

Characterizing Patient Flow After an Academic Hospital Merger and Acquisition

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As health care becomes increasingly value based, health care organizations are working to efficiently use their resources, reduce costs, and improve quality of care. One of the strategies used to achieve these goals is through engaging in hospital mergers and acquisitions. Recent data have shown a rising rate of hospital mergers and acquisitions since 2010 when the Affordable Care Act was enacted. In 2017, there were 115 transactions of hospital and health system partnerships, and the number continues to grow.^{1,2} This approach can improve care quality and reduce health care costs through standardizing clinical operations across all hospitals of a health system and implementing best practices to deliver more cost-effective care.³ Several studies have examined the impact of merger and acquisition on health care delivery efficiency, costs, and quality of care.⁴⁻⁷ Their findings suggest that there is little evidence that mergers improve the quality of care,⁵ yet they reduce costs and improve hospital culture.^{4,6}

To our knowledge, no studies have assessed health care utilization (HCU) and patient flow across newly merged institutions. Understanding the patient population and patient flow through different institutions following a hospital merger is critical for understanding the particular needs of different communities and improving the efficiency of health systems. In addition, hospital management administrators and research units have frequently launched quality improvement projects and comparative effectiveness research; thus, understanding the patient population and resource utilization are necessary to guide the overall study design and participant recruitment.

Understanding the effect of hospital mergers on health services utilization and patient flow is essential as these acquisitions become more common. The purpose of this investigation was to quantify differences in facility utilization and describe patient flow across 3 merged institutions: an academic medical center (AMC), a primary and specialty care alliance (PSC), and a community-based medical center (CMC). Using the consolidated electronic health record (EHR) system supported by the AMC, we further describe a conceptual framework for classifying patients' "home" health care institution and identifying their primary care setting. This

ABSTRACT

OBJECTIVES: Hospital mergers and acquisitions are increasingly used as a strategy to facilitate value-based care. However, no studies have assessed health care utilization (HCU) and patient flow across merged institutions. We aim to evaluate patient population distribution, HCU, and patient flow across a recent hospital merger of an academic medical center (AMC), a primary and specialty care alliance (PSC), and a community-based medical center (CMC).

STUDY DESIGN: This was a retrospective observational study.

METHODS: The study used 2018 adult demographic and encounter data from electronic health records. Patients' parent health care institution was determined by the most frequently visited site of face-to-face visits. Differences in patient demographics and HCU (ie, emergency department [ED] visits, hospitalizations, primary care visits) were compared. Independent factors associated with utilization were identified using adjusted logistic regression models.

RESULTS: A total of 406,303 adult patients were identified in the cohort. The PSC setting, compared with the AMC and the CMC, had significantly more female (62.7% vs 54.4% and 58.5%, respectively), older (mean [SD] age, 52.0 [18.1] vs 51.1 [17.8] and 49.2 [17.8] years), and privately insured (63.6% vs 51.3% and 56.0%) patients. A higher proportion of patients at the CMC (27.5%) visited the ED compared with patients at the AMC (10.8%). Approximately 1645 primary care patients (7%) at the CMC setting went to the AMC for specialized care such as oncology, surgery, and neurology.

CONCLUSIONS: Hospital mergers are increasing across the United States, allowing AMCs to expand their reach. These findings suggest that patients mainly sought care at their parent health care institution, yet appropriately received specialized care at the AMC. These results provide insights for future mergers and guide resource allocation and opportunities for improving care delivery.

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TAKEAWAY POINTS

We assessed health care utilization and patient flow after a recent merger of community practices, a community hospital, and an academic medical center.

- ▶ Variations existed in patient characteristics across the different health care institutions, with the academic medical center serving older, more complex, and non-White patients compared with the community practices and community medical center.
- ▶ Patients sought care mainly at their parent health care institution and appropriately received specialized care at the academic medical center.
- ▶ Continuous tracking of service utilization and patient flow is needed after hospital mergers and acquisitions to better deliver integrated, cost-effective care.

work provides a baseline for understanding patient movement in newly merged and acquired health care systems using EHRs, which is necessary to identify and accommodate the specific needs of different communities.

