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RESEARCH **ORIGINAL ARTICLE**

Comparison of Hospitalization and Post-Hospitalization Outcomes among Family Medicine Hospitalists and Internal Medicine Hospitalists in a Tertiary Center: A Prospective Cohort Study

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ABSTRACT

BACKGROUND - There is a lack of studies comparing hospitalization and post-hospitalization outcomes between internal medicine (IM) hospitalists and family medicine (FM) hospitalists.

OBJECTIVE - To compare the length of stay (LOS), hospital cost, and 30-day all-cause readmission rate among patients treated by IM hospitalists and FM hospitalists.

DESIGN AND SETTING - Prospective cohort study in a referral center. Propensity score matching was used to balance baseline characteristics between comparative arms.

PARTICIPANTS - 747 patients 18 years and older who were admitted to the hospitalist services.

INTERVENTION - Treatment by IM hospitalists and FM hospitalists.

MAIN MEASURES - LOS, hospital cost, and 30-day all-cause readmission. Treatment arms were compared by two methods. We compared patients who were treated by FM services exclusively with those treated by IM services exclusively. Covariate adjusted differences in outcomes were estimated by multivariable regression. For a secondary set of analyses, exposure to FM and IM was converted to a continuous independent variable.

KEY RESULTS - Forty, 333, and 374 patients were seen by FM, IM, and a combination of both services, respectively. Using average treatment on the treated as the estimand, FM care provided a shorter weight-adjusted LOS by 0.5 days (CI: -0.92 - -0.04, P =0.026) compared to IM, but no difference in hospital cost (-126, CI: -906 - 653, P=.74). There was no difference in adjusted hazard for 30-day readmission between FM and IM (HR: 2, CI: 0.67-6.2, P =0.062). Propensity weight-adjusted multiple regression models of the complete cohort (n=747) did not show any difference in any outcomes with increased exposure to FM care.

CONCLUSIONS - Understanding variation in practices and outcomes between different hospitalist models opens opportunities to improve care and decrease the length of stay.

KEYWORDS - Internal medicine, family medicine, hospitalist, length of stay, patient readmission, hospital costs

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INTRODUCTION

The American Board of Physician Specialties defines a hospitalist as "a physician who dedicates his or her career to providing care to hospitalized patients" (1). In the 2018 Medical School Graduation Questionnaire, the Association of American Medical Colleges reported that the number of graduates interested in a career as a hospitalist was 19.4% (2). Hospitalists outnumbered other internal medicine (IM) sub-specialties with an estimated workforce of 50,000 hospitalists in 2016 (3). Around 75% of hospitals utilize hospitalists for in-patient care (3). Many studies have shown decreased length of stay and cost after introducing a hospitalist model (4, 5). Despite that, there is a constant concern regarding a "decline in comprehensive care" provided by hospitalists compared to community physicians (6).

With the increasing number of family physicians working in the hospital setting, the American Board of Family Medicine and the American Board of Internal Medicine started a program for Recognition of Focused Practice in hospital medicine in 2009 (7). Weaver et al. showed that family medicine (FM) program directors felt neutral or positive about this hospitalist model (8). Moreover, hospitalists play a significant role in FM education and training (9). All of these factors have increased the number of FM hospitalists. Around 17% of hospitalists identify themselves as FM-trained physicians (10). Several studies have compared different FM and IM models serving hospitalized patients (11-13), but there are no studies comparing FM hospitalists to IM hospitalists. In a subanalysis of a prospective cohort study we conducted previously (14), we compare the length of stay, cost of hospitalization, and 30-day all-cause readmission in hospitalized patients treated by FM versus IM hospitalist services at a single institution.

METHODS

STUDY DESIGN - The University of Toledo institutional review board (IRB) approved study protocol and consent forms. As we previously described (14), we conducted a classical prospective cohort study with standard data collection interval and follow-up using standardized protocols. Patients were recruited between 2/25/2019 and 4/30/2019. After study conclusion, an IRB-approved amendment to protocol expanded the study sample to include patients who had not consented and hence were missed during the recruitment window. The amendment complied with 'common rule' regulations (15).

