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EDITORIAL NOTE

In this study, the authors use a large archival data set to examine differences in medical services received under insurance plans offered through alternative Medicare provisioning channels. They find these channels have a significant impact on the types of services that patients receive and the related costs. The study also shows how health care providers (primary care physicians) and insurance companies collaborate to promote wellness of Medicare beneficiaries. The study's value is in its rigorous method, which integrates statistical analysis of patient microdata and qualitative interviews with practitioners. It provides insight for actionable policies and strategies for healthcare financing and delivery.

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ABSTRACT

This study investigates differences in annual healthcare services usage by enrollees in various Medicare and Medicare Advantage plans with consideration of the major factors that should account for such differences. Using the Centers for Medicare and Medicaid Services' detailed patient-encounter and diagnostic records for a random sample of one million Missouri Medicare beneficiaries, we compared healthcare services received by individuals insured under different Medicare and Medicare Advantage plans. With complementary information about patient demographics and access to healthcare resources, we examine the factors affecting healthcare services received. The results show that plan and provider choices relate to significant utilization variances even after considering enrollee attributes, access to medical providers, and terms of their insurance plans. There also is evidence that agency relationships between payers and risk-sharing providers may be a contributing factor to those variances. These results merit careful consideration by all parties involved in healthcare financing and delivery as they develop health policy, negotiate insurance arrangements, plan facilities, install equipment, and staff for services. Further research to identify successful and replicable payer-provider arrangements offers opportunities for significant Medicare program savings.

SYNOPSIS

Purpose. Our goal is to reveal how services received by Medicare patients depend on the organization that provides the insurance coverage (after controlling statistically for other factors that are expected to contribute to the differences) and to share perspectives of practicing physicians on likely reasons for the differences and their consequences.

Problem of Practice. The Centers for Medicare and Medicaid Services (CMS) has partnered with competing Medicare Advantage Organizations (MAOs) to market and administer Medicare healthcare insurance, thus shifting the risks of related costs to organizations in the private sector. In 2024, 32.8 million Medicare Advantage enrollees account for $462 billion in federal Medicare spending (Freed et al., 2024). Financial incentives in capitated reimbursement schemes, intended to promote the efficient use of medical resources and to encourage preventative care, can have significant financial effects on all parties (i.e., insurers, medical providers, and patients). They can affect the care that patients receive and pose substantial risk for medical practices. Rosenthal et al. (2001) found that 31 of 153 California healthcare practices that rely heavily on capitated reimbursement failed financially (went out of business) between 1998 and 2000.

Results. Medicare beneficiaries who receive their Medicare insurance through MAOs have dramatically lower use of high-cost medical services than beneficiaries covered under traditional Medicare – even after controlling statistically for patients' personal attributes (health status and demographics); access to medical providers near their place of residence; and the terms (e.g., deductibles, co-payments) of their insurance plans. Differences are greatest for the MAOs that have engaged primary care physicians (PCPs) more extensively under risk-bearing capitated compensation arrangements. Primary care physicians interviewed to discuss these differences suggest that both collaborative information sharing for case management and performance incentives (including capitated reimbursement between the CMS and MAOs and, further, between MAOs and primary care physicians) are contributing to these differences.

Conclusions. Public–private partnerships in the delivery of Medicare are effectively lowering the use of high-cost medical services and shifting financial risk from the public sector to the private sector. Combinations of financial incentives in capitated payment arrangements, collaborative information sharing and encouragement of preventative care, and organizational changes in venues for receiving outpatient services are changing the resources required for hospital inpatient treatments; outpatient treatments; general carrier services, including physician visits; home health care; and skilled nursing facilities.

Practical Relevance. Understanding these phenomena is essential as parties involved in healthcare financing and delivery develop policy, negotiate insurance arrangements, plan facilities, install equipment, and staff for services. Sustainable healthcare systems require a fair sharing of risk and rewards among participants and careful assessment of the effects on the health status of individuals.

METHODS

Research Questions. How do services received in major treatment venues (e.g., hospital admissions, hospital outpatient, carrier services (including physician office visits), home health visits, and stays in skilled nursing facilities) compare for individuals enrolled with different MAOs versus those enrolled in traditional Medicare? What managerial practices are contributing to these differences?