METHODS

Data Source

This retrospective observational study included data from the 3 merged health care organizations: AMC, PSC, and CMC. The AMC provides a wide breadth of specialized and advanced health care services for complex illnesses and injuries and delivers primary and specialty care in more than 600 clinics; the PSC was formed in 2011 and includes more than 70 primary and specialty clinics located across California Bay Area communities. The CMC provides both inpatient and outpatient services in the East Bay's Tri-Valley region and was acquired by the AMC in 2015. All health care settings in this merger and acquisition now share the same EHR system by Epic. The current EHR system at the CMC went live in early 2018 and replaced the previous paper-based system. Patients were identified from the clinical data warehouse, which included patient data from AMC, PSC, and CMC. The institutional review board of Stanford University approved the study.

Cohort Selection

The study included adult patients who had encounters of any type recorded in EHRs of the 3 organizations in 2018. Patients were excluded if they (1) did not have a face-to-face encounter (ie, hospital encounter, office visit) in 2018; (2) were 90 years or older, due to small sample size; (3) had died in 2018; or (4) were not California residents based on residential zip code.

Measures

Patient demographics were retrieved for each patient, including age, gender, race, ethnicity, and health insurance. Insurance types were categorized into private, Medicare, Medicaid, and other; both fee-for-service and managed care programs were included when applicable. The modified Charlson Comorbidity Index (CCI) score was calculated to categorize and represent patients' comorbid conditions.^{8,9} The CCI contains 17 selected conditions and is designed

for use with EHR data based on *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnosis and procedure codes. A CCI score for each patient in 2018 was calculated.

HCU was obtained for each patient, including emergency department (ED) visits and hospitalizations; specialty and primary care visits; and face-to-face, telephone, and email encounters. For the face-to-face visits, we obtained the care settings (ie, AMC, PSC, or CMC), and the department specialties (eg, family medicine, cardiology, oncology) of these visits for each

patient. Primary care visits were identified by the department specialties, including family medicine, family practice, general internal medicine, general practice, geriatric medicine, primary care, internal medicine, and coordinated care (ie, a primary care clinic that specialized in treatment of chronic or complex diseases). No-show or canceled appointments were excluded from the calculation of utilization rates.

Patient encounters were assigned to 1 of the 3 health care institutions: AMC, PSC, or CMC. Each patient was assigned to their "home" institution (ie, AMC, PSC, or CMC) based on the institution with the highest number of face-to-face visits in 2018. For patients with the same number of visits to 2 or more institutions, the following priority rule was applied, CMC > PSC > AMC, because an individual who visited a community health center was more likely to be from that community than other, farther locations. Once the patient's home institution was determined, descriptive statistics were calculated comparing demographic and clinical characteristics across the 3 institutions.

Similarly, each patient's primary care "home" was determined by the primary care location visited most. This algorithm was validated by manual chart review by a research nurse of 150 patients (50 from each institution) and confirmed using the patient's residential zip code or, if not recorded, any location for physical therapy (PT). We used PT as an additional estimator in an absence of a zip code because the clinician consultants for the project stated that patients tend to choose PT locations close to their residence location.

Statistical Analysis

Descriptive statistics were used to summarize demographic and encounter-specific information across the 3 institutions. We categorized age into 4 categories (ie, 18-34, 35-49, 50-64, and ≥65 years) for a better understanding of the population difference. Count and frequency were used for describing categorical demographic variables. Comparisons of age among the 3 health care institutions were performed using a 1-way analysis of variance (ANOVA). Chi-square tests of independence for categorical variables and Kruskal-Wallis nonparametric tests for continuous variables were used to test differences in demographic and clinical characteristics among groups. Post hoc pairwise comparisons were performed following ANOVA/Kruskal-Wallis with Bonferroni

correction for multiple tests. Logistic regression was applied to assess differences in HCU (ie, ED visits, hospitalizations, and primary care visits) controlling for other known demographic (ie, age, gender, race, ethnicity, and health insurance) and clinical (ie, CCI) factors. Primary care visit was included as a factor for ED and hospitalization prediction. Patients from PSC were removed from regression analysis due to the large amount of missing data of the outcome variables. The level of significance was set at .05, and all statistical analyses were performed in Statistical Package for Social Sciences version 26.0 (IBM).

