

**Provider Characteristics that Promote Interpersonal Continuity in
Clinical Practice**

*An OHSU Family Medicine analysis of the effects of various provider practice
parameters on the Usual Provider Continuity Index (UPC)*

By

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Abstract:

Purpose: The numerous benefits of interpersonal continuity in primary care practice are well described in the literature. Our analysis assessed the association between provider practice features and interpersonal continuity using the Usual Provider Continuity Index (UPC: the ratio of the number of patient visits with their personal primary provider divided by total patient visits to the clinic).

Methods: We conducted a sequential explanatory mixed-methods study of the effects of several provider practice parameters on UPC in four university-based family medicine clinics. A retrospective cohort was used for quantitative analysis and provider focus groups were conducted to validate our quantitative aims. Data were extracted from monthly provider performance reports from July 1, 2009 to June 30, 2010. The unit of analysis was an individual primary care provider (n=63) from four academic family medicine clinics. We tested the effect of five practice parameters on UPC: (1) Clinic frequency; (2) Panel size; (3) Patient load (ratio of panel size to clinic frequency); (4) Attendance ratio; and (5) Duration in practice. Clinic, care team, provider gender and provider type (physician vs. mid-level) were analyzed as covariates. Simple and multiple linear regression were used for statistical modeling. Sequential thematic coding was used for qualitative analysis.

Results: There were strong linear associations between UPC and both clinic frequency ($\beta = 0.94$; 95% CI 0.62, 1.27; $p < 0.0001$) and patient load ($\beta = -0.37$; 95% CI -0.48, -0.26; $p < 0.0001$). A multiple linear regression including clinic frequency, patient load, duration in practice and provider type explained over 60% of the variation in UPC (Adjusted $R^2 = 0.629$, $p < 0.0001$). Focus groups identified six themes (clinic diversity, provider diversity, patient diversity, visit type, non-PCP continuity, absences) as other potential sources of variability in UPC.

Conclusions: Variability in UPC between providers is largely a function of (1) how often a provider is in clinic; (2) sufficient clinic frequency to care for an assigned patient panel; and (3) maturity of practice. Future research should attempt to quantify additional sources of variability in UPC.

Introduction

Interpersonal continuity, a central tenant of primary care, is defined by the IOM as the product of “personal interactions that include trust and partnership between patients and clinicians.”(1) Numerous studies have demonstrated the benefits of enhanced interpersonal continuity, including increased patient and provider satisfaction (2)(3)(4)(5), healthier patient behaviors (6), increased receipt of preventive and screening services (7)(8)(9)(10)(11), reduced hospitalization rates (12)(13), decreased emergency department (ED) and intensive care unit (ICU) utilization (14)(15)(16), decreased overall health costs (17) and reduced elderly mortality (18)(19). Despite broad consensus regarding the benefits of interpersonal continuity, underlying contributors remain poorly understood. Additionally, trends such as remote patient interactions and team based care are leading to new ideas of continuity outside of traditional face-to-face encounters.(20) This highlights the need for research that characterizes the evolving nature of interpersonal continuity while identifying key determinants.

Decades of research have employed a variety of outcome measures attempting to characterize the intuitive advantages of personal doctor-patient relationships.(21) Prior to electronic health records (EHR) there were few feasible methods for prospective collection of accurate continuity data, requiring investigators to infer continuity from chart review, claims analysis or survey data.(22) This presented many barriers to accurate quantitative assessment of interpersonal continuity and limited investigators abilities to perform rigorous analyses. As a result, there is little consensus on how to interpret quantitative measures of continuity, or whether there is such a thing as a benchmark continuity rate.

In 2008 the Oregon Health & Science University (OHSU) Department of Family Medicine embedded a system within the EHR for automated collection of the Usual Provider Continuity Index (UPC), a quantitative measure of continuity based on the proportion of visits in which a patient sees their personal primary care provider (PCP) rather than an alternate provider. This has provided for a robust database of prospectively collected continuity data, allowing for analyses of the determinants of continuity that were previously not possible. Furthermore, similar systems are now required for patient-centered medical home (PCMH) certification,

suggesting that available data for continuity research will expand substantially in the coming years.(23, 24)

The objective of our study was to utilize the OHSU UPC database to investigate whether certain provider practice parameters were associated with higher continuity. We specifically looked at clinic frequency, panel size, patient load (ratio of panel size to clinic frequency), clinic attendance rate and duration in practice as potential predictors. Additionally, we conducted provider focus groups at each of the involved clinics to generate expert opinion into the evolving nature of continuity and gauge whether our quantitative methods accurately capture the essence of ongoing therapeutic relationships between patients and providers. Appendix A holds expanded background discussions of continuity (A.1), UPC (A.2) and PCMH standards (A.3).

Methods

Design

We conducted a sequential explanatory mixed-methods study (25) of the effects of several provider practice parameters on interpersonal continuity as measured by UPC. We utilized a retrospective cohort for quantitative analysis and provider focus groups under an expert panel paradigm for qualitative analysis. The quantitative component was the primary study objective, with the qualitative portion designed to serve as an explanatory complement to quantitative findings.