Method and Design. To account for systematic influence of other factors, we use Poisson regression. In the qualitative phase, we use open-ended, structured interviews with primary care physicians, reviews of contractual documents between physicians and MAOs, and observations at Joint Operating Committee meetings between physician and MAOS.

Data Collection, Sample, and Analysis. We obtained CMS microdata for all medical encounters occurring in 2016 by a random sample of one million Missouri Medicare beneficiaries. Age, gender, ethnicity, place of residence, and insurance plan for the individual were extracted from the CMS data. Charlson comorbidity scores were computed from diagnostic information to indicate individuals' medical risks. Socioeconomic status was inferred from Census demography in postal ZIP codes and counties for enrollees' principal residence. Indicators of hospital access and concentration of practicing physicians were derived from directories of professional services.

PRACTICAL PROBLEM

The Centers for Medicare and Medicaid Services (CMS) offers health insurance through the Traditional Medical (TM) program and in partnership with private companies, known as Medicare Advantage Organizations (MAOs). By 2022, approximately half of all Medicare beneficiaries (over 28 million people) were enrolled in Medicare Advantage plans (Kaiser Foundation, 2022). MAOs in the private sector thereby assume financial risks for delivery of healthcare services under Medicare, and, they in turn, engage healthcare providers under contracts that shift financial risks further onto healthcare organizations and medical professionals.

The Medicare Advantage program involves a chain of agency relationships among parties with asymmetric power and information (Exhibit 1). Note, for example, how the CMS as a principal engages MAOs as agents, who in turn become principals who engage Provider Groups, who deliver care to the insured patients. Agency theory suggests that the complex chain of business relationships in administering Medicare Advantage insurance plans might lead to inefficiencies in providing healthcare services as participating parties pursue their individual interests. Adverse agency effects are greatest when, as in this setting, there are asymmetries in negotiating power and differences in the information available to participating parties. Major shifts in the demand for and

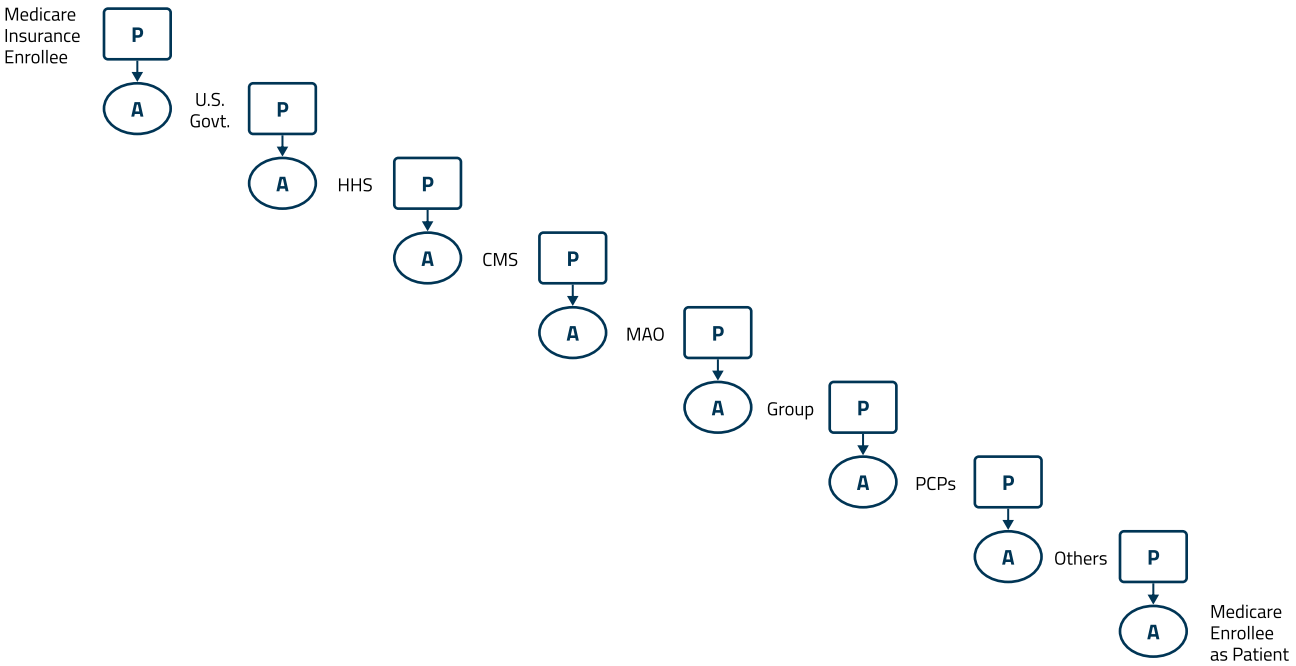
supply of services in the different healthcare venues may therefore occur as participating parties pursue their particular interests (Stout, 2020).

