Multisite Study to Examine the Amount of Inpatient Physician Continuity Experienced by Hospitalized Patients

Kathlyn E. Fletcher, MD, MA
Siddhartha Singh, MD, MS
Jeff Whittle, MD, MPH
Vishal Ratkalkar, MD, FACP
Alexis M. Visotcky, MS
Purushottam Laud, PhD
Andrew Kordus, BS
Marilyn M. Schapira, MD, MPH

ABSTRACT

Background Continuity for inpatient medicine has been widely discussed, but methods for measuring it have been lacking.

Objective To measure the continuity of care experienced by hospitalized patients and to identify predictors of continuity.

Methods This was a multisite prospective cohort study and retrospective chart review that took place at 3 hospitals: an academic tertiary care center, a Veterans Affairs medical center, and a community teaching hospital. Subjects were general medicine patients and internal medicine residents. We measured continuity of care using 3 metrics: (1) the percentage of hospital time covered by the primary intern; (2) the amount of time between admission and the first handoff of care; and (3) admission-discharge continuity. We conducted univariate analyses to identify patient and hospital factors that may be associated with each type of continuity of care.

Results Our sample included 869 patients with a mean age of 62.6 years (SD = 17.2) and 34% female patients. The mean percentage of hospital time covered by the primary intern was 39.2% (SD = 16.3%). The mean time between admission and the first handoff of care was 13.3 hours (SD = 7.1). Forty percent of patients experienced admission-discharge continuity. In univariate and multivariable modeling, the site was significantly associated with each type of continuity.

Conclusions The amount of continuity varied greatly and was influenced by the site and other factors. No site maximized every aspect of continuity. Programs and institutions should decide which aspects of continuity are most important locally and design schedules accordingly.

Introduction

Continuity of care is important in ambulatory medicine,[1–3] and for hospitalized patients, continuity has gained notice because of the resident physician duty hour limits. When the Accreditation Council for Graduate Medical Education instituted duty hour limits for residents[4] in 2003, these rules limited weekly hours to 80 hours. Furthermore, the 2011 revision to the standards placed additional limits on the number of consecutive hours.[5]

Residency programs' strategies to adjust to the limits have frequently resulted in reduced continuity.[6,7] Residents, faculty, and program directors have expressed concern about the effect of reduced inpatient continuity of care on the quality of care and resident learning.[8–12] Despite these concerns, the concept of inpatient continuity has remained vague, and in contrast to continuity in the outpatient setting,[13] measures of continuity of inpatient care have remained elusive. In this study, we aimed to measure the amount of continuity that is experienced by hospitalized patients and to identify factors associated with continuity.

DOI: http://dx.doi.org/10.4300/JGME-D-14-00648.1

Methods

We conducted a multisite prospective study of continuity of care for internal medicine residents using retrospective patient chart review. The study was conducted at 3 sites. The first site is a tertiary care Veterans Affairs hospital. Site 2 is a private teaching hospital and the primary affiliate of the Medical College of Wisconsin's (MCW) internal medicine residency program, and site 3 is a community-based hospital that has its own transitional year interns. The MCW interns and residents also rotated on the general medicine services at site 3 (TABLE 1). At sites 2 and 3, some patients were assigned to hospitalist teams and some were assigned to resident teams. Our report includes only patients admitted to resident teams.

Subjects

Residents and patients were subjects in this study. We recruited residents rotating on general internal medicine

teams between March 2009 and March 2010. Collecting data for 1 year eliminated the possibility of seasonal variation in case mix or continuity. All residents on a team had to agree to participate for the team to be included. Physician participants gave written informed consent. A random number table was used to select a random sample of patients from participating teams. We chose 7 to 8 patients per week at each site, and we obtained a waiver of informed consent for patient chart review. Exclusion criteria for patients were (1) having a fourth-year medical student (subintern) as the primary hospital clinician; (2) being admitted directly to an intensive care unit; (3) being admitted for observation at Froedtert Memorial Lutheran Hospital (this service was organized differently); and (4) being hospitalized for less than 48 hours. Data were recorded in REDCap.[14]

What was known and gap

Continuity is an important concept for the quality of patient care and for resident education, but accepted measures are lacking.

What is new

A new measure showed that the amount of continuity in inpatient care varied among sites and was influenced by different factors.

Limitations

Single specialty study limits generalizability; exclusion of some patients may have resulted in underestimating continuity.

Bottom line

Selected aspects of continuity have an impact on quality or resident learning, so programs need to decide which aspects are important and design schedules accordingly.