Setting

The OHSU Department of Family Medicine has four academic primary care clinics. These include one Federally Qualified Health Center (FQHC) and one Rural Health Clinic (RHC). All of the clinics are recognized as level-3 Patient-Centered Medical Homes (PCMH) by the State of Oregon's designation system, which is similar to that of the National Committee for Quality assurance (NCQA). Each of the clinics are divided into care teams, which consist of physician and mid-level providers, residents (with the exception of the rural health clinic), nurse coordinators, medical assistants and ancillary staff. Electronic health records are used in each of the clinics. The EPIC electronic health record is used in each of the clinics. Two years prior to

the start of this project, each of the clinics engaged in a comprehensive quality improvement project to insure that the primary care provider field in every patient's health record was accurate and up to date, listing the patients chosen personal primary care professional. One year prior to the project, the department began to track the UPC rate for every provider on a monthly basis. Since every provider is a member of a discrete team, the UPC for each team is also tracked monthly.

Subjects for Quantitative Analysis

The unit of analysis for this study was a provider, specifically individual faculty physician and mid-level primary care providers at each of the four OHSU FM clinics. Post-graduate clinical fellows were included as faculty physicians; residents were excluded from the analysis. Inclusion required that providers had a registered patient panel for which they were the designated PCP during the defined study period of July 1, 2009 to June 30, 2010. In an attempt to ensure that all eligible subjects were identified, we began by searching departmental records of all providers who had documented clinic sessions at any of the four clinics during the study period. We expanded the search to include all providers identified by departmental payrolls. This yielded 124 potentially eligible providers. A total of 32 providers were identified as physicians without primary care patient panels. This included 15 consulting specialists, 7 locum tenens physicians, 5 non-clinical faculty, 3 exclusive resident preceptors and 2 non-clinical fellows. One additional faculty and 1 fellow were excluded because each had a mixed primary care and specialty sports medicine role, which prohibited exclusive analysis of primary care continuity. Two additional providers were identified as acupuncturists and 2 as clinical social workers. One PA was identified as a roving provider without an assigned panel. Five physician providers left the department prior to the study period but still appeared on payroll for part of the year. Nine providers were recently graduated fellows who had not yet been removed from payroll. Additionally, 8 mid-level providers had left or entered the department without logging any clinic days during the study period. In sum, 61 providers were excluded for the conditions noted above. This yielded a final study population of 63 providers, including 45 physicians and 18 mid-levels. Provider data was historic in nature and de-identified prior to analysis, thus an exemption was granted by the OHSU IRB.

Data Collection and Outcome Variable

System-wide EHR use allows for continuous data collection with respect to provider panel sizes, clinic frequency and visit volumes. In 2008 an automated system for measuring the Usual Provider Continuity Index (UPC) was built into the departments' data analytics system. This feature keeps a running monthly tab of the proportion of visits in which an individual patient sees their self-identified PCP rather than an alternate provider.

$$UPC = \frac{\text{Total number of clinic visits with PCP}}{\text{Total number of clinic visits with any provider}}$$

At each month's end, this patient level metric is aggregated for each PCP to generate a monthly provider UPC score. For example, if there are 200 visits in a single month by patients on a given PCP's panel and the provider is present for 140 of those visits, the monthly UPC for the provider would be 140/200 or 70%. This provides a quantitative assessment of the availability of each provider to the patients for whom they are the registered PCP. Data is disseminated in monthly provider performance reports (Appendix B). To ensure correct PCP data, patients are asked to identify their PCP each time they have an encounter with the clinic, which includes phone calls, lab visits, nursing visits and provider visits. Because of this protocol, a current and accurate PCP field is verified at every patient encounter. Our outcome variable was mean monthly provider UPC, the average UPC for each provider over the 12 month study period.

Predictor Variables

The following practice parameters were investigated as potential independent predictors of UPC:

Clinic Frequency: Defined as the number of monthly clinic half-days for a given provider. Counts were obtained from departmental records and averaged over the twelve month study period to yield a single mean monthly half-day count for each provider.

Panel Size: End-of-month patient panel size for each provider was obtained from departmental records. Panel size values are determined from the total number of patient charts in the EHR with a given provider listed in the PCP field. Patients who have not seen their PCP in three or

more years are dropped from the providers panel, thus end-of-month panel size reflects a three year running average.

Patient Load: Defined as the ratio of panel size to clinic frequency (panel-to-half-day ratio). This variable normalizes panel size for part-time providers and was obtained by dividing mean monthly panel size by mean monthly half-days for each provider.

Attendance Ratio: Clinic attendance ratio was calculated for each provider by dividing the mean actual monthly half-day count by the expected monthly half-day count as dictated by their contracted clinical full-time equivalent (FTE). A 1.0 clinical FTE corresponds to 8 clinic half-days per week for mid-level providers and 7 half-days per week for physicians, as all physicians have one half-day per week designated for resident precepting. This measure did not discriminate by reason for clinic absence, be it vacation, illness, CME, maternity/inpatient care, etc... This was strictly a measure of consistency between actual and expected numbers of monthly clinic sessions.

Duration in Practice: Duration in practice was defined as the total number of years within OHSU Family Medicine at the end of the study period, June 30, 2010, based on departmental hire dates.

Other Covariates: Clinic and care team assignments for each provider were obtained from monthly performance reports (Appendix B). Provider type (physician vs. mid-level) and gender were obtained from departmental records.