LITERATURE REVIEW

Decades ago, Jensen and Meckling (1976) recognized tensions and distortions that occur in service systems as agents pursue their own interests at the expense of the principal parties – especially when business relationships occur with asymmetric power and information. Kralewski et al. (1999) determined that an interplay among patient characteristics, physician characteristics, risk-sharing arrangements in insurance plans, norms of practice in the medical community, and organizational characteristics of a medical practice all affect resources used for episodic patient care. Burns (2000) recognized the need for research on the effects of privatization and healthcare finance on provision of health care services. Bennet (2012) described how efficiency and effectiveness of healthcare delivery are promoted at the institutional level through the Medicare Shared Savings Program (SSP) and with Accountable Care Organizations (ACOs) under the Affordable Care Act. Chukmaitov et al. (2019) found that hospitals that had risk-sharing contractual arrangements with physicians were more likely to participate in two-sided risk-sharing contractual arrangements for services delivered under Medicare. Diana et al. (2019) found that a hospital's engagement as an ACO seemed to have positive effects on patients' experiences if the hospital already was performing at a relatively high level.

Landon et al. (2012) compared overall service use by TM versus MA beneficiaries in years 2003–2009 and found that MA enrollees experienced 20% to 30% fewer treatments in major categories of care. Mandal et al. (2017) concluded that value-based arrangements, such as risk-bearing contracts, drive innovative primary care strategies that lead to more cost-efficient outcomes. Ghany et al. (2018) found that MA enrollees who received "high-touch" primary care had lower healthcare costs and hospital use than a matched group that received standard care. Curto et al. (2019) examined amounts billed for services and found healthcare spending for MA enrollees to be about 25 percent lower than for TM enrollees. They determined that differences in service use, rather than price, accounted for most of the difference. Moy et al. (2021) suggested that PCP selection can result in reduced spending and elimination of wasteful services. Agarwal et al. (2021) performed a meta-analysis of 48 peer-reviewed journal articles and found that the studies generally indicate that MA enrollees experience higher use of preventative care services and lower use of acute care services compared to their TM counterparts; but they saw "challenges with the comparability of data (due to selection bias, challenges in risk adjustment, and unobserved differences related to social determinates of health)."

Exhibit 1. Medicare Advantage Cascading Agency Relationships.



Source: Stout (2020)

P = Principal, A = Agent, U.S. Govt. = United States Government, HHS = Department of Health and Human Services, CMS = Centers for Medicare and Medicaid Services, MAO = Medicare Advantage Organization, Group = Provider Group or Network, PCPs = Primary Care Physicians, Others = Other Medical Providers

Using individual patient encounter data, Hanlon et al. (2022) found that patients' health status and the indices of social vulnerabilities of people in their residential neighborhood together affected proneness to hospital admissions and use of emergency department services in a large health system. They did not consider insurance coverage in their analysis.

In sum, researchers have compared services received by individuals who are insured under TM versus MA programs, but they generally do so without regard for the specific organization responsible for administering the medical insurance provided, and without the benefit of information in the medical records of individual patients. Aggregate statistics typically have been used in comparative studies, and researchers recognize that important factors known to affect use of services are ignored when making comparisons overall. Smith et al. (2022) used Poisson regression to consider patient-specific medical information, demographic attributes, and access to healthcare providers when comparing service use by individuals covered by TM versus MA insurance. They found that dramatic differences persisted even after controlling for these factors. However, they did not consider the specific MAO administering the Medicare insurance plan or the coverage offered by the insurance plans chosen by enrollees.

