent with a study that found increased ED use among patients of PC practices with APPs (Lowe *et al.*, 2005). Our finding likely indicates that APPs refer patients to the ED more than physicians, perhaps due to restrictions in their scope of practice or due to differences in clinical training. Specifically, it could reflect that during visits, APPs refer patients to a physician, either a PC physician within the practice or the ED. When PC physicians are not available within an appropriate time frame, the patient may prefer to go to the ED even if a referral to the ED is not explicitly made by the APP, which would essentially reflect substitution between PC physician and the ED. This is a feasible explanation regardless of whether scope-of-practice laws or differences in clinical training account for the dissimilar PC provision. If differences in clinical training primarily underlie this phenomenon, another potential explanation could be that the referral to the ED is made primarily for diagnostic reasons: where a PC physician could make a diagnosis based on the examination, an APP might be more likely to require diagnostic procedures that may not be available at the clinic and consequently refer to the ED, or a patient might self-refer to the ED when faced with a potential wait for an authorisation for the procedure from the managed care plan. Another potential explanation for the observed pattern could potentially be lower patient satisfaction with APP-provided care and subsequent ED visits.

To guide health policy, a better understanding of the underlying reasons for the positive relationship between APP supply and ED visits during the day, which likely reflects how primary care is provided by APPs, is needed. If scope-of-practice laws are too restrictive for APPs to provide patient care in the clinic, expanding the scope of practice might be a good strategy to prevent ED use for PCT conditions from increasing, assuming no unintended negative effects on the quality of care. A recent study found that states with more restrictive nurse practitioner scope-of-practice laws, such as New York, saw larger increases in ED visit rates than states where nurse practitioners are more independent (McMichael *et al.*, 2019).

For ED visits at nights and on weekends, there is heterogeneity in the relationship between PC supply and ED visits across areas, both for PC physician and APP supply. PC physician supply is associated with more ED visits in highly urban and wealthier counties and fewer ED visits in poorer counties. In contrast, PC APP supply is associated with fewer ED visits in highly urban and wealthier counties and more ED visits in poorer counties. The relationship between PC supply and ED visits at night and on weekends, when PC clinics are generally closed, likely reflects how PC practice characteristics, particularly relating to after-hours availability, generate demand for ED care. In highly urban areas, there may be more demand for after-hours care due to larger populations and higher overall demand for care, whereas PC practices in wealthier areas are more likely to have the resources to provide after-hours care. What role PC physician vs APP supply play in generating ED demand across areas is not clear based on the findings of this work and future research could address this question.

4.3 Changes in the relationship from pre- to post-expansion

Comparison of pre- and post-expansion periods indicates that how people used bundles of ED and primary care changed after the coverage expansion. The emergence of complementarity after the expansion suggests that the economic relationship between types of health care is not fixed over time, and policies may change whether the ED is used as a substitute or complement to primary care. The emergence of complementarity could be potentially explained by changes in Medicaid enrolment. Urban and poorer counties are likely to have experienced larger absolute increases in enrolment after the expansion. Changes in Medicaid population composition could also provide an explanation: for example, prior research demonstrates that the Medicaid expansion in New York had a larger effect on enrolment among non-Hispanic whites and the working poor (Denham and Veazie, 2019), or urban poor in poorer counties could be relatively sicker. Also, increased Medicaid coverage and potential subsequent constraints on both enrolees

and health care providers may have changed how Medicaid managed care population as a whole views or is able to access combinations of care settings as well as changed their reasons for ED use. Interestingly, a recent study reported that Medicaid expansion was associated with a reduction in low-income adults reporting barriers to outpatient care as the reason for their ED visit (Chou *et al.*, 2020); this is consistent with our finding of decreasing prominence of substitution from pre- to post-expansion and emerging complementarity, which likely underlies other potential reasons for using the ED in that study. Given our supposition above that the relationship between PC supply and ED visits at night and on weekends is underpinned by PC practice characteristics, the emerged complementarity after 2014 could also reflect changes in PC practices. We are unable to determine whether the pre- to post-expansion changes are due to post-expansion enrolment, due to increases in physician reimbursement rates, which also took place in 2014 (with unobserved varying start dates of actual implementation across New York state), or due to other temporal changes not related to a specific policy. Future research could address these questions.

4.4 Policy implications

In general, our finding that overall Medicaid enrolees use the ED as a substitute for primary care indicates that improved primary care access should lead to decreases in low-acuity ED use. However, there are several caveats, which suggest that this strategy will not necessarily be effective.

First, increasing PC access at night and weekends (e.g. via increased after-hours care) may not necessarily divert Medicaid enrollees away from the ED. The evidence of complementarity at night and on weekends in highly urban and wealthier counties suggests that PC practices in these areas refer patients to the ED in the after-hours. Prior research shows that extended primary care hours are associated with decreased ED use, although none of the studies focused on the Medicaid population (Lowe *et al.*, 2005; Jerant *et al.*, 2012; Villani and Mortensen, 2013; Zickafoose *et al.*, 2013). Presumably, the effect of additional appointments during extended hours would be similar to the relationship between PC and ED care during the day on weekdays, where we find substitution. If findings of these studies are confirmed for the Medicaid population, additional appointments in the evenings and on weekends could decrease ED use for low-acuity conditions in Medicaid. In addition to extended hours, many PC clinics also have over-the-phone triage or advice at nights and on weekends: a 2005 study that surveyed PC practices found that 41% had a human answer the phone and 57% had voicemail with an option to reach a person (Lowe *et al.*, 2005). Although this needs to be confirmed in future research, we expect that referrals are more likely with the over-the-phone service rather than when actual appointments take place in the after-hours. While we do not observe how after-hours care is delivered across New York counties, our findings suggest that referrals to Medicaid patients are commonly made at night and on weekends in highly urban and poorer counties.