Statistical Analysis

Stata 11.0 statistical software was used for all analyses. (StataCorp, College Station, TX) Simple linear regression was used for univariate analyses of the outcome variable (UPC) on each of the individual predictors, as well as for assessment of correlation between multiple predictors. ANOVA with Bonferroni adjusted pairwise comparisons was used for assessment of variability in UPC by clinic and team assignments. Two-sample t-tests were used for comparisons of outcome and predictor variables by provider type (physician vs. mid-level) and gender. Multiple linear regression modeling was performed using backward elimination method, Mallows' criteria and adjusted R^2 for development of the model with the highest predictive capability.

Qualitative Methods, Subjects and Analysis

The qualitative portion of our sequential explanatory mixed-methods design utilized provider focus groups under an expert panel paradigm.(25, 26) We introduced our hypotheses and predictor variables to provider groups to generate expert opinion regarding our proposed methods and quantitative aims, as well as to generate additional hypotheses for future study. Particular attention was paid to unique characteristics of clinics or individual providers that could limit the validity of our quantitative findings, as well as provider commentary on shifting perceptions of interpersonal continuity. Groups were conducted and audio recorded by author TM during pre-scheduled faculty meetings at each of the four clinics, using a standardized script (appendix C). Physician and mid-level provider participants were not formally identified at the time of the focus groups. Audio recordings were transcribed by author TM, with anonymity of respondents maintained. Transcripts were independently coded into themes, sub-themes and representative quotations by authors TM and JS, with subsequent joint reconciliation and finalization of thematic coding.

Results

Descriptive Analysis

A total of 63 providers and 15 care teams from 4 clinics were included in our quantitative analysis. Among participants, 58.7% (n=37) were female and 28.6% (n=18) were mid-level providers. A descriptive summary of outcome and predictor variables is given in Table 1. There were significant differences in UPC, clinic frequency and patient load by provider type. There were no significant differences in UPC or predictor variables by provider gender (Appendix D.1).

Variable		Mean	Std. Dev.	Min	Max	P-value*
UPC % (Outcome)	All Providers	62.92	11.55	37.30	87.40	0.033
	Physician	60.97	9.84	37.29	78.64	
	Mid-Level	67.78	14.16	41.93	87.41	
Clinic Frequency (Monthly Half-Days)	All Providers	16.83	7.27	4.92	31.30	0.000
	Physician	13.63	5.04	4.92	24.42	
	Mid-Level	24.85	5.63	15.06	31.30	
Panel Size (# of pts)	All Providers	577.4	315.8	65	1377	0.144
	Physician	540.5	274.3	92	1288	
	Mid-Level	669.7	395.4	65	1377	
Patient Load (panel-to-half-day ratio)	All Providers	38.21	19.96	2.40	93.67	0.049
	Physician	41.32	18.80	5.90	93.70	
	Mid-Level	30.41	21.22	2.41	72.55	
Attendance Ratio	All Providers	1.01	0.26	0.56	2.15	0.140
	Physician	1.04	0.30	0.56	2.14	
	Mid-Level	0.93	0.13	0.68	1.29	
Duration in Practice (yrs)	All Providers	6.35	6.38	0.42	24.92	0.099
	Physician	7.19	6.85	0.67	24.92	
	Mid-Level	4.26	4.50	0.42	16.75	

Table 1. Descriptive summary of outcome and predictor variables with stratification by provider type.

* Two-Sample T-test for difference in mean by provider type

Clinic and team analyses are represented in Figures 1 and 2, with further numerical representation in Appendix D.2. On comparative team and clinic analyses, clinic 1 had significantly lower mean provider UPC relative to the remaining three clinics (56.1% vs. 65.4%, $p < 0.05$). This was further investigated through linear plots of UPC on predictor variables with

stratification by clinic (Appendix D.3). This revealed similar trends in UPC across all clinics, with the only discrepancy being a lower baseline UPC for clinic 1, thus there appears to be no effect modification by clinic. There were no significant differences in UPC between care teams in a given clinic.

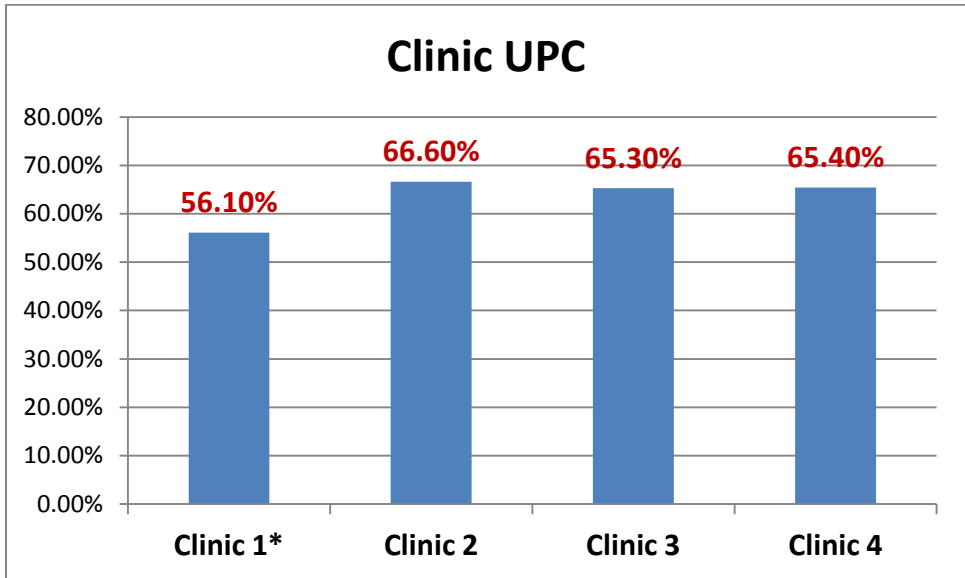


Figure 1. Distribution of mean UPC among each of the four clinics
*UPC for clinic 1 significantly lower than for clinics 2, 3 & 4 (p<0.05)