RESEARCH METHOD

For this study, we used mixed methods to investigate how service use is related to individuals' health insurance coverage and other factors. In the quantitative phase, we used detailed medical encounter data, augmented with indicators of the policy options selected by insured individuals, to examine how use of services in five major venues – hospital inpatient, hospital outpatient, general carrier services including primary care medical practices, home health agency (HHA) care, and skilled nursing facilities (SNF) – is related to coverage from specific Medicare insurers. The frequencies and venues by which services are received are key considerations as healthcare organizations, medical practices, and providers of supporting services invest in facilities and equipment, hire staff for services, negotiate contracts, and manage their finances. In the qualitative phase, we used open-ended, semi-structured interviews with practicing physicians and observations of business practices between PCPs and MAOs to identify features of case management and reimbursement methods that appear to reduce the use of high-cost medical services. We coded the interviewees' responses and used nominal grouping of themes that emerged in discussions and observations of the business process, in a manner similar to the one advocated by Braun and Clarke (2012); however, our research did not include a formal documentary process, as Braun, et al. suggest, because we primarily intended to set the stage for future research on possible strategies to effect systemic improvement.

FINDINGS FROM QUANTITATIVE ANALYSIS

In Table 1, we present average use rates in each of the five venues for both TM enrollees and enrollees with the four largest MAOs: Essence, United Healthcare (UHC), Humana, and Aetna. Comparison of the MAO data with TM program data showed that inpatient stays ranged from 18% lower (Humana) to 38% lower (Essence). Outpatient services ranged from 44% lower (Aetna) to 59% lower (Essence). Carrier services, including physician visits, ranged from 14% higher (UHC) to 18% lower (Essence). HHA visits ranged from 15% lower (Humana) to 80% lower (Essence). Discharges from SNFs ranged from 50% lower (UHC) to 76% lower (Essence).

Next, to consider the effects of the various factors that can affect use of the healthcare services, we constructed Poisson regression models that account for the effects of the other factors expected to affect service use. To represent the coverage by individuals' chosen insurance plans, we included the following variables:

- An indicator (0-1) variable for whether the policy has gap coverage for the pharmacy benefit (Part D) "donut hole"
- An indicator of whether the plan has an enhanced Part D benefit
- The average copayment required for individual medical services
- Maximum copayment for a hospital admission

Table 1. Annual service use rates per enrollee for MAOs compared with TM

Service Metric	TM Mean	Essence Mean	Essence Pct. Diff.	United Healthcare Mean	United Healthcare Pct. Diff.	Humana Mean	Humana Pct. Diff.	Aetna Mean	Aetna Pct. Diff.
Inpatient Discharges	0.333	0.172	-38.2	0.215	-23.1	0.229	-17.9	0.204	-27.1
Outpatient Services	9.444	3.454	-58.9	4.199	-50.1	4.535	-46.1	4.716	-43.9
Carrier claims	22.955	18.925	-18.1	26.238	13.6	20.667	-10.6	22.674	-1.9
HHA Visits	1.858	0.388	-80.0	0.723	-62.6	1.645	-15.0	1.157	-40.2
SNF Discharges	0.177	0.041	-76.4	0.087	-49.9	0.081	-53.5	0.066	-62.1

- An indicator of whether the maximum annual copayment exceeds $4,000
- An indicator of whether users have no copayment for medical services
- An indicator of whether users have no maximum on the copayment for a hospital admission
- An indicator of whether the plan has no Part D coverage
- An indicator of whether no premium is charged for Part C and Part D coverage
- An indicator of whether the monthly premium for Part C and Part D coverage exceeds $30
- An indicator of whether the plan is designated as a private-fee-for-service plan
- An indicator of whether the plan is designated as a preferred provider organization plan
- An indicator of whether the plan provides access to a local provider network
- An indicator of whether the plan provides access to a regional provider network
- An indicator of whether the plan has a high rating (4.5 or higher)
- An indicator of whether the plan has a low rating (less than 4.5).