Physician Schedule Data

A research assistant at each site met with each resident to ask them what time they left the day before, what time they arrived that morning, and whether they had left at any other time (eg, for the clinic). This information was recorded in 15-minute increments, and the dates that residents rotated off the participating teams ("switch days") were abstracted from the available schedule data.

Patient Data

We conducted chart reviews after each discharge. Trained nurses abstracted baseline data by using a standardized guide.[15–17] Nurses collected information on age, sex, race, comorbidities (using the Charlson comorbidity index[18]), admitting diagnosis, date/time of admission, date/time of discharge or transfer to another facility, and transfers of care to another service.

Sign-Out

Written sign-out documents were downloaded from electronic folders daily in the early morning, assuming that they had not been changed since the night before (the convention for covering teams was not to change

TABLE 1
Site Descriptions

Description	Site 1	Site 2	Site 3
Type of hospital	Veterans Affairs	Academic medical center	Community teaching hospital
Coverage for general medicine patients	Almost entirely resident based	Separate resident and hospitalist/physician assistant services	Separate resident and hospitalist/nurse practitioner services
Call schedule	Every fourth night long call; short call every post-post day on weekdays only	Every sixth night long call; short call every post-post day including weekends; "morning" call for rollover patients every precall day, including weekends	Every fourth night long call; no short call
No. of residents assigned to teams	1 senior resident, 2 interns on each of 4 teams (12 total)	1 senior resident, 2 interns on each of 6 teams (18 total)	1 senior resident, 2 interns on each of 4 teams (12 total)
Medical record details	Electronic health record	Changed to an electronic health record during the study	Paper charts
Sign-out documents	Linked to electronic health record for most of the study	Microsoft Word or Excel documents	Microsoft Word or Excel documents

the sign-out documents). The sign-out templates varied by site and sometimes by a team within a site.

Physicians Involved in Patient Care

A physician reviewer or a trained research assistant abstracted the admitting and discharging physicians from the health record. The admitting physician was determined based on who wrote the admitting history and physical document. When more than 1 such document was present, the most junior physician who wrote a history and physical was deemed the admitting physician. The discharging physician was identified as the physician who wrote the final discharge order. The primary inpatient intern was identified from the sign-out document. When this information was missing, the primary intern was determined by who wrote the preponderance of daily progress notes. For patients admitted over team switch days, the new primary intern was determined in the same manner.

This study was approved by the Institutional Review Boards at all 3 hospitals.

Data Analysis

Construction of the Continuity Variables: We combined the physician schedule data and the patient admission and discharge data into 3 primary variables.

The percentage of hospital time covered by the primary intern is the percentage of the patient's hospitalization time that the intern from the inpatient team provided care, calculated as a ratio of the hours the primary in-hospital intern was in the hospital and the hours of the patient's stay. In the event that a patient's hospitalization extended across a switch day, the newly assigned intern was considered a primary intern, and his or her information was incorporated into the numerator.

The amount of time between the patient's admission and the first handoff of care was determined by calculating the time that elapsed between each patient's admission to the hospital ward and the time that the admitting physician first handed off that patient's care to another physician. Because we did not collect schedule data from the residents on night float or hospitalists who were covering nights, we had some patients admitted by providers whose schedule data were not accessible. These patients were excluded from this analysis.

For admission-discharge continuity, patients who experienced admission-discharge continuity were admitted and discharged by the same physician. In addition to the 3 main continuity variables, we also calculated the number of patients who were hospitalized over a "switch day," defined as either of their resident team members rotating off the team.

Factors Associated With Continuity: We conducted univariate analyses to look at factors associated with continuity. We looked at patient factors (age, race, sex, comorbidities), length of stay, and site. All analyses were 2-tailed, with $P < .05$ considered to be significant. Comorbidities were quantified using the Charlson score.[19] This score was converted into a dichotomous variable with a score of 0 versus 1 or more, and age was converted to a dichotomous variable: younger than 65 years versus 65 years and older.

Multivariable Models: We constructed multivariable models to predict continuity and included the factors that were significant at $P < .10$ in the univariate analyses.

Results

We included a total of 869 patients in the study (44 patients were excluded because their primary intern had incomplete schedule data, and 78 patients were excluded because they did not have an identified admitting physician). The mean age was 62.6 years (SD = 17.2), and 34% (299 of 869) were women (TABLE 2). Ninety-three percent (204 of 220) of the eligible residents participated in the study. Three residents withdrew early. For the site that contributed the most patients (n = 387), a total of 1905 charts were reviewed. We excluded 294 charts (15%) for length of stay shorter than 48 hours.