RESULTS

Patient Demographics and Comparison by Institution

A total of 677,115 unique patients were identified with at least 1 encounter in 2018. A total of 270,812 (40.0%) were excluded: 159,232 (23.5%) did not have any face-to-face visits, 54,052 were younger than 18 years, 6239 were older than 90 years, 3069 had died in 2018, and 48,220 came from outside California. Finally, a total of 406,303 patients were included in the study (Figure). Overall, the mean (SD) age of patients was 51.2 (17.9) years; 57.6% (n = 234,217) were women and 11.7% (n = 47,437) were Hispanic. Distribution of patient race was 49.7% White (n = 202,037), 19.5% Asian (n = 79,366), and 4.3% Black (n = 17,454). Fifty-six percent of patients were privately insured (managed care programs accounted for 53.8% of the privately insured individuals), 25.8% had Medicare, 8.5% had Medicaid, and 9.8% had other/unknown insurance. Based on the patient's most frequently visited location in 2018, they were categorized into AMC (n = 220,410), PSC (n = 132,300), or CMC (n = 53,593). Table 1 presents demographic and clinical characteristics of patients by institution. AMC had the greatest number of racial and ethnic minorities, with 42.4% non-White (PSC, 36.2%; CMC, 39.7%) and 13.0% Hispanic (PSC, 9.6%; CMC, 11.3%) patients. PSC, as a community-based outpatient care institution, had the highest percentage of women (62.7% vs 54.4% for AMC and 58.5% for CMC) and the highest number of patients with private insurance (63.6% vs 51.3% and 56.0%, respectively) compared with the other 2 institutions. CMC had the youngest patient population (mean [SD] age, 49.2 [17.8] years vs 51.1 [17.8] for AMC and 52.0 [18.1] for PSC) and more White representation (56.0% vs 46.1% and 53.1%) than the other 2 institutions. All differences were statistically significant.

Health Care Service Utilization by Home Institution

Table 2 displays the health care service utilization in 2018 by the institution that provided the majority of care to the patient, which was designated the home institution. There was variability across different institutions for the complexity of patients. Patients whose home institution was AMC had the highest mean (SD) number of comorbid conditions (0.9 [1.8]), followed by CMC (0.5 [1.4]; $P < .001$) and PSC (0.4 [0.9]; $P < .001$). Also, AMC patients had the highest mean (SD) number of face-to-face visits (6.15 [10.14]) and email and telephone encounters (8.86 [13.74]) compared with patients

FIGURE. Cohort Selection Diagram

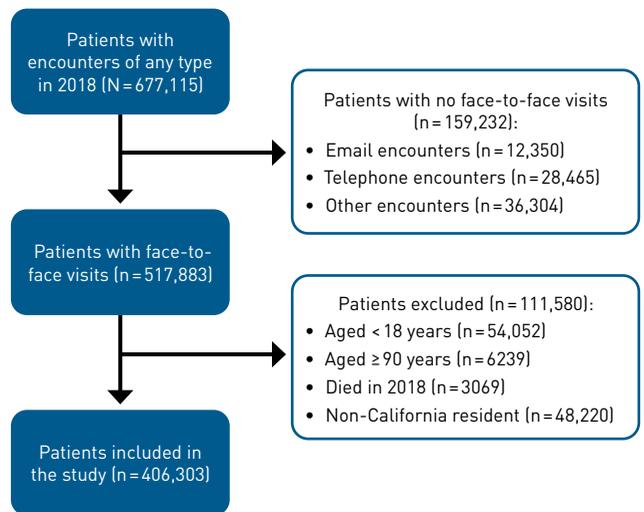


TABLE 1. Patient Demographics Stratified by Home Care Institution, 2018

Characteristic	AMC	PSC	CMC
Total, n	220,410	132,300	53,593
Age in years, mean [SD]	51.1 [17.8]	52.0 [18.1]	49.2 [17.8]
Age category			
18-34 years	22.8%	20.6%	24.9%
35-49 years	23.7%	24.3%	25.7%
50-64 years	26.6%	26.6%	27.4%
≥ 65 years	26.9%	28.5%	21.9%
Gender, female	54.4%	62.7%	58.5%
Race			
White	46.1%	53.1%	56.6%
Asian ^a	19.8%	19.2%	19.5%
Black	3.3%	5.9%	4.4%
Other ^b	20.2%	11.1%	15.9%
Unknown	11.5%	10.7%	3.7%
Ethnicity, Hispanic/Latino	13.0%	9.6%	11.3%
Health insurance			
Medicare	26.4%	27.2%	19.9%
Medicaid	10.8%	3.8%	10.5%
Private	51.3%	63.6%	56.0%
Other ^c	6.5%	1.6%	4.3%
Unknown	5.0%	3.8%	9.3%
Charlson Comorbidity Index score, mean [SD]	0.9 [1.8]	0.4 [0.9]	0.5 [1.4]

AMC, academic medical center; CMC, community-based medical center; PSC, primary and specialty care alliance.