The Poisson regression models predict the logarithm of the number of encounters in each venue. From these models, we obtain "incident impact factors" that indicate the multiplicative effect of unit increases in each explanatory variable on the rates of service use, after fixing the values of each of the other variables in the model. We constructed the Poisson regression models using a randomly selected "fitting" sample constituting 75% of our sample population (n = 484,436), and we reserved the remaining 25% (n = 161,764) for testing alternative model forms on an independent set of observations. To deal with multicollinearity among the explanatory variables, we used backward elimination of variables that were not statistically significant (with marginal $p > 0.05$). To represent the marginal explanatory power of the explanatory variables, we provide their levels of statistical significance (the likelihoods that their estimated effects may have occurred randomly). Impact factors for the marginal effects of each of the variables on service use in each of the five treatment venues are provided in Appendix 2. Table 2 identifies the impact factors for variables that were statistically significant at the .0001 level in each of the five Poisson Regression models for service in respective treatment venues.

The rates of service use of Essence enrollees relative to "other" enrollees (i.e., the MAO category for individuals not enrolled in Essence, United Healthcare, Humana or Aetna plans) are 42% lower for inpatient hospital admissions, 30% lower for hospital outpatient services, 36% lower for general carrier services including physician visits, 76% lower for HHA claims, and 49% lower for SNF stays**.** Examining the incidence factors for each of the MAOs in the full table (Appendix 1), we see strong evidence that services received by enrollees with each of the four major MAOs differ systematically, on some dimension, from services received by enrollees of the "other" competitors.

In row 3, which shows factors for the largest comorbidity score computed from diagnostic data in the five service venues, we see that each unit increase in the largest comorbidity score for the patient (*ceteris paribus*) is associated with a 29% increase in the rate of hospital inpatient admissions, an 18% increase in hospital outpatient visits, a 17% increase in carrier service visits, a 27% increase in home health visits, and a 30% increase in stays at SNFs. This indicator of an individual's health status is the predominant factor in the model for predicting use of healthcare services (as it should be); however, other factors also are shown to be materially influential across all services, as revealed in prior research. For example, impact factors for females range from 9% more inpatient admissions to 53% more stays in SNFs. Each additional year of age (with other variables held constant) increases use rates for each of the venues, except hospital outpatient visits. However, note that coincidental increases in comorbidities with age would result in a higher number of outpatient visits as well. Residents of neighborhoods with higher housing values tend to have lower use of services in each of the venues except general carrier services (which includes physician office visits). Higher copayments tend to be associated with lower service use. The magnitude of the individual impact factors (see Appendix 1) indicate the systematic

Table 2 Impact Factors of Variables Statistically Significant at the .0001 level for Service Use in All Five Service Venues

	Inpatient Rate Factor	Outpatient Rate Factor	Carrier Serv. Rate Factor	Home Health Rate Factor	SNF Rate Factor
Essence	0.5800	0.6989	0.6435	0.2436	0.5069
United Healthcare	0.7987	0.8834	0.9051	0.5290	1.0382
Max. Comorbidity Score	1.2866	1.1806	1.1678	1.2746	1.2987
Female	1.0871	1.1739	1.1036	1.4259	1.5267
Age of Person	1.0161	0.9957	1.0031	1.0628	1.0738
Median Housing Valuation	0.9988	0.9979	1.0008	0.9991	0.9986
Max. Inpatient Copay	0.9998	0.9999	0.9999	0.9997	0.9998

Note: Max. = Maximum

effects of each of the explanatory variables on service use in each treatment venue.

From our multivariate statistical analysis, we concluded that factors beyond individuals' general health status, age, gender, ethnicity, socioeconomic surroundings, access to medical services, and terms of coverage in the health insurance policies chosen by enrollees are causing large differences in rates of service use among the MAOs

Findings and Insights from Interviews with Physicians and Observations of Business Processes

For insights into the possible effects of MAO-provider agency on service delivery, we conducted in-depth interviews with ten physicians in four different primary care practice groups that had operated successfully under risk-sharing contractual arrangements with MAOs for over a decade. We examined the related contractual documents and attended Joint Operations Committee (JOC) meetings between the physicians and MAO representatives to see how they collaborated in monitoring patient care and encouraging preventative medical practice.