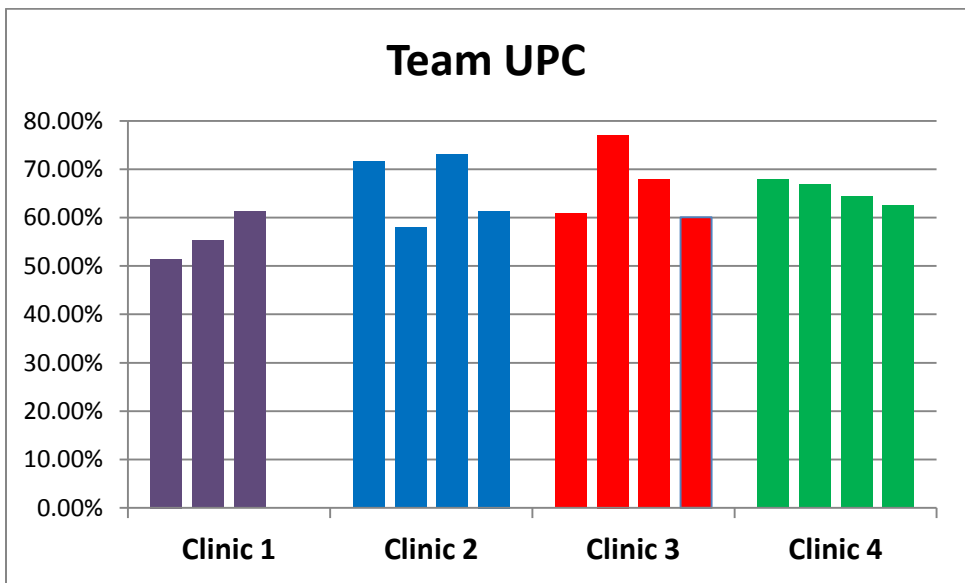


Figure 2. Distribution of mean UPC among each care team within the four clinics
* No statistically significant differences in UPC between teams within any given clinic

Univariate Analysis

Simple linear regression of UPC on predictor variables is summarized in Table 2 and graphically represented in Appendix D.4. There were statistically significant positive linear associations between UPC and both clinic frequency (Figure 3) and panel size. There was a significant negative linear association between UPC and patient load (figure 4). There was no significant linear association between UPC and clinic attendance ratio. While there was no significant linear association between UPC and duration in practice, a strong association was observed between patient load and duration in practice ($\beta=1.75, r=0.55, p<0.001$). This suggested that providers care for more patients with fewer clinic half-days as their practices mature, thus duration in practice should be investigated as a potential confounder in multivariate modeling (Appendix D.4).

Predictor Variable	β	95% CI		r	P-value
Clinic Frequency	0.944	0.618	1.271	0.595	<0.0001
Panel Size	-0.009	-0.018	0.000	0.209	0.044
Patient Load	-0.370	-0.005	-0.256	0.639	<0.0001
Attendance Ratio	0.050	-0.061	0.162	0.115	0.370
Duration in Practice	-0.265	-0.724	0.193	0.146	0.252