Second, increasing PC supply will not necessarily result in reduced Medicaid-paid ED visits, even with substitution, if an area's PC supply is already sufficient. As our model implies, the relationship between PC and ED care is manifest in counties where PC supply is insufficient (i.e. left spline), while with sufficient PC supply, the two types of care will be demanded at the optimum (i.e. right spline) (see Methods, Theoretical framework). Therefore, we would only expect interventions to decrease low-acuity ED use via increasing PC supply to be effective in areas with low levels of primary care, i.e. in areas where substitution (the left spline) kicks in.

Third, increasing PC supply and access via hiring more APPs is expected to increase low-acuity ED use by patients with Medicaid coverage, rather than reduce ED visits. With persistent shortages of PC physicians, the effort to increase PC supply has recently focused on increasing supply of APPs (Auerbach *et al.*, 2020). Our work suggests that the two provider types are not equivalent in how they relate to Medicaid enrolees' ED use and that substituting APPs for physicians may drive patients with Medicaid coverage to the ED more. Further research

is needed to fully understand these differentials in physicians and APPs. If future research determines that expanding nurse practitioners' scope of practice makes the relationship between PC visits with them and ED visits more substitutionary, then such policies will be expected to decrease ED use (or prevent increases). Research into physician- vs APP-initiated referrals to the ED can also point to some policy solutions and potential interventions.

Although increasing PC physician supply appears to be a superior policy solution to high day-time ED use among patients with Medicaid coverage, it may not be a cost-effective solution to the problem of high ED use for low-acuity conditions. It is important to note, however, that increased PC access has significant benefits for patients other than its potential to reduce ED visits and policy decisions regarding access to primary care should not be based on its effect on ED use alone.

4.5 Limitations

Our study has several limitations. First, due to aggregated enrolment reports, we cannot differentiate between adults and children on Medicaid. Second, our measure of provider supply is imperfect. While we are able to capture the number of providers per enrolee in a county, we cannot capture appointment availability, capacity for same-day appointments, and other potential barriers that Medicaid patients may face even when the provider supply technically exists. Third, provider data in quarter 3 of 2013 was not available and we used data from quarter 2 of 2013 for that period, potentially resulting in a measurement error.

Further, our approach assumes that primary care supply in the Medicaid enrolees' county of residence represents the availability of primary care to them, i.e. they do not access primary care across borders. This assumption could be particularly problematic in New York City, where the county (borough) borders are porous.

Next, our findings may not generalise to other states and time periods, warranting further research to understand the dynamics and drivers of substitution and complementarity and variation in the relationship across geographic areas. Since we focus on Medicaid managed care population, our findings do not generalise to insurance groups other than Medicaid and may not generalise to fee-for-service Medicaid.

Finally, robust data on urgent care clinics supply is limited, which affects our ability to appropriately adjust for urgent care clinic supply in our models. We considered this adjustment using publicly available data from U.S. Census County Business Patterns on freestanding ambulatory surgical and emergency centres, a broader category that, in addition to freestanding urgent care clinics, includes freestanding ambulatory surgical centres and clinics, freestanding laser surgery centres, and freestanding trauma centres. However, in these data there was minimal within-county variation over our study period and urgent care availability measured in this way is essentially subsumed in county fixed effects.

This last limitation brings up a discussion on urgent care in relation to our findings. First, because urgent care clinics are in general a prominent care setting at night and on weekends, dominating complementarity during these times in highly urban counties may be related to urgent care provision rather than after-hours care of primary care clinics (assuming these two are substitutes). On the other hand, urgent care is not a prominent care setting for Medicaid enrolees. There is evidence that retail clinics are less likely to be located in minority and low-income neighbourhoods (Pollack and Armstrong, 2009; Rudavsky *et al.*, 2009). Because urgent care clinics normally do not operate under the EMTALA and primarily serve privately insured and Medicare patients (rather than Medicaid enrolees, who they reportedly serve less due to low reimbursement rates) (Yee *et al.*, 2013), these clinics are unlikely to be extensively used by patients with Medicaid coverage. One study showed that Medicaid enrolees are not as responsive to urgent care clinics opening in proximity of an ED as other insurance groups (Llovera *et al.*, 2019). Second, potential relationships of PC and ED care with urgent care may reflect economic relationships between physicians and APPs, regardless of the care setting. An overlap in the

supply of providers between these care settings may be challenging for future research and may complicate practical implications. This overlap in providers is likely since over half of urgent care centres employ APPs (at rates half of that of physicians) (Weinick *et al.*, 2009) and retail clinics are typically staffed by nurse practitioners (Scott, 2007) and urgent care centres tend to employ both family medicine and emergency medicine physicians (Weinick *et al.*, 2009).

5. Conclusions

Policy approaches to ED overcrowding based on the assumption that the ED is used for low-acuity conditions as a substitute for primary care are justified when applied to Medicaid managed care population in regions with low PC supply. However, in the post-expansion period, the ED is used in a complementary manner at night and on weekends in some areas, potentially revealing increased referrals from PC to the ED in the after-hours. The relationship between ED and primary care depends on whether primary care is provided by physicians or APPs. Policies to reduce low-acuity ED use via improved PC access in Medicaid are likely to be most effective if they focus on increasing actual appointment availability, ideally by physicians, in areas with primary care provider shortages. Importantly, researchers and policy makers should recognise that primary care access is a broad and multifaceted concept and that different aspects of access may be differently related to low-acuity ED use.

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