From our interviews with the PCPs and our examination of their business contracts, we identified incentives linked to direct patient care activity, care coordination with other providers, and information sharing with various Medicare agents. Combinations of capitation payments, incentive bonuses related to total expenditures for healthcare in all treatment venues for patients under their PCP care, stop-loss provisions through re-insurance, and fees for services rendered all affected the annual income of the practitioners. In our interviews, the PCPs stated that timely information sharing, process-oriented rewards, coordinated patient care management, and fair and well-structured contracts encourage effective and sustainable business partnerships for healthcare delivery.

In their quarterly JOC meetings, MAO representatives reviewed initiatives to encourage preventative care, such as eye exams, cancer screening, checks of pharmacy prescription compliance, and periodic physical exams. The representatives also shared statistics to reveal trends in patient participation in such initiatives and in rates of hospital inpatient admissions, of emergency department visits, of referrals to specialists, and of medical tests, medical procedures, pharmaceutical prescriptions, and more. In short, JOC members revealed obvious processes and incentives intended to encourage efficient delivery of effective healthcare. There was genuine collaboration between the agents in the interest of the clients (patients), as well as in their own financial interests.

LESSONS FOR PRACTICE

Enrollment in Medicare Advantage plans, relative to traditional Medicare, is steadily increasing and now is approaching 50%. If use of healthcare services under the different Medicare plans continues to reflect the patterns revealed in our statistical models, the resulting efficiencies in healthcare delivery may amount to tens of billions of dollars per year. The implied changes in services to be rendered have important implications as healthcare providers invest in physical facilities, equipment, and medical information systems; collaborate in management of patient care; hire, retain, and schedule staff; design benefit packages; and negotiate reimbursement contracts.

There is inevitable asymmetry in information, financial risk, and negotiating power between MAOs and their contracted healthcare providers. Smaller practices, in particular, face exposure to financial risk attributable to low-frequency, high-severity events, such as patients with rare conditions that require high-cost medical treatments. Multivariate statistical models similar to the ones presented here can be embedded in simulation models to assess operational and financial risks of providing medical services to population subgroups. The models effectively make distinctions between high-risk and low-risk patient groups in terms of the services they require and the related costs. Smith et al. (2024) demonstrate how, in these model applications, a blending of empirical distributions and regression models better captures the risk of low-frequency but costly outliers than standard theoretical distributions do. This kind of risk assessment is important for individual medical practices to consider because they cannot rely on the diversification that the insurance companies enjoy, with their enormous pools of covered individuals.

Additional research on the magnitude of financial risk that PCPs and other medical groups assume under alternative contractual arrangements is required. Payer-provider contracts typically are proprietary and confidential. Collaboration among the CMS, MAOs, medical providers, and researchers would be required to enable such ongoing study.

Our findings engender questions about the effects of the differences in medical services received and possible consequences of services not received. How are shifts in timing and locales of medical treatments affecting use of healthcare resources, financial results for the various parties, and clinical outcomes for patients? This research requires additional longitudinal data.

In sum, our findings suggest that healthcare providers, as they invest in facilities, equipment, and staff, need to consider the way that services delivered to Medicare beneficiaries are changing, both in frequency and venue, as MAOs assume increasing responsibility for administering Medicare on behalf of the CMS. Careful analysis of the risks and rewards both for insurers and for healthcare providers is required as they create reimbursement mechanisms and negotiate contracts that involve combinations of capitation payments, fee-for-service, stop-loss provisions, and performance incentives related to "best practice," costs of care, and patient wellness.

CONTRIBUTION TO THEORY

Agency theory warns of potentially adverse effects as agents pursue their own interests in rendering services. However, our findings suggest that something of an "Agency

paradox" may be present in the shift from traditional Medicare to Medicare Advantage plans, administered by competing organizations in the private sector. MAOs are creating infrastructures for efficient sharing of valuable clinical information and encouraging preventative primary care. Medical practices are changing the scope of services provided and increasing access to care in settings that have lower financial overhead than traditional hospital settings or large medical complexes. However, a by-product of these seemingly beneficial forces is a shift of activity (and revenue) from large, sophisticated medical centers that provide training and vital care for the most complex cases. New problems arise over how to provide the necessary resources for sustainable delivery of high-quality care to all segments of the population.