^aAsian includes Asian and Pacific Islander.

^bOther race category includes other and Native American.

^cOther insurance category includes other and worker's compensation.

TABLE 2. Health Care Utilization Stratified by Home Care Institution, 2018

Item	Health care institution		
	AMC (n = 220,410)	PSC (n = 132,300)	CMC (n = 53,593)
Face-to-face visits			
Total visits	1,356,423	381,561	184,914
Mean (SD) visits ^a	6.15 (10.14)	2.88 (3.04)	3.45 (4.57)
Median (IQR) visits	3.00 (6)	2.00 (2)	2.00 (3)
Hospitalizations			
Patients, n (%)	15,126 (6.9%)	206 (0.2%)	4232 (7.9%)
Total inpatient visits	20,327	230	5110
Mean (SD) inpatient visits ^a	1.34 (0.94)	1.12 (0.46)	1.21 (0.62)
Median (IQR) inpatient visits	1.00 (0)	1.00 (0)	1.00 (0)
Mean (SD) among all ^b	0.09 (0.42)	0.00 (0.05)	0.10 (0.37)
ED visits			
Patients, n (%)	23,844 (10.8%)	926 (0.7%)	14,732 (27.5%)
Total ED visits	32,712	1041	19,575
Mean (SD) ED visits ^a	1.37 (1.10)	1.12 (0.41)	1.33 (1.08)
Median (IQR) ED visits	1.00 (0)	1.00 (0)	1.00 (0)
Mean (SD) among all ^b	0.15 (0.56)	0.01 (0.10)	0.37 (0.82)
PCP visits			
Patients, n (%)	61,055 (27.7%)	81,911 (61.9%)	23,171 (43.2%)
Total PCP visits	158,042	198,272	56,803
Mean (SD) PCP visits ^a	2.59 (3.03)	2.42 (1.94)	2.45 (2.05)
Median (IQR) PCP visits	2.00 (2)	2.00 (2)	2.00 (2)
Mean (SD) among all ^b	0.72 (1.97)	1.50 (1.93)	1.06 (1.82)
Telephone and email encounters			
Patients, n (%)	140,146 (63.6%)	92,923 (70.2%)	24,108 (45.0%)
Total encounters	1,241,711	485,748	126,747
Mean (SD) encounters ^a	8.86 (13.74)	5.23 (6.80)	5.26 (7.35)
Median (IQR) encounters	4.00 (8)	3.00 (5)	3.00 (5)
Mean (SD) among all ^b	5.63 (11.76)	3.67 (6.18)	2.36 (5.58)

AMC, academic medical center; CMC, community-based medical center; ED, emergency department; IQR, interquartile range; PCP, primary care physician; PSC, primary and specialty care alliance.

^aMean was calculated for each patient with at least 1 inpatient/ED/primary care visit.

^bMean was calculated among all patients of each institution.

seen most by the other 2 institutions ($P < .001$). PSC had the highest percentage of patients with primary care visits ($n = 81,911$; 61.9%).

Patients whose home institution was CMC had a significantly higher mean (SD) number of ED visits (0.37 [0.82]) compared with AMC (0.15 [0.56]; $P < .001$) and PSC (0.01 [0.10]; $P < .001$). A total of 14,732 (27.5%) unique patients were seen at the ED of CMC in 2018. Results of multivariable logistic regression on HCU (Table 3) were consistent with findings from univariate analyses; patients at CMC had higher odds of ED visits (adjusted odds ratio [OR], 1.97; 95% CI, 1.88-2.07) and hospitalizations (adjusted OR, 1.51; 95% CI, 1.45-1.57) compared with patients at AMC, adjusted for other covariates in the model. We observed a small number of PSC patients who had hospitalizations ($n = 206$; 0.2%) and ED visits ($n = 926$; 0.7%), possibly due to the missing data for this patient population.