STUDY SITE - The study was conducted in Promedica Toledo hospital, an 800-bed tertiary center. Promedica Health System serves Northwest Ohio and Southeast Michigan and includes 13 hospitals.

INTERVENTION - Internal medicine services were divided into non-teaching services and teaching services. At admission, patients were screened and assigned to teaching or non-teaching services by a board-certified physician. Patients assigned to the non-teaching services were distributed to the floors based on bed availability and reason for admission. Both IM hospitalists and FM hospitalists could cover any of the non-teaching teams non-preferentially. Any patient admitted to the non-teaching services could be seen by an IM hospitalist, an FM hospitalist, or a combination of both during their stay. During the study period, both FM hospitalists and IM hospitalists covered services daily. The non-teaching service was covered by 9 (20%) FM board-certified physicians and 37 (80%) IM board-certified physicians. All non-teaching services were covered exclusively by hospitalists. Patients admitted to the intensive care unit were followed exclusively by critical care physicians, and care was transferred back to hospitalist service upon transfer to the regular floor.

PARTICIPANTS ENROLLMENT - Participant recruitment was dynamic, and potential enrollees included all consecutive adult (18+ years) admissions for any medical reason to the hospitalist services at Promedica Toledo Hospital during the recruitment period.

Every 12 hours, all patients admitted to IM services were screened and assigned by the attending physician to an IM resident to obtain patient consent, baseline characteristics and contact information, and contact information for family members for outcomes ascertainment post-discharge. A team of 10 residents participated in the enrollment over 65 consecutive days, and at least three residents enrolled patients daily.

Patients were excluded if they declined to join the study, retracted their consent, or were transferred to non-hospitalist service during admission. Patients transferred to the intensive care unit after admission to hospitalist services were not excluded. Patients who were missed during the recruitment period were included, and their data were collected retrospectively.

VARIABLES - Data were extracted by IM residents. Patient baseline characteristics included: age, biological sex (patient determined), ethnicity (patient determined), assistance at home (yes/no), food security most of the year (yes/no), residence before admission, type of insurance, admission diagnosis, and comorbidities. Further details about comorbidities and diagnoses collected are described in the supplementary materials. All baseline characteristics, admission diagnosis, and comorbidities were standardized to minimize misclassification.

Exposure was captured and classified as IM or FM. Patients could be treated by IM hospitalists, FM hospitalists, or a mixture of both services. To account for this, we collected daily data on assigned treating physicians for each patient during their hospitalization. A continuous version of this information was created, "family medicine percentage," which was calculated by dividing FM hospitalist-days by the sum of FM hospitalist-days and IM hospitalist-days. Family medicine percentage ranged from 100% for patients treated exclusively by FM hospitalists to 0% for patients treated exclusively by IM hospitalists.

STUDY OUTCOMES - study outcomes were classified into hospitalization outcomes and post-hospitalization outcomes. Hospital outcomes included length of stay and hospital costs. Length of hospitalization was measured in (integer) days. All days in which a patient was admitted to hospitalist services for any duration between 12:00 am till 11:59 pm were counted as a full day in terms of the length of stay measurement. Hospital costs included both variable direct and fixed direct costs incurred during the hospitalization. Post-hospitalization outcome included 30-day readmission rate. All-cause readmission included any admission for any reason to any hospital, excluding elective admissions (i.e., elective surgery) or admissions to psychiatry hospitals. Both observation and in-patient statuses were counted as admissions.

Readmissions outcome were captured by two methods, active and passive ascertainment. A group of 4 IM residents contacted all study participants on or around 31 days post-discharge to inquire about readmission within 30 days after discharge. Patients who did not answer were contacted by alternative methods, including text messages, voice messages, emails, secondary phone numbers of family members, or home phone numbers based on patient preference. At least two additional attempts were made to contact the patient, family members, or friends for outcome ascertainment.