Healthcare services in the United States are provided with a unique combination of public and private resources that involves a blend of competitive and cooperative behaviors. Healthcare managers, MAOs, and medical practitioners are under constant pressure to execute their responsibilities with concern for short-term operating performance. We recognize that the behavior of individuals and organizations, as revealed by the intensive analysis of micro-data, may be examined and interpreted through lenses of alternative theoretical frameworks. The measures we chose capture traditional transactional cost elements for individuals (i.e., terms of insurance plans, socioeconomic factors) and the general nature of contractual (agency) arrangements for reimbursement of costs of medical services. Future research, blending quantitative and qualitative inquiry, could focus on foundational business strategies of stakeholders, strategies for risk management, development of information systems for collaborative business alliances, effects of financial structure and market concentration, opportunism in service supply chains, and effects of information asymmetries in negotiations. In addition, future research might attend to sociological phenomena in Gidden's (1984) structuration theory – especially the ways in which physicians consciously adapt to forces affecting their medical practice and exert influence in changing systems for healthcare delivery.

LIMITATIONS

The data used in this study came solely from residents of Missouri. Each state has its own regulatory regimes for medical insurance and medical practices, and states vary in their concentration of medical facilities and practicing professionals. Further, states have differing histories with MAOs and varying experience with managed patient care. Nevertheless, Medicare is administered through similar agency relationships and healthcare is subject to similar economic forces nationwide.

This study does not address the intensity or quality of care through time. We acknowledge the assertions of Busse et al. (2019), who write that "despite the vast literature base and its universal acknowledgment of its importance in health systems, there is no common understanding of the term 'quality of care,' and there is disagreement about what it encompasses." We leave specifics of the nature of medical treatments and their outcomes for future research.

Our analysis is based on pre-Covid activity over a single year. Insurers, healthcare organizations, and medical practitioners constantly react to financial performance, patient outcomes, and market opportunities. Longitudinal data and analysis are required to reveal the effects of these intertemporal dynamics.

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APPENDIX 1

Method

Composition of the Sample. By restricting the sample to Missouri (where Medicare Advantage Organizations (MAOs) have been present for more than 20 years), we ensured that the MAO plans, enrollees, and healthcare providers were subjected to the same state regulations and oversight. Using a comprehensive sample of Missouri beneficiaries, we had an experimental environment ranging from metropolitan areas with major academic medical centers to rural areas with limited resources.

We excluded individuals under age 65 at the beginning of the year, as well as those not covered under the same plan for the entire year and those in hospice care, in treatment for end-stage renal disease, or with mid-year address changes. The resulting sample comprised 646,200 enrollees, representing 55.7% of the Missouri Medicare population. Of these individuals, 432,765 were covered under traditional Medicare (TM) programs, and 213,435 were covered under MAO plans. We validated our statistics for service use in each venue, as derived from the Centers for Medicaid and Medicare Services (CMS) encounter microdata, against summary data in the CMS master beneficiary summary file (MBSF). The encounter data included diagnostic codes (DRGs), procedure codes (CPTs), and provider identifiers (NPIs) for the service-rendering organizations and professionals. The enrollee's consolidated annual record was our unit of analysis.

Variables for Explanatory Factors. We used the "percent of households having a bachelor's degree or more" and "households with a manager or professional employee" in the enrollee's ZIP code tabulation areas (ZCTA) as surrogates for the enrollee's level of education and ability to navigate the complexities of plan choice and service use. Average housing valuation is measured in thousands of dollars.

To quantify hospital access for residents in each Missouri county, we considered the shortest driving distances from the county seat to each hospital in the state. Each county was categorized as: (1) having at least one hospital within its boundaries, (2) without a hospital but having one within a distance of 27 miles or less, or (3) having no general-access hospitals within 28 miles of the county seat. For access to physicians, we totaled the number of physicians in each county who were not under disciplinary action and had an active license since 2015, and we used the number of physicians per 1,000 residents as the physician-access variable.

Variables were defined to indicate whether the chosen plan is for coverage by a health maintenance organization, a preferred provider organization, or a private fee-for-service plan; whether coverage is restricted to local or regional provider networks, the annual out-of-pocket limits for all covered services, and average copayments required for various medical services.