Overall Continuity

The mean percentage of a patient's hospital time that was covered by their primary intern was 39% (SD = 16%). The first handoff of care occurred at a mean of 13 (SD = 7) hours after admission, 350 (40%) patients experienced admission-discharge continuity, and 237 (27%) were hospitalized over a switch day.

Factors Associated With Continuity

In univariate and multivariable analyses, the site was statistically significantly associated with percentage of hospital time covered by the intern, time to first handoff, and admission-discharge continuity (TABLE 3). Some patient demographic factors were associated with the continuity measures in univariate analyses,

TABLE 2
Demographics of Patient Participants

	Total (N = 869)	Site 1: VA (n = 387)	Site 2: AMC (n = 221)	Site 3: CH (n = 261)
Age,[a] mean (SD)	62.6 (17.2)	67.7 (12.9)	58.9 (19.7)	58.2 (18.5)
Sex (% female)[a]	299 (34%)	22 (5.7%)	128 (57.9%)	149 (57.3%)
Race				
White	465 (53.5%)	266 (68.7%)	132 (59.7%)	67 (25.7%)
African American	349 (40.2%)	79 (20.4%)	85 (38.5%)	185 (70.9%)
Other	55 (6.3%)	42 (10.9%)	4 (1.8%)	9 (3.4%)
Charlson score[b]				
0	164 (19.5%)	59 (15.6%)	45 (21.3%)	60 (23.8%)
1	182 (21.6%)	76 (20.1%)	52 (24.6%)	54 (21.4%)
2+	495 (58.9%)	243 (64.3%)	114 (54%)	138 (54.8%)
Length of stay, mean (SD)	5.5 (4.3)	5.8 (4.4)	5.2 (4.2)	5.3 (4.2)

Abbreviations: VA, Veterans Affairs; AMC, academic medical center; CH, community hospital.
[a] $P < .001$.
[b] $P < .05$.

but most of these associations were nonsignificant in the multivariable models. The multivariable models explained little of the variance ($r^2 = 0.027$ for hospital time covered by primary intern; $r^2 = 0.21$ for time to first handoff; and Wald score = 61.4 for admission-discharge continuity).

Discussion

We found that the primary intern was available in the hospital during 39% of a patient's hospital stay, and that fewer than half of patients were admitted and discharged by the same physicians. We also found a large range in the amount of time between admission and the first handoff of care. There was significant variation among the sites for all 3 measures of continuity. Schedules varied considerably across sites, and the association between site and continuity offers some validity evidence that schedules affect continuity.

Many studies[20] have used proxy measures for continuity that are not generalizable. For example, 1 study[21] compared patients admitted by a "short call" team (ie, a team that admits during the day, but goes home in the evening) to those admitted by a "long call" team (ie, a team that admits patients and stays overnight). However, short call as a measure of continuity (or discontinuity) offers limited information. In our study, measuring the time between admission and the first handoff of care allowed us to assess the admitting resident's presence during the intense, early hours of the hospitalization across 3 sites.

Percentage of hospital time covered by the primary intern is a concept that is frequently discussed, but to our knowledge has not previously been measured. This was the most complicated measure to construct, but it provides an important point of reference: primary interns were available for less than 40% of patient stays. This raises the question whether the primary intern is the only one with enough knowledge to provide high-quality care. In a survey study, interns reported that they do not feel the same degree of responsibility for their co-interns' patients as they do for their own, and that they know less about them.[22]

Even after adjustment for other factors, the sites remained significantly associated with all 3 continuity measures. Each site had advantages and disadvantages with respect to maximizing continuity, and we hypothesize that scheduling plays a major role in these measures. For example, while site 2 had a significantly higher percentage of hospital time covered by the primary interns, it had the shortest time between admission and the first handoff of care. No site maximized all measures of continuity, making it important to study the impact of these types of continuity on patients and residents. Programs may need to choose what aspect of continuity is the most important and design approaches to maximize it.