For passive ascertainment, we checked Promedica electronic health records and the University of Toledo health records for readmission. Health records were checked at least three months post-discharge to maximize data accuracy. Promedica Health System utilizes Epic electronic medical records, which supports a feature called Care Everywhere. Care Everywhere is a health network connecting all hospitals that utilize Epic. Data was also collected from Care Everywhere to cover a large geographical area, which included most tertiary hospitals in Northwest Ohio and Southeast Michigan. Referral health systems that utilize Care Everywhere include Mercy Health, Cleveland Clinic and Ohio State University Medical Center in Ohio and Henry Ford Health System, University of Michigan, and Beaumont Health System in Michigan (16). Lucas County, including Toledo city, is served by three separate systems: Promedica Health Care, Mercy Health, and University of Toledo Medical Center (17). Readmission events and dates were included if patient-reported readmission or readmission was evident from the electronic medical records.

DATA SOURCES - IM residents collected data from collection sheets used at the screening process, Promedica and University of Toledo electronic medical records, communication with patient/ family members, and Epic's Care Everywhere health network. Outcomes were obtained or calculated electronically to improve accuracy. Data were checked extensively and validated to ensure accuracy before analysis.

STATISTICAL ANALYSIS

PRIMARY EXPOSURE - Two different approaches were used to measure the exposure to IM versus FM hospitalists. In the first approach, only patients who were seen either by IM exclusively or FM exclusively throughout their entire admission were analyzed.

The second method included all study participants and used a continuous measure, the percentage of hospital days that the participants were seen by an FM hospitalist, to quantify the degree of FM versus IM exposure.

STATISTICAL METHODOLOGY - Descriptive statistics are presented as means with standard deviation for continuous variables and numbers with percentages for categorical variables. Unadjusted baseline characteristics between the two exposure groups were compared using t-test for continuous variables and Pearson's chi-square or Fisher's exact test, as appropriate, for categorical variables. Survival outcomes were compared using the log-rank or Wilcoxon rank test.

The first stage of the analysis included only patients seen either by IM exclusively or FM exclusively throughout their entire admission. Propensity score weighting was used to balance these two groups for differing characteristic profiles. The propensity of each patient to be seen by an FM hospitalist was computed via logistic regression with demographic and clinical predictors. A weighted matching approach was used to pair each patient in the IM group with a similar patient in the FM group. Simple linear regression was used to estimate the difference in length of stay and hospital cost between comparison arms. Simple Cox proportional hazards regression was used to estimate the relative hazard of 30-day readmissions between the comparison arms. These multivariable linear and cox regression models were extended to include covariates used in the propensity score computation to adjust for residual post-matching differences in the two exposure groups (18).Variables were added or dropped from multivariable models if the coefficient of interest changed more than or equal to 10% or improved the Akaike information criterion without changing the coefficient.

In multivariable Cox proportional hazards models, we used a robust variance estimator to account for within-person homogeneity induced by matching (19).

In the second stage of analysis, we analyzed the complete study sample (n=747), and the primary exposure of interest was the continuous variable FM percentage. A generalized linear regression was used to estimate propensity scores outcome/exposure comparisons. Inverse probability weight-adjusted simple linear and Cox proportional hazards regression models were used to estimate propensity-score matched associations between the primary and exposure and the length of stay, cost of stay, and 30-day readmission rate.

Regression diagnostics were used to evaluate regression model assumptions. All statistical tests were two-sided. Tests with p-values <0.05 were considered statistically significant. Investigators used R-statistical software (version 3.6.1) for analysis(20). Further details regarding adjustment via weighting and methods used to deal with missing data are described in the supplementary materials.

RESULTS

STUDY POPULATION CHARACTERISTICS - During the study period, 735 unique patients were admitted at least once to non-teaching services, totaling 747 separate admissions (figure 1). Around 97% of patients consented to join the study, and 3% of patients were missed at initial screening, and their data were collected retrospectively.

Table 1 shows baseline characteristics of the complete cohort (n= 747 patients) and the comparison between patients seen exclusively by FM hospitalists (n=40) and those seen exclusively by IM hospitalists (n=333) before and after adjustment using weighting. Figure 2 demonstrates covariate balance before and after propensity matching using weighting by odds, and Supplementary figure 1 demonstrates covariate balance before and after generalized propensity matching using inverse probability of treatment weighting for complete cohort analysis.