Table 2. Simple linear regression of UPC on predictor variables

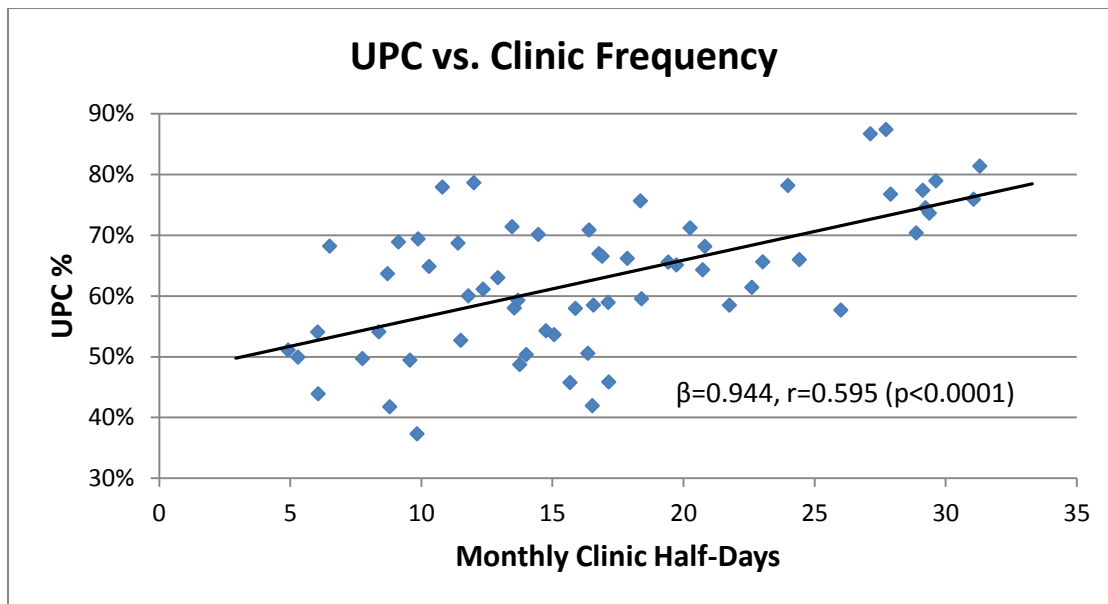


Figure 3. Simple linear regression of UPC on clinic frequency

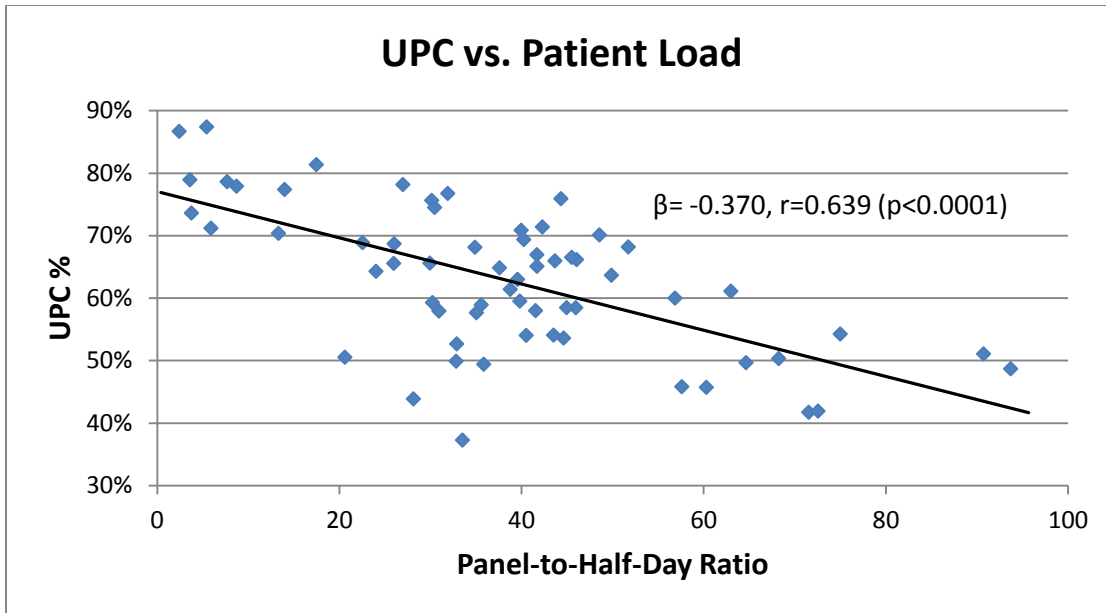


Figure 4. Simple linear regression of UPC on patient load

Multivariate Analysis

The components of our optimal multiple linear regression are given in Table 3. Clinic frequency and patient load are the primary modifiable predictors of UPC in our population. Duration in practice is included as a significant confounder of the association between UPC and patient load. Provider type is included as an effect modifier, due to significant differences in the effect of clinic frequency on UPC between physician and mid-level providers. This model explains over 60% of the variation in UPC across our population of clinicians (Adjusted $R^2 = 0.629$, $p < 0.0001$).

Variables	β	95% CI		P-value
Clinic Frequency	1.52	0.84	2.19	<0.001
Patient Load	-0.32	-0.45	-0.20	<0.001
Duration in Practice	0.61	0.27	0.95	0.001
Provider Type	23.01	5.62	40.41	0.010
Type/Half-Day Interaction	-0.81	-1.58	-0.04	0.039
Intercept	62.91	54.74	71.07	<0.001

Table 3. Optimal multivariate linear model for prediction of UPC

* P-values reflect partial F-tests for significance of individual terms within the model

** Data centered around mean clinic frequency of 16.8 monthly clinic half-days (mean clinic frequency for all providers)

Effect modification by provider type is further represented in Figure 5, which demonstrates the differential association between UPC and clinic frequency among physician and mid-level providers, assuming that patient load and duration in practice are held constant.