Results of analysis of HCU data from patients whose home institution was AMC or CMC showed demographic and clinical factors associated with HCU (Table 3). Compared with White patients, Asian patients were more likely to have primary care visits (adjusted OR, 1.68; 95% CI, 1.65-1.72); also, the odds of ED visits were higher (adjusted OR, 1.18; 95% CI, 1.12-1.26) and of hospitalizations significantly lower for Asian patients (adjusted OR, 0.82; 95% CI, 0.79-0.86). In contrast, Black patients had higher odds of ED visits (adjusted OR, 1.66; 95% CI, 1.50-1.83) and hospitalizations (adjusted OR, 1.11; 95% CI, 1.03-1.19) than White patients. Additionally, Hispanic patients were less likely to have primary care visits (adjusted OR, 0.83; 95% CI, 0.80-0.86) and more likely to have hospitalizations (adjusted OR, 1.247; 95% CI, 1.18-1.32) than non-Hispanic patients. Similarly, patients insured with Medicaid had significantly lower odds of primary care visits (adjusted OR, 0.11; 95% CI, 0.11-0.12) compared with privately insured patients, but the odds of visiting the ED were higher (adjusted OR, 1.62; 95% CI, 1.52-1.72) and the odds of being hospitalized were greater (adjusted OR, 2.19; 95% CI, 2.09-2.30) than for privately insured patients.

Patient Flow Across Institutions

Using the most frequently visited primary care location as the patient's primary care institution, our approach achieved 96% accuracy after the chart review. The eAppendix Figure (available at ajmc.com) presents the care utilization patterns across the 3 health care settings of patients who participated in at least 1 primary care visit. Overall, 240,166 patients (59.1%) were excluded because they were not seen by a primary care provider during the study period, leaving 166,137 patients (40.9%) in the cohort; their home primary care institutions were AMC ($n = 61,055$), PSC ($n = 81,911$), and CMC ($n = 23,171$). As shown in the eAppendix Figure, a majority of patients remain at their home institution for specialty care (AMC, 90.7%; PSC, 78%; CMC, 88.3%). We observed that 21.0% of primary care patients ($n = 17,201$) at PSC received specialty care at the AMC; the department with the greatest number of visits was oncology, followed by surgery, dermatology, ophthalmology, and cardiology. For primary care patients at CMC, a small proportion ($n = 1043$; 4.5%) received specialty care at the PSC and approximately 7.1% ($n = 1645$) received it at the AMC. Similar findings were observed for privately insured individuals in the managed care programs: 7.1% visited AMC and 5.5% visited PSC.

TABLE 3. Logistic Regression of Factors Associated With Health Care Utilization

Characteristic	ED visits		Hospitalizations		PCP visits	
	OR	95% CI	OR	95% CI	OR	95% CI
Age	0.982***	0.980-0.983	1.001*	1.000-1.003	0.995***	0.994-0.995
Gender						
Female			Reference			
Male	1.021	0.978-1.065	0.985	0.954-1.016	1.046***	1.027-1.065
Race						
White			Reference			
Asian	1.184***	1.117-1.256	0.820***	0.785-0.857	1.682***	1.645-1.720
Black	1.658***	1.502-1.829	1.107**	1.027-1.193	1.057*	1.006-1.111
Other	1.376***	1.289-1.469	0.892***	0.849-0.936	0.878**	0.853-0.903
Ethnicity						
Non-Hispanic			Reference			
Hispanic	1.001	0.931-1.075	1.247***	1.182-1.316	0.828***	0.800-0.858
Insurance						
Private			Reference			
Medicaid	1.620***	1.523-1.723	2.191***	2.088-2.299	0.113***	0.107-0.119
Medicare	1.029	0.965-1.097	1.534***	1.464-1.608	0.725***	0.705-0.746
Other	2.076***	1.907-2.261	0.895**	0.836-0.959	0.784***	0.761-0.809
Charlson Comorbidity Index score	0.828***	0.822-0.835	1.338***	1.331-1.345	1.025***	1.021-1.030
No. of PCP visits	1.158***	1.144-1.173	0.984***	0.975-0.992	N/A	N/A
Home institution						
AMC			Reference			
CMC	1.971***	1.875-2.073	1.512***	1.454-1.573	2.190***	2.144-2.238

AMC, academic medical center; CMC, community-based medical center; ED, emergency department; N/A, not applicable; OR, odds ratio; PCP, primary care physician.
* $P < .05$; ** $P < .01$; *** $P < .001$.