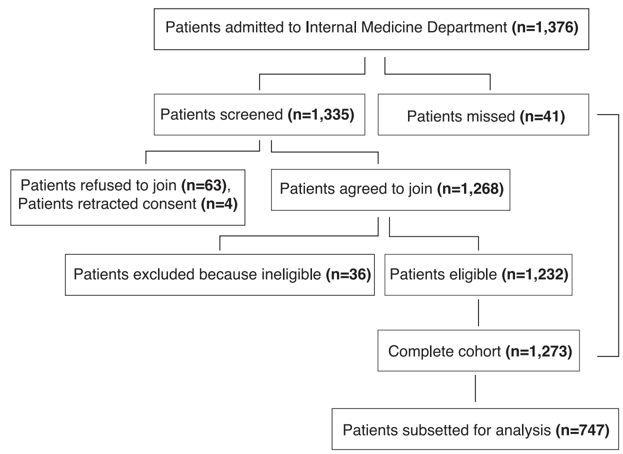

Figure 1. Flow chart of the study population

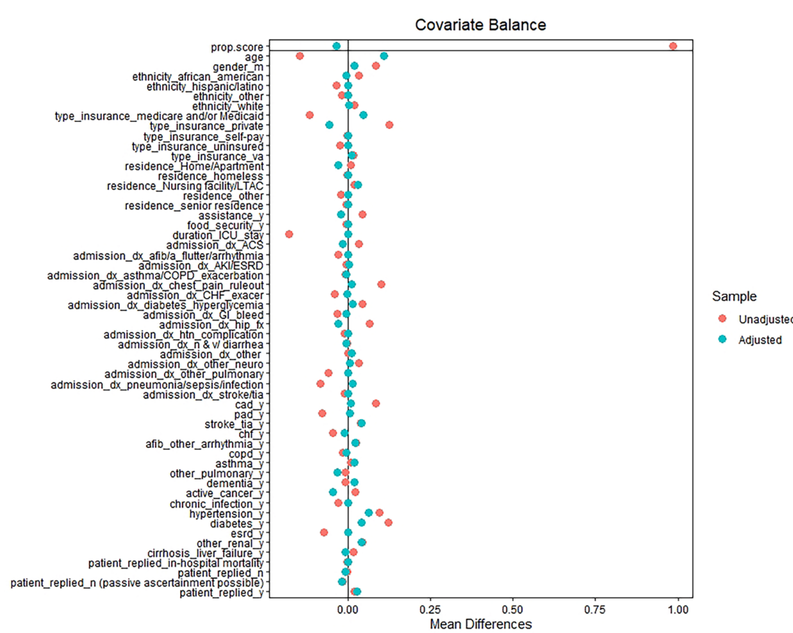

Figure 2. Unadjusted and Adjusted covariate balance using propensity score weighting by the odds

PATIENT OUTCOMES - In this section, we present the ATT estimands. Adequacy of matching was assessed (figure 2). The adjusted length of stay was 0.96 (95% CI: 0.12-1.78, P=.02) days longer in IM (4.5 ± 0.3) compared to FM (3.6 ± 0.28), using adjusted t-test. The adjusted cost of hospitalization was not statistically different between the two services (4836 ± 756 vs. 4047 ± 503 dollars, respectively (mean difference=789 dollars, CI: -974-2442, P=.38) using adjusted t-test. Using Wilcoxon and log-rank post-adjustment, there was no difference in 30-day all cause-readmission between the two groups (P=.27, respectively). Supplementary tables 1-3 show the results from the weight-adjusted multiple regression models to calculate the estimand of interest, including the length of stay, cost of hospitalization, and 30-day readmission.

Using weighted multivariable linear regression, we found that patients treated by FM had a half-day shorter hospital stay on average compared to patients treated by IM (-0.49 days, CI: -0.92- -0.05, P=.03), and we found no difference in the cost of hospitalization on average between patients treated by FM and IM (-126, CI: -906 - 653, P=.74). Thirty-day all-cause readmission was not statistically different between patients treated by FM compared to IM (hazard ratio=2, CI: 0.7 - 6.2, P=.06) based on the multivariate Cox regression models (figure 3).

In the second analysis phase, we used family percentage as a continuous independent variable to estimate the average treatment effect. There was no statistically significant difference in outcomes with incremental family medicine care. Refer to Supplementary for further details.