This study has limitations. While it is a multi-institution study, it used residents in a single internal medicine program, with most rotating at all 3 sites. This limits generalizability. We also used self-reports to determine resident hours and did not further validate this measure. Furthermore, collecting data daily from residents was challenging, and we experienced missing data because of that. Third, because the study was conducted after the 2003 duty hour rules went into effect, but before the 2011 rules were implemented, the new 16-hour limit for interns may result in differences in continuity for current patients and residents. Fourth, our definition of admission-discharge continuity is limited because we defined the discharging physician by who wrote the final discharge order. Finally, we excluded patients

TABLE 3
Univariate Associations Between Continuity and Patient Factors

Factor	Type of Continuity		
	Percentage of Time Covered by Primary Intern, % (SD) (n = 797)	Time to First Handoff, mean (SD), h (n = 787)	Patients Experiencing Admission-Discharge Continuity, % (n = 869)
Age, y	$P = .24$	$P = .92$	$P = .28$
< 65	39 (16)	13.3 (7.1)	39
65+	38 (17)	13.3 (7.2)	42
Sex	$P < .001$	$P = .015$	$P = .10$
Female	42 (18)	14.1 (6.9)	36
Male	38 (15)	12.9 (7.2)	42
Race	$P = .42$	$P < .001$	$P < .01$
White	40 (17)	12.1 (7.0)	45
Nonwhite	39 (16)	14.6 (7.0)	34
Charlson score	$P = .65$	$P = .06$	$P = .17$
0	38 (15)	14.3 (7.0)	45
1+	39 (16)	13.1 (7.2)	39
Site	$P < .001$	$P < .001$	$P < .001$
1	37 (15)	11.5 (6.8)	50
2	42 (17)	10.5 (6.2)	46
3	39 (17)	18.2 (5.7)	21
Length of stay	$P < .001$	NT	$P = .002$
	For every 1-h increase, there is a 1% drop in % time covered		Shorter for those who experience AD continuity

Abbreviations: NT, not tested; AD, admission-discharge.

with stays shorter than 48 hours, and these patients may have experienced more continuity than our sample did.

Future research needs to be done. Programs should study continuity, adapting our approach and using definitions that make sense for their workflow to gain a more robust understanding of continuity of care experienced by hospitalized patients. Future research also should explore the relationship between measures of continuity and outcomes of interest. For example, resident learning and experiential outcomes and patient satisfaction and safety outcomes may be influenced by inpatient continuity of care.

Conclusion

In this multisite study, we present a new approach for measuring continuity of inpatient care and provide baseline data for 3 aspects of continuity for patients hospitalized for more than 48 hours. Our findings showed significant variations by site, which appeared to result from scheduling. While sites may be able to maximize 1 type of continuity, it is unlikely that they could maximize all types, suggesting programs and institutions should focus on the type of continuity deemed most important by them.

References

1. Hänninen J, Takala J, Keinänen-Kiukaanniemi S. Good continuity of care may improve quality of life in Type 2 diabetes. *Diabetes Res Clin Pract*. 2001;51(1):21–27.
2. Gill JM, Mainous AG 3rd. The role of provider continuity in preventing hospitalizations. *Arch Fam Med*. 1998;7(4):352–357.
3. De Maeseneer JM, De Prins L, Gosset C, Heyerick J. Provider continuity in family medicine: does it make a difference for total health care costs? *Ann Fam Med*. 2003;1(3):144–148.
4. Philibert I, Friedmann P, Williams WT; ACGME Work Group on Resident Duty Hours. New requirements for resident duty hours. *JAMA*. 2002;288(9):1112–1114.
5. Nasca TJ, Day SH, Amis ES Jr; ACGME Duty Hours Task Force. The new recommendations on duty hours from the ACGME Task Force. *N Engl J Med*. 2010;363(2):e3.
6. Wallach SL, Alam K, Diaz N, Shine D. How do internal medicine residency programs evaluate their resident float experiences? *South Med J*. 2006;99(9):919–923.
7. Cull WL, Mulvey HJ, Jewett EA, Zalneraitis EL, Allen CE, Pan RJ. Pediatric residency duty hours before and after limitations. *Pediatrics*. 2006;118(6):e1805–e1811.
8. Akl EA, Bais A, Rich E, Izzo J, Grant BJB, Schünemann HJ. Brief report: internal medicine residents', attendings', and nurses' perceptions of the night float system. *J Gen Intern Med*. 2006;21(5):494–497.
9. Byrnes MC, Narciso VC, Brantley L, Helmer SD, Smith RS. Impact of resident work-hour restrictions on trauma care. *Am J Surg*. 2006;191(3):338–343.