DISCUSSION

In this study, we describe the patients and patterns of their care across different health care institutions after a hospital merger and acquisition in the Northern California Bay Area. We observed variations in patient characteristics across the different health care institutions, with the AMC serving older, more complex, and more non-White patients compared with the PSC and CMC institutions. After the merger, the majority of patients continued receiving care from their home institution for routine checkups whereas a small proportion of patients sought highly specialized services, such as oncology or surgery, at the AMC. Interestingly, compared with those at the AMC, patients at the CMC had higher rates of HCU and were more likely to have ED, inpatient, or primary care visits. These findings provide insights of patient utilization after mergers between academic and community medical centers and can guide resource allocation and opportunities for improving care delivery.

In general, the patient population of the study is diverse and, compared with Census data from 2019,¹⁰ consists of more Asian patients and fewer White and Black patients. Within this refined area, the populations that the AMC and CMC serve are very different, with the AMC serving older patients who are sicker with more complex diseases. This finding is consistent with those of other studies^{11,12}

because the AMC provides tertiary and quaternary care to more challenging patients and often functions as a referral center for the CMC. In addition, another study has reported that compared with CMCs, AMCs have a higher share of Medicare- and Medicaid-insured patients.¹³ This is also evident in our study, in which a higher proportion of AMC patients are insured by Medicare than CMC patients. In addition to the differences in the patient community it serves, the level of care offered by the AMC is comparable with that of other AMCs in the nation, providing both general acute care services and tertiary medical care for patients who are based locally, nationally, and internationally.

After the hospital merger, we found that patients generally received nonspecialty care at their home institute. Community medical centers serve as the primary sites for health care most of the time. Patients whose home institution is community-based “cross over” to receive care at another institution more than those whose home institution is an AMC. The patient movement across institutions is likely a result of the severity and complexity of disease conditions and the restricted care specialties provided in the home institution. Health insurance coverage might be another factor affecting utilization; inadequate health coverage may limit patients’ ability to visit multiple offices and providers. The results from this work provide an understanding of patient flow following

hospital acquisitions that may be applicable to other hospital mergers and help with resource planning.

We found significant differences in ED visits and hospitalizations of patients across the 3 institutions, in that patients whose home institution was PSC had a significantly smaller number of ED visits and hospitalizations. These differences are likely due to the availability of health care services for acute and complex conditions within a specific region served by each institution. PSC outpatient clinics serve individuals of a wider region in the Bay Area where several other health systems are also accessible to patients. Thus, patients are likely to access EDs that are closer in distance and are hospitalized in other acute care facilities. It is likely, therefore, that ED visits and hospitalization records of these patients are not recorded in the EHR data set. CMC hospitals and clinics, however, cover patients in a relatively limited region with few other health care facilities; thus, it is likely that patients visited the CMC for an emergent health condition, and we are able to capture a higher proportion of ED visits and hospitalizations for patients whose home institution was CMC.

Limitations

We acknowledge several limitations of the study. First, this study is just one example among many hospital mergers and acquisitions, and these findings may not generalize to other health care systems. However, the merger and acquisition of academic and community hospitals are becoming more common, and the results from this study are likely applicable to other mergers and acquisitions. Second, several other health systems are situated in the local area, which may affect the complete capture of HCU, such as ED utilization. This is particularly true at the AMC, which may treat out-of-state patients for specialty care. However, the complete capture of utilization is not unique to our health care setting, and therefore the results from this study are likely comparable with other AMCs. Last, the recent acquisition of hospitals may not have reached “equilibrium” yet in terms of patient service utilization. Continuous tracking of service utilization and patient flow is needed to guide future decision-making.