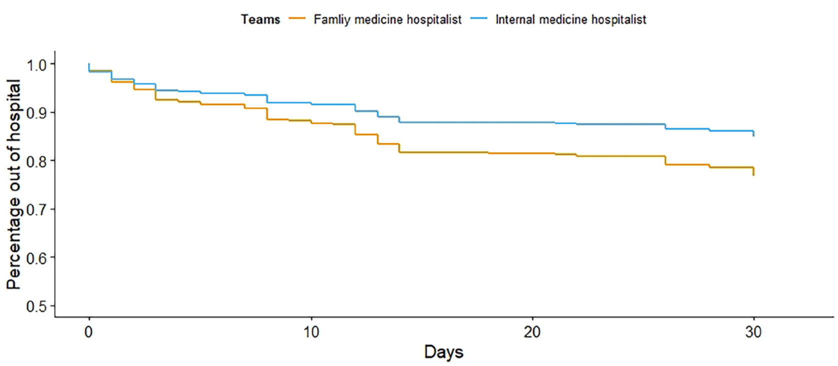

Figure 3. Thirty-day readmission in family medicine and internal medicine hospitalists using weight-adjusted cox proportional hazard survival curves estimates

Table 1. Baseline characteristics of the total cohort, family medicine vs. internal medicine before propensity score weighting and post-weighing

Characteristic	Complete cohort (no.=747)	Unadjusted comparison: Family Medicine vs. Internal Medicine			Adjusted comparison: Family Medicine vs. Internal Medicine		
Patients		**Family Medicine (no.=40)**	**Internal Medicine (no.=333)**	**P-Value**	**Family Medicine (no.=40)**	**Internal Medicine (no.= 58)**	**P-Value**
Age, mean (SD), y	60.5 (19.3)	58 (16.5)	61 (19.8)	<0.001	58 (16.5)	56 (13.7)	0.6
Female, no. (%)	389 (52)	17 (43)	170 (51)	0.39	17 (43)	25 (43)	0.8
Ethnicity							
White, no. (%)	560 (75)	30 (75)	243 (73)	0.8	30 (75)	44 (76)	1
African American, no. (%)	141 (19)	9 (23)	63 (19)		9 (23)	13 (22)	
Hispanic/ Latino, no. (%)	35 (5)	1 (3)	20 (6)		1 (3)	2 (3)	
Asian, no. (%)	1 (<1)	0 (0)	0 (0)		0 (0)	0 (0)	
Other, no. (%)	9 (1)	0 (0)	6 (2)		0 (0)	0 (0)	
Missing, no. (%)	1 (<1)	0 (0)	1 (<1)		0 (0)	0 (0)	