10. Chudgar SM, Cox CE, Que LG, Andolsek K, Knudsen NW, Clay AS. Current teaching and evaluation methods in critical care medicine: has the Accreditation Council for Graduate Medical Education affected how we practice and teach in the intensive care unit? *Crit Care Med*. 2009;37(1):49–60.
11. Fletcher KE, Parekh V, Halasyamani L, Kaufman SR, Schapira M, Ertl K, et al. The work hour rules and contributors to patient care mistakes: a focus group study with internal medicine residents. *J Hosp Med*. 2008;3(3):228–237.
12. Coverdill JE, Finlay W, Adrales GL, Mellinger JD, Anderson KD, Bonnell BW, et al. Duty-hour restrictions and the work of surgical faculty: results of a multi-institutional study. *Acad Med*. 2006;81(1):50–56.
13. Saultz JW. Defining and measuring interpersonal continuity of care. *Ann Fam Med*. 2003;1(3):134–143.
14. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):377–381.
15. Layde PM, Meurer LA, Guse C, Meurer JR, Yang H, Laud P, et al. *Medical Injury Identification Using Hospital Discharge Data*. Rockville, MD: Agency for Healthcare Research and Quality; 2005.
16. Laine C, Goldman L, Soukup JR, Hayes JG. The impact of a regulation restricting medical house staff working hours on the quality of patient care. *JAMA*. 1993;269(3):374–378.
17. Weissman JS, Rothschild JM, Bendavid E, Sprivulis P, Cook EF, Evans RS, et al. Hospital workload and adverse events. *Med Care*. 2007;45(5):448–455.
18. Charlson M, Szatrowski TP, Peterson J, Gold J. Validation of a combined comorbidity index. *J Clin Epidemiol*. 1994;47(11):1245–1251.
19. Charlson ME, Pompei P, Ales KL, Mackenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40(5):373–383.
20. Griffith CH 3rd, Wilson JF, Rich EC. Intern call structure and patient satisfaction. *J Gen Intern Med*. 1997;12(5):308–310.
21. Schuberth JL, Elasy TA, Butler J, Greevy R, Speroff T, Dittus RS, et al. Effect of short call admission on length of stay and quality of care for acute decompensated heart failure. *Circulation*. 2008;117(20):2637–2644.
22. Martin K, Frank M, Fletcher KE. Intrateam coverage is common, intrateam handoffs are not. *J Hosp Med*. 2014;9(11):734–736.

Kathlyn E. Fletcher, MD, MA, is Associate Program Director for Research Scholarship, Internal Medicine Residency, Clement J. Zablocki VA Medical Center, and Associate Professor of Medicine, Department of Internal Medicine, Medical College of Wisconsin; **Siddhartha Singh, MD, MS,** is Associate Chief Medical Officer, Medical College Physicians and Froedtert Hospital, and Associate Professor, Department of Internal Medicine, Medical College of Wisconsin; **Jeff Whittle, MD, MPH,** is Associate Professor, Clement J. Zablocki VA Medical Center and Department of Internal Medicine, Medical College of Wisconsin; **Vishal Ratkalkar, MD, FACP,** is a Physician in Private Practice; **Alexis M. Visotcky, MS,** is Biostatistician, Department of Biostatistics, Medical College of Wisconsin; **Purushottam Laud, PhD,** is Professor, Department of Biostatistics, Medical College of Wisconsin; **Andrew Kordus, BS,** is a Medical Student, Nova School of Osteopathic Medicine; and **Marilyn M. Schapira, MD, MPH,** is Associate Professor, Department of Internal Medicine, Philadelphia VA Medical Center and University of Pennsylvania Perelman School of Medicine.

Funding: This project was funded by VA Health Services Research & Development Investigator-Initiated Research No. 07-201-2.

Conflict of interest: The authors declare they have no competing interests.

Some of the data were presented in poster form at the National Society of General Internal Medicine Annual Meeting in Phoenix, Arizona, May 4–7, 2011.

The authors would like to thank Sherrie Smaxwill, Susan Framberg, RN, and Christa Kallio, RN, for their study coordination efforts. The authors would also like to acknowledge Andrea Bruckbauer, Carrie Schauer, and Jessica Schmidt for the data collection. Finally, the authors would like to thank Sanjay Saint, MD, MPH, for his guidance on design and methods.

Corresponding author: Kathlyn E. Fletcher, MD, MA, Clement J. Zablocki VA Medical Center, 5000 West National Avenue, Milwaukee, WI 53295, 414.384.2000, ext. 46450, fax 414.382.5017, kfletche@mcw.edu

Received November 13, 2014; revisions received May 11, 2015, and July 21, 2015; accepted July 21, 2015.