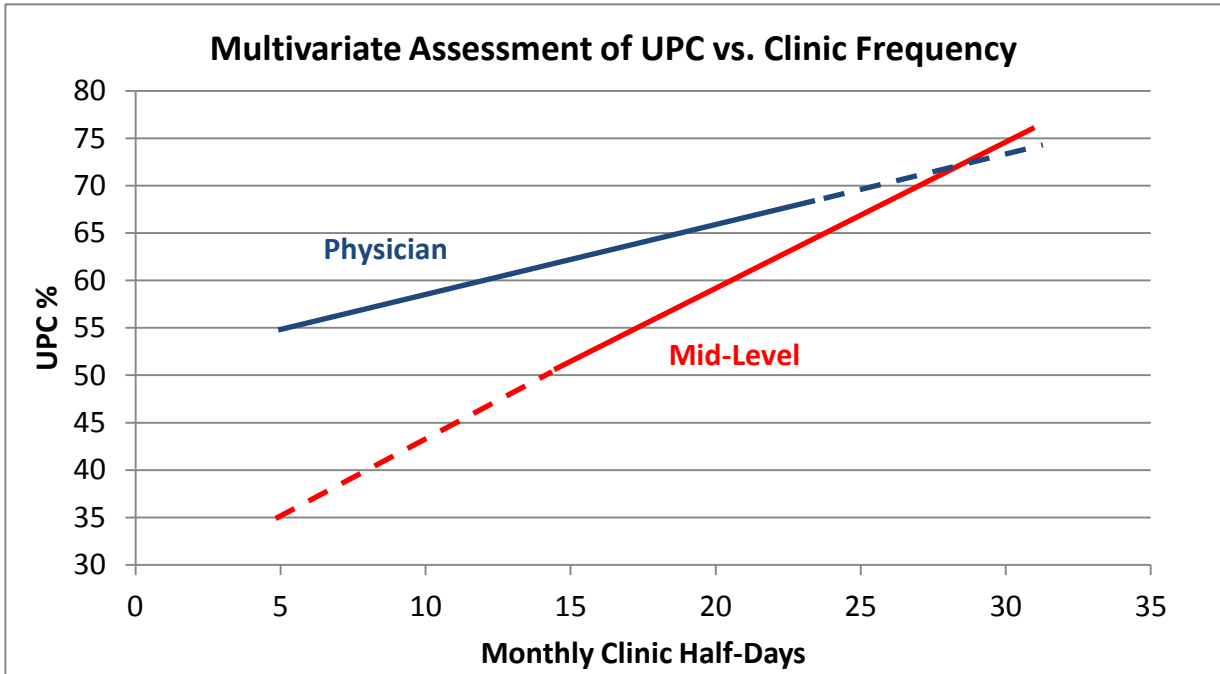


Figure 5. Multivariate prediction of UPC based on clinic frequency, stratified by provider type. Predicted UPC calculated at fixed values for patient load (panel-to-half-day ratio = 38.2) and duration in practice (6.35 years).

* Dashed lines denote data extrapolation outside of the observed range of clinic frequency for either provider type.

Qualitative Analysis

Physician and mid-level providers (n=35) from each of the four clinics participated in focus groups. Six general themes were identified during sequential coding of provider responses (Table 4). Themes 1-3 identify potential sources of variation in UPC that are intrinsic to specific clinics, providers or patient populations. Themes 4 and 5 focus on alternative perceptions of interpersonal continuity beyond face-to-face encounters between a single patient and their personal PCP. Theme 6 addresses the potential relationship between clinic absences and interpersonal continuity.

Theme	Sub-themes	Description
1. Clinic Diversity	1.1 PCP Assignment Accuracy	Clinics have different systems for ensuring that PCP fields are frequently updated and accurate.
	1.2 Scheduling	Clinics place variable importance on scheduling patients with their PCP rather than the first available provider.
	1.3 Location/Type	University, FQHC and Rural clinics may have intrinsic differences in patient population and structure.
2. Provider Diversity	2.1 Provider Type	Physician (MD/DO) and mid-level (PA/FNP) providers may have differences in both scope of practice and approach to care.
	2.2 Provider Gender	Female and male providers may have differences in both scope of practice and approach to care.
	2.3 Scope of Practice	Providers who do maternity care, inpatient care, sports medicine, suboxone, resident precepting, etc... may have different UPC patterns than providers who solely conduct outpatient continuity clinics.
	2.4 Non-clinical Duties	Providers with more academic/administrative responsibilities may have different UPC patterns than those with strictly clinical practices.
	2.5 Clinic Scheduling	Providers with more open schedules or night/weekend clinics may have different UPC patterns than those with primarily pre-scheduled daytime clinics.
	2.6 Location of Residency	Providers who trained at OHSU may have more developed panels for their year in practice than providers who trained elsewhere.
3. Patient Diversity	3.1 Panel Demographics	SES, gender, race, ethnicity, age, medical complexity, visit frequency and other panel demographics are likely to influence UPC for a given provider.
	3.2 Importance of Continuity to Patient	Some patients frequently change providers for a variety of reasons, making their PCP field relatively arbitrary.
4. Visit Type	4.1 Acute Care	Acute care visits may not be as important as chronic or ongoing care in terms of actual continuity.
	4.2 Non-Office Visits	Current calculation of UPC does not take into account phone, email or MyChart encounters, where a meaningful interaction occurs without face to face contact.
5. Non-PCP Continuity	5.1 Team Continuity	Patients may value continuity with a team of providers more than with a specific provider.

	5.2 Clinic Continuity	Patients may value continuity with a particular clinic more than with an individual or team of providers.
	5.3 Family Continuity	Continuity across families may be more important than continuity with individual patients.
6. Absences	6.1 Planned vs. Unplanned	Are all absences from clinic a diversion from continuity (e.g. deliveries, inpatient, etc...), or is it just unplanned absences (e.g. illness, etc...)?
	6.2 New-Parent Leave	Specific extended absence that may behave differently than other absences in terms of continuity.