Food security							
Yes, no. (%)	710 (95)	39 (98)	322 (97)	0.74	40 (100)	58 (100)	1
No, no. (%)	16 (2)	0 (0)	5 (2)		0	0	
Missing, no. (%)	21 (3)	1 (2)	6 (2)		0 (0)	0 (0)	
Assistance at home							
Yes, no. (%)	621 (83)	35 (88)	279 (84)	0.67	36 (90)	54 (93)	1
No, no. (%)	102 (14)	4 (10)	46 (14)		4 (10)	4 (7)	
Missing	24 (3)	1 (2)	8 (2)		0 (0)	0 (0)	
Residence prior to admission							
House or apartment, no. (%)	681 (91)	37 (93)	309 (93)	0.66	38 (95)	56 (97)	0.6
Nursing facility or LTACH, no. (%)	28 (4)	2(5)	10 (3)		2 (5)	2 (3)	
Senior residence, no. (%)	8 (1)	0 (0)	2 (<1)		0 (0)	0 (0)	
Shelter, no. (%)	2 (<1)	0 (0)	0 (0)		0 (0)	0 (0)	
Homeless, no. (%)	0 (0)	0 (0)	1(<1)		0 (0)	0 (0)	
Other, no. (%)	2 (<1)	0 (0)	6 (2)		0 (0)	0 (0)	
Missing, no. (%)	16 (2)	1 (2)	4 (1)		0 (0)	0 (0)	
Type of insurance							
Medicare or Medicaid, no. (%)	435 (58)	18 (45)	188 (56)	0.38	18 (45)	23 (39)	0.8
Private, no. (%)	286 (38)	21 (53)	133 (40)		21 (53)	34 (58)	
Veteran's affairs, no. (%)	8 (1)	1 (2)	3 (1)		1 (2)	1 (2)	
Self-pay, no. (%)	1 (<1)	0 (0)	1 (<0.1)		0	0	
Uninsured, no. (%)	17 (2)	0 (0)	8 (2)		0	0	
Discharge destination							
Home, no. (%)	439 (59)	27 (67)	208 (62)	0.13	27 (67)	38 (66)	0.14
Home health care, no. (%)	141 (19)	3 (8)	63 (19)		3 (8)	10 (17)	
In-patient rehabilitation, no. (%)	7 (<1)	0 (0)	2 (1)		0 (0)	0 (0)	
Skilled nursing facility, no. (%)	111 (15)	6 (15)	42 (13)		6 (15)	8 (14)	
LTACH, no. (%)	3 (<1)	0 (0)	1 (<1)		0 (0)	0 (0)	
Hospice, no. (%)	7 (<1)	0 (0)	2 (1)		0 (0)	0 (0)	
AMA, no. (%)	16 (2)	4 (10)	6 (2)		4 (10)	0 (2)	
Other, no. (%)	20 (2)	0 (0)	8 (2)		0 (0)	1 (2)	
Missing, no (%)	1 (<1)	0 (0)	0 (0)		0 (0)	0 (0)	
In-hospital mortality, no. (%)	2 (<1)	0 (0)	1 (<1)	1	0 (0)	0 (0)	1
Duration of ICU stay , mean (SD), d	0.13 (0.9)	0 (0)	0.12 (0.7)	0.002	0 (0)	<0.01 (<0.01)	0.32

30-day outcome ascertainment (n=745)							
Active and passive, no. (%)	349 (47)	20 (50)	160 (48)	0.95	20 (50)	28 (48)	1
Passive, no. (%)	383 (51)	19 (47.5)	163 (49)		19 (47.5)	29 (50)	
Lost to follow-up, no. (%)	13 (2)	1 (2.5)	9 (3)		1 (2.5)	1 (2)	
Principal diagnosis							
Acute coronary syndrome, no. (%)	15 (2)	2 (5)	6 (2)	0.029	2 (5)	4 (7)	0.99
Non-coronary chest pain, no. (%)	59 (8)	7 (18)	25 (8)		7 (18)	9 (16)	
Atrial fibrillation or arrhythmia, no. (%)	21 (3)	0 (0)	10 (3)		0 (0)	0 (0)	
Heart failure exacerbation, no. (%)	40 (5)	1 (3)	22 (7)		1 (3)	1 (2)	
Acute kidney injury or ESRD complication, no. (%)	33 (4)	2 (5)	18 (5)		2 (5)	3 (5)	
Pneumonia, sepsis or infection, no. (%)	145 (19)	5 (13)	69 (21)		5 (13)	6 (10)	
Asthma or COPD exacerbation, no. (%)	44 (6)	2 (5)	19 (6)		2 (5)	3 (5)	
Other pulmonary disease, no. (%)	33 (4)	0 (0)	20 (6)		0 (0)	0 (0)	
Hyperglycemia crisis, no. (%)	5 (<1)	2 (5)	2 (1)		2 (5)	3 (5)	
Hypertensive crisis, no. (%)	10 (1)	0 (0)	3 (1)		0 (0)	0 (0)	
Gastrointestinal bleeding, no. (%)	45 (6)	1 (3)	19 (6)		1 (3)	1 (2)	
Hip fracture, no. (%)	20 (3)	3 (8)	3 (1)		3 (8)	7 (12)	
Nausea, vomiting and/or diarrhea, no. (%)	54 (7)	3 (8)	26 (8)		3 (8)	4 (7)	
Stroke or TIA, no. (%)	8 (1)	0 (0)	3 (1)		0 (0)	0 (0)	
Other neurologic disease, no. (%)	49 (7)	4 (10)	22 (7)		4 (10)	6 (10)	
Others, no. (%)	166 (22)	8 (20)	66 (20)		8 (20)	11 (19)	
Comorbidities- yes							
Coronary artery disease, no. (%)	222 (29.7)	16 (40)	105 (32)	0.36	16 (40)	23 (40)	1
Cerebrovascular disease, no. (%)	75 (10)	5 (13)	29 (9)	0.38	5 (13)	4 (7)	0.47
Heart failure, no. (%)	171 (22.8)	8 (20)	82 (25)	0.62	8 (20)	13 (22)	0.89
Peripheral artery disease, no. (%)	66 (8.8)	1 (3)	34 (10)	0.15	1 (3)	1 (2)	1
Atrial fibrillation or other arrhythmia, no. (%)	147 (19.6)	9 (23)	67 (20)	0.88	9 (23)	12 (21)	0.81
COPD, no. (%)	158 (21.2)	8 (20)	72 (22)	0.97	8 (20)	12 (21)	0.97
Asthma, no. (%)	103 (13.8)	6 (15)	47 (14)	1	6 (15)	7 (12)	0.63