CONCLUSIONS

This study characterizes patient flow between newly acquired and merged hospitals and highlights movement from CMC to AMC for specialty care. This work demonstrates differences in patient demographics and HCU across different types of health care institutions now merged into a single health system. Patients were more likely to stay at their parent institutions and seek advanced cancer care

or surgery at the AMC. It is also important to note the differences in patient populations at the individual institutions as hospitals respond to increasing pressures of health care reform and attempt to acquire a broader array of services to better deliver integrated, cost-effective care. This work provides novel information regarding patient movement among institutions following hospital mergers and acquisitions. ■

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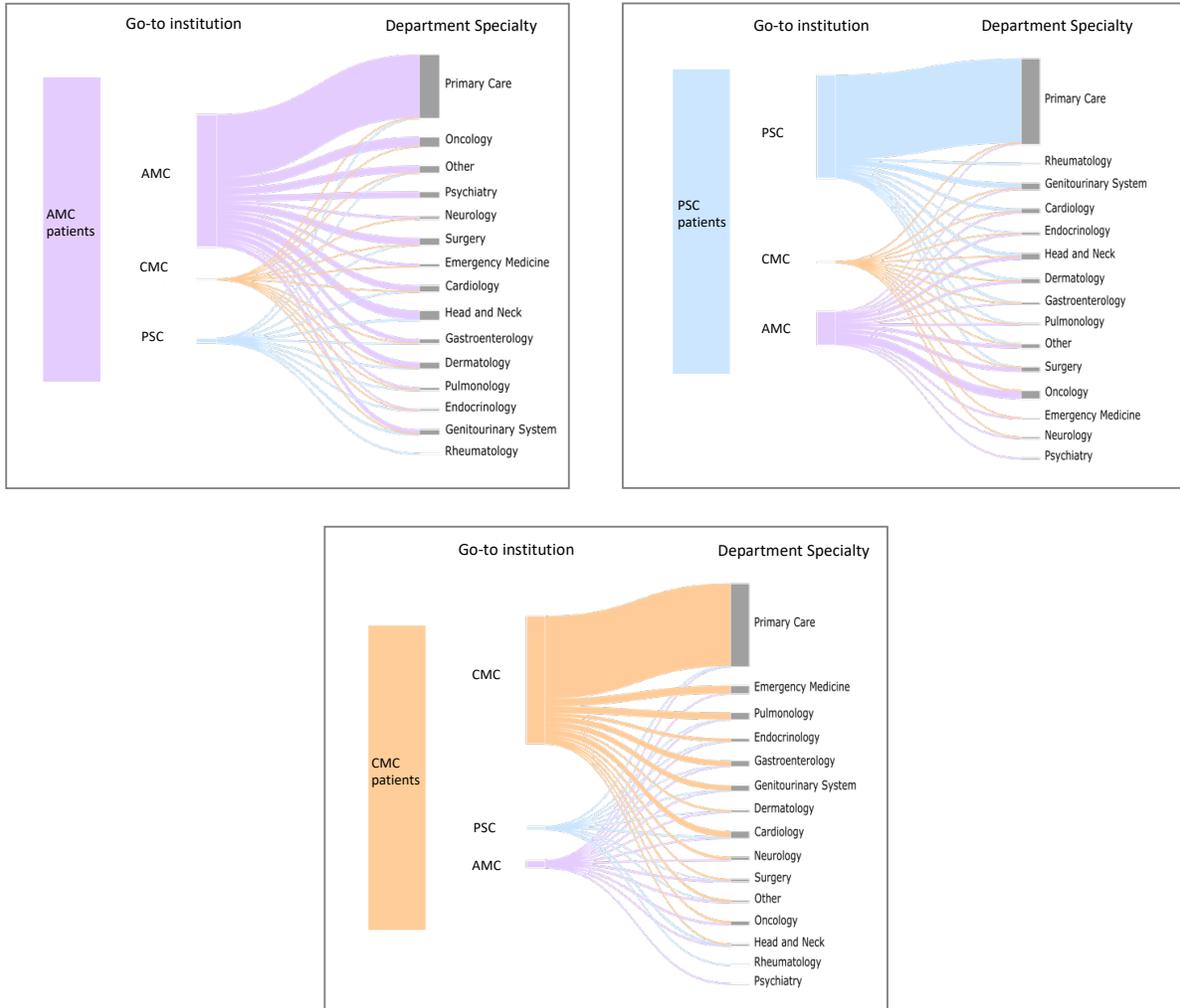
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eAppendix Figure. Health Care Utilization Across Institutions by Home Institution for Patients With at Least 1 Visit in 2018



AMC, academic medical center; CMC, community-based medical center; PSC, primary and specialty care clinics.