Table 4. Qualitative Summary

Discussion

Our findings should be immediately useful to clinic managers seeking to describe trends of interpersonal continuity within their clinics and implement strategies for improvement. It should be noted that this method of analysis is only possible when patients' PCP assignments are known to be highly accurate and frequently updated, thus similar efforts should begin by ensuring that these conditions are satisfied. We identified patient load and clinic frequency as major modifiable predictors of UPC, both of which could be manipulated to achieve higher UPC. Based on our model, a physician provider at the mean of all studied parameters (clinic frequency = 13.6 monthly half-days; panel size = 540 patients; PTHD ratio = 39.7; duration in practice = 7.2 years) can expect a UPC of 61.3%, nearly identical to our observed mean (61.0%). Under the more useful example of 14 half-days per month, UPC would be 62.0%. If this same provider were to add one half-day per week, or 4 half-days per month, without a change in panel size, UPC would increase to 67.7%. Similarly, this same provider, now with a clinic frequency of 18 clinic half-days, could increase her panel size to 848 patients while maintaining a UPC of 62.0%. Qualitative analysis identified that clinic scheduling (sub-theme 2.5), in addition to clinic frequency, may account for additional unexplained variability in UPC. Providers also felt that continuity was likely more important for visits relating to chronic or ongoing care, suggesting that these visits should be treated differently than acute care visits when assessing UPC (sub-theme 4.1).

We identified key differences in UPC patterns between physician and mid-level providers, mostly due to higher clinic frequencies among mid-levels. In comparison to the physician example above, for a mid-level provider at the mean of all parameters (clinic frequency = 25 monthly half-days; panel size = 670 patients; PTHD ratio = 26.8; duration = 4.26 years), expected UPC is 69.1%. For this provider, adding 4 monthly clinic half-days would increase UPC to 76.4%, thus the incremental increase in UPC with addition of monthly clinic half-days is greater for mid-levels than physicians. Focus group participants hypothesized that other intrinsic differences may contribute to variability in UPC trends by provider type, including approach to patient care (sub-theme 2.1), scope of practice (sub-theme 2.3) and breadth of non-clinical duties (sub-theme 2.4). It is worth noting that the practices of mid-level providers in academic clinics may be a better representation of community-based physician practices, in

which clinical duties occupy the vast majority of providers' time. Along these lines, a specific limitation of our study is that it only included providers in academic practices, which calls into question whether our findings would be reproducible in community-based practices.

Another key finding in our study was that longer duration in practice appeared to lead to lower UPC until adequately controlling for patient load, as providers care for larger panels with fewer clinic sessions as their practices mature. In multivariate modeling, in which duration was included as a confounder of the relationship between patient load and UPC, increased practice duration was associated with higher UPC. Qualitative analysis suggested that providers with more years in practice may achieve continuity that is not accounted for in current UPC calculations, such as during resident precepting (sub-theme 2.3). Additionally, providers with more established practices may be able to achieve the benefits of interpersonal continuity through less frequent patient visits, as their relationships with their patients may be more mature.

One of the more pervasive themes in our qualitative analysis was the potential for variability in UPC between providers of different genders. Female providers in particular were concerned that differential rates of maternity and well-woman care (sub-theme 2.2), as well as extended absences in the form of maternity leave (sub-theme 6.2), would lead to lower UPC among female providers. We were pleased to discover in our quantitative analysis that there were no significant differences in either UPC or any of our predictor variables by provider gender.

Our measure of clinic absence frequency (attendance ratio) failed to quantify the likely association between absences and interpersonal continuity. The key flaw in our measure was the lack of differentiation between planned and unplanned absences, a limitation that was identified during multiple focus groups (sub-theme 6.1). Additionally, we utilized the mean monthly attendance ratio, averaged over the 12 month study period, which dilutes the effect of absences over a large period of time. A much more useful measure would be provider "bump rate", or the proportion of visits in which a provider unexpectedly cancels on short notice. The OHSU Department of Family Medicine recognized the value of this measure and began tracking bump rates for all providers beginning in 2010, thus data will soon be available for analysis. Unfortunately, these data were not available during our study period.

The evolving nature of interpersonal continuity was discussed at length during each of the provider focus groups. Participants felt that efforts to quantify continuity should account for alternative forms of patient visits, such as phone calls, emails or interactions through the electronic health record (sub-theme 4.2). These were felt to be meaningful interactions in which interpersonal continuity was enhanced, despite the absence of a face-to-face encounter. Providers also felt that the value of interpersonal continuity needed to be reevaluated in light of growing reliance on team-based care (sub-theme 5.1). The patient-centered medical home model strongly emphasizes the value of team-based care (in addition to geographic or clinic-based care), though the implications of team-centric care on interpersonal continuity remain poorly understood. Further research is needed to investigate the value of continuity with a team of providers versus an individual provider.

This study is a novel approach to prospective quantitative assessment of interpersonal continuity in clinical practice. Our methods should be easily reproducible by any clinic or health system seeking to gain a better understanding of interpersonal continuity among their population of clinicians. Our findings come at a particularly auspicious moment in the evolution of the patient-centered medical home movement, given current PCMH requirements for measurement and benchmarking of interpersonal continuity. We have contributed to a better collective understanding of the predictors of continuity and furthered efforts toward establishment of benchmark UPC rates. Our mixed-methods study design provided for real-time qualitative validation of our quantitative aims, and identified a number of key elements for future study. Future quantitative efforts should attempt to identify additional predictors of variability in UPC, such as patient panel demographics, while continuing to addressing the evolving nature of interpersonal continuity in modern primary care practice.