Other pulmonary disease, no. (%)	136 (18.2)	7 (18)	61 (18)	1	7 (18)	12 (21)	0.73
Hypertension, no. (%)	487 (65.2)	29 (73)	210 (63)	0.31	29 (73)	38 (65)	0.5
Diabetes, no. (%) mellitus	251 (33.6)	18 (45)	109 (33)	0.17	18 (45)	24 (41)	0.67
ESRD, no. (%)	48 (6.4)	0 (0)	24 (7)	0.09	0 (0)	0 (0)	1
Other renal disease, no. (%)	152 (20.3)	10 (25)	69 (21)	0.67	10 (25)	13 (22)	0.69
Cirrhosis, no. (%)	13 (1.7)	1 (3)	3 (1)	0.36	1 (3)	1 (2)	1
Other gastrointestinal disease, no. (%)	250 (33.5)	8 (20)	107 (32)	0.16	8 (20)	17 (29)	0.26
Dementia, no. (%)	33 (4.4)	1 (3)	11 (3)	1	1 (3)	0 (0)	0.49
Active cancer, no. (%)	62 (8.3)	4 (10)	26 (8)	0.54	4 (10)	8 (14)	0.54
Chronic infection, no. (%)	23 (3.1)	0 (0)	10 (3)	0.6	0 (0)	0 (0)	1

No: number; SD: standard deviation; LTACH: long-term acute care hospital; AMA: against medical advice; ICU: intensive care unit; COPD: chronic obstructive pulmonary disease; TIA: transient ischemic attack; ESRD: end-stage renal disease.

DISCUSSION

Since the incorporation of the hospitalist role in US healthcare in the mid-1990s (21), there has been a progressive growth in the number of hospitalists (3, 10). In 2013, the number of FM hospitalists was estimated to be 5,962 physicians compared to 28,404 IM hospitalists (10). Despite the increasing number of FM hospitalists, no studies have compared their outcomes to IM hospitalists. In this study, we compared FM to IM hospitalist services by analyzing a cohort of patients admitted to hospitalist services in a tertiary center. First, we compared patients seen solely by IM to those seen solely by FM and estimated the ATT as a causal inference estimand. This analysis was performed to produce a homogenous, easy-to-understand comparison. Secondly, to account for patients seen by both services, the exposure to FM was converted to a continuous variable and fitted into multiple regression models to estimate outcomes using the complete cohort data.

Our study found that patients solely treated by FM had a half-day shorter stay compared to IM. There was no difference in hospital costs. Using the complete data, incremental exposure to FM physicians was not associated with statistically significant differences in length of stay, cost of hospitalization, or 30-day readmission; this might be due to insufficient power to detect differences using these models. Table 2 shows studies comparing different FM services to IM services. In a retrospective database analysis, Lindenauer et al. compared care provided by 18,813 FM providers to 24,772 hospitalists (11); they found that care provided by hospitalists had a 0.4 day shorter stay but no difference in hospitalization cost, 14-day readmission, or in-patient mortality. In this study, FM practitioners were primarily community physicians and treated patients when hospitalized. Hospitalists were mainly internists and less commonly FM hospitalists. It is difficult to compare this study's results to ours because the target populations are fundamentally different.