APPENDIX 2

Impact Factors for Rates of Service Use with MA Plan Characteristics Considered

Text	Inpatient Rate Factor	*p* value	Out-patient Rate Factor	*p* value	Carrier Serv. Rate Factor	*p* value	Home Health Rate Factor	*p* value	SNF Rate Factor	*p* value
Intercept	0.0323	<.0001	5.4648	<.0001	12.137	<.0001	0.0029	<.0001	0.0001	<.0001
Aetna	0.8905	0.0004	1.0272	<.0001	0.8760	<.0001	1.1125	<.0001	0.9809	0.721
Essence	0.5800	<.0001	0.6989	<.0001	0.6435	<.0001	0.2436	<.0001	0.5069	<.0001
Humana	1.0334	0.418	1.0282	<.0001	0.8139	<.0001	1.8058	<.0001	1.0224	0.7017
United Healthcare	0.7987	<.0001	0.8834	<.0001	0.9051	<.0001	0.5290	<.0001	1.0382	0.4971
Max. Co-Morbidity Score	1.2866	<.0001	1.1806	<.0001	1.1678	<.0001	1.2746	<.0001	1.2987	<.0001
Female	1.0871	<.0001	1.1739	<.0001	1.1036	<.0001	1.4259	<.0001	1.5267	<.0001
Asian	0.4713	<.0001	0.7473	<.0001	0.8033	<.0001	0.3494	<.0001	0.2892	0.0005
Age of Enrollee	1.0161	<.0001	0.9957	<.0001	1.0031	<.0001	1.0628	<.0001	1.0738	<.0001
Black	0.9272	<.0001	0.8429	<.0001	0.8779	<.0001	.	.	0.8382	<.0001
Median Housing Valuation	0.9988	<.0001	0.9979	<.0001	1.0008	<.0001	0.9991	<.0001	0.9986	<.0001
Gap Coverage	0.8462	0.0006	.	.	0.8903	<.0001	0.7935	<.0001	.	.
Enhanced Part D	1.1615	0.0014	0.9332	<.0001	1.1176	<.0001	1.2894	<.0001	1.1535	0.0412
Av. Med. Serv. Copay Amt.	0.9984	0.0343	0.9987	<.0001	0.9996	<.0001	0.9966	<.0001	0.9973	0.0212
Max. Inpatient Copay	0.9998	<.0001	0.9999	<.0001	0.9999	<.0001	0.9997	<.0001	0.9998	<.0001
Max. Out-of-pocket > 4000	1.0885	0.0002	0.9470	<.0001	0.9680	<.0001	1.1797	<.0001	1.1294	<.0001
No Max. Inpatient Copay	.	.	0.5390	0.0088	1.1744	0.0264	1.5779	<.0001	.	.
No Copay for Med. Serv.	.	.	1.6059	0.0468	0.7417	<.0001	.	.	.	.
No Part D Cov.	.	.	0.8729	<.0001	0.9146	<.0001	1.0912	0.0073	.	.
No Part C and D Prem.	1.0515	0.025	0.9556	<.0001	0.8868	<.0001	1.2804	<.0001	1.0698	0.0278
Part C and D Prem. > 30	1.1025	<.0001	0.9038	<.0001	1.0241	<.0001	1.0992	<.0001	.	.
PFFS Plan	1.2148	0.0025	1.7099	<.0001	1.1082	<.0001	1.5178	<.0001	1.2983	0.0262
PPO Plan	0.8860	0.0048	1.1381	<.0001	0.9668	<.0001	0.8724	<.0001	.	.
Local Provider Network	1.1956	0.0004	1.2655	<.0001	1.1481	<.0001	1.5331	<.0001	1.4128	0.0002
Regional Provider Network	1.3202	<.0001	.	.	1.1904	<.0001	0.8729	<.0001	1.3905	<.0001
High Star Rating	1.1394	0.0058	1.0506	<.0001	1.0216	<.0001	1.2477	<.0001	.	.
Low Star Rating	.	.	.	.	.	.	1.1874	<.0001	1.2262	0.0149

Note: Max. = Maximum, Med. = Medical, Serv = Service, Av. =Average, Amt. = Amount, Cov. = Coverage, Prem. = Premium, PFFS = Private Fee for Service, PPO = Preferred Provider Organization.

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