In-patient exposure in IM training is higher than in FM training; the Accreditation Council for Graduate Medical Education (ACGME) in the US mandates that at least one-third of IM training occurs in the in-patient setting and at least one-third in the outpatient setting (22). On the other hand, the ACGME mandates that FM residents see patients in FM practice for a minimum of forty weeks of the year (23). Because of the difference in the training and skills (24), authors hypothesize that FM hospitalists tend to leave part of patient medical needs to community physicians where they can be addressed in outpatient settings leading to shorter hospital stays.

LIMITATIONS

Our study has several limitations; it represents a single-center experience, which limits the

Table 2. Comparison of family medicine and Internal medicine services

Author/ Year	Design/ Study population	Comparison/ allocation	Outcome	Pertinent findings*	Remarks
Current study/2022	Prospective cohort study/ single institution/ all comers	FM hospitalist: IM hospitalist. Unpredictable allocation	LOS, HC, 30-day readmission rate and 30-day mortality rate.	ATT estimates: LOS ~0.5 days shorter in FM compared to IM but 2 times higher readmission hazard ratio. No difference in HC or mortality.	Baseline characteristics and observable confounders were controlled using propensity score.
Lindenauer (11)/ 2007	Retrospective cohort/ multi-institution/ database analysis	Hospitalist: general internist: FM. Unclear how patients allocated	LOS, HC, 14 days-of all cause-readmission (odds ratio) and in-patient mortality (odds ratio).	LOS of hospitalist 0.4 days less than FM. HC, mortality and readmission was not different.	Hospitalist were internist (usually) or family medicine. FM were family medicine practitioner and not hospitalists. HC and LOS were trimmed to 3 SD.
Smith (13)/ 2002	Retrospective cohort/ single institution/ patients admitted only for pneumonia	Critical care hospitalist: FM-hospitalist: PCP. Allocation depends on insurance type	LOS, HC, intensive care unit LOS	Family medicine primary care physician had shorter stay (3.8: 3.9: 2.6 days). FM less HC than critical care (5,680 $: 10,231 $)	Critical care hospitalist were pulmonologist. FM-hospitalists are outpatient FM who work for 8-weeks in hospital and PCP follow their clinic patients when admitted
Tingle (12)/ 2001	Retrospective cohort/ single institution/ 10 most frequent diagnosis	Academic FM teams: non-academic hospitalist. Allocation is 2:1, criteria not mentioned	HC, LOS, in-patient mortality (odds ratio), discharge status	No difference	Academic FM teams are residency based services. Hospitalist were 5 IM physicians.

Family medicine: FM; Hospital cost: HC; Internal medicine: IM; Length of stay: LOS; Primary care physicians: PCP, ATT: average treatment on the treated causal effect. * Pertinent findings are statistically significant differences reported.

generalizability of the results. Another limitation is the ascertainment of post-discharge outcomes; around 50% of patients' outcomes were ascertained passively because of the inability to contact the patient or family. Checking two electronic medical records and Epic's Care Everywhere to ascertain outcomes passively and actively improved accuracy, and only 1 out of the 349 patient readmission statuses were changed after contacting patients. Excluding psychiatric hospitals, Lucas County is served exclusively by three hospital systems: Promedica Health Care, Mercy Health, and University of Toledo (17), all of which medical records were searched for outcome ascertainment. Our study is observational. However, investigators attempted to minimize confounding using propensity score followed by multiple regression models to estimate the outcome of interest. This study is a subanalysis of a prospective cohort study and was not powered to detect a difference in readmission in the comparison groups. Because of the few events in mortality, we could not compare that between groups.

CONCLUSIONS

Using ATT as an estimand, we demonstrated that care provided by FM hospitalists compared to IM hospitalists was significantly associated with shorter hospital stays by half days. There was no difference seen in the cost of hospitalization or 30-day readmission. Understanding variation in outcomes of patients treated by different hospitalist models and determining the causes behind these variations open opportunities to improve care and invite more research to unravel these differences.

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