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Appendix A. Supplemental Background

A.1 Continuity of Care.

The American Academy of Family Practice (AAFP) defines Family Medicine as “...the medical specialty which provides continuing, comprehensive health care for the individual and family.”(27) Implicit in this definition is the concept of continuity, or provision of a stable usual source of care for delivery of healthcare services to individual patients over time. This is a foundational tenant of primary care, perennially identified as an area for focus and improvement. While there is wide consensus among patients and providers in support of the general concept of continuity, actual definition and quantification of continuity remains at the forefront of investigation.(28) While early analyses focused on continuity as a single entity, more recent work has defined three distinct subcategories, providing for more focused research endeavors.(29) The first of these is ‘informational’ continuity, or the ability for an individual patients health history and care plan to be readily accessible by any provider from whom the patient may receive care. The second is ‘management’ continuity, most accurately described as secure, predictable coordination of follow-up and long term care. The final entity is ‘relationship’ continuity, or the interpersonal connection between patient and physician that grows from a long-term exchange of knowledge and trust.(28, 29)

Arguing that the entity defined as ‘management’ continuity is unduly limited to coordination of care, Saultz proposes a reorganization of these subcategories into ‘informational’, ‘longitudinal’ and ‘interpersonal’ continuity.(21) Longitudinal continuity includes a stable geographic location or ‘medical home’ where patients receive most or all of their care from a consistent team of providers. Also proposed in this alternative framework is the concept of a continuity hierarchy, in which interpersonal continuity is dependent upon provision

of informational and longitudinal continuity. Among these subcategories, interpersonal continuity is both the highest endeavor and the most elusive target for quantitative research.(21, 30)

A.2 *Usual Provider Continuity Index (UPC).*

Numerous studies have shown significant associations between interpersonal continuity and enhanced patient and provider satisfaction.(4) Recent work suggests a relationship between interpersonal continuity and both health behaviors and patient adherence to treatment plans.(6) Further studies have investigated the association between interpersonal continuity and health outcomes, with varied results.(31, 32) A common obstacle encountered by researchers in this area has been the absence of standardized methods for data collection and analysis. A 2003 literature review identified that 21 different indices for defining and measuring interpersonal continuity had been used for various studies.(21) Among the indices used, few assessed continuity at the patient or provider level, but rather looked at broader clinic trends. Several studies utilized definitive measures of individual patient-provider continuity, but data was not collected prospectively. In essence, most studies of interpersonal continuity have largely been based on retrospective claims data or patient surveys, neither of which is optimal.

This suggests the need for a simplified measurement index, as well as prospective collection of continuity data. The most appropriate index for measurement of continuity is the Usual Provider Continuity index (UPC). This index uses the number of yearly clinic visits in which an individual patient sees their self-identified usual provider, divided by their total number of clinic visits with any provider. Thus the UPC is the percentage of total visits that occur with the patients usual provider. This individual patient metric can be aggregated for each provider, care team or clinic to assess trends within a clinic or health system.

A.3 *Interpersonal Continuity as a Standard for Patient Centered Medical Home (PCMH) Certification.*

The nationwide embrace of the PCMH model has signaled a positive trend in our health system. It has also created new challenges for healthcare certification organizations, requiring definition of the fundamental characteristics necessary for clinic recognition as a medical home. In the Fall of 2009, the National Committee for Quality Assurance (NCQA) commissioned an AAFP task force to review existing standards for PCMH certification and make recommendations. The task force identified four pillars of primary care and concluded that only accessibility and care coordination were appropriately addressed by current standards. They suggested the remaining elements of comprehensiveness and continuity needed further consideration. Regarding interpersonal continuity, the taskforce made the following recommendation:

“The practice (must have) a process for maintaining updated records of each patient’s choice of personal clinician, and measure (using the UPC), track and benchmark the level of interpersonal continuity for the practice and its clinicians.”(33)

This was recommended as a “must pass” element, suggesting that a clinic could not be certified as a medical home without meeting this standard.

As a result of this recommendation, both the Oregon Health Policy Board (OHPB) and the NCQA have integrated requirements for measurement and benchmarking of interpersonal continuity into PCMH certification requirements. The OHPB certifies medical homes from tier 1 (entry level) to tier 3 (highest level). Regarding interpersonal continuity, tier 1 certification requires that clinics “report the percentage of active patients assigned a personal clinician and team” and “report patients’ usual provider continuity with their assigned personal clinician or a

team member.” For tier 2 certification clinics must “meet a benchmark or demonstrate improvement in the percentage of active patients assigned to a personal clinician and team” and “meet a benchmark or demonstrate improvement in patients’ usual provider continuity with their assigned personal clinician and team.”(23) NCQA language states that “the practice (must) provide continuity of care for patients/families by expecting patients/families to select a personal clinician, documenting the patient’s/family’s choice of clinician (and) monitoring the percentage of patient visits with selected clinician or team.”(24)

This is of great significance, as medical home certification will likely play a major role in healthcare reimbursement in the near future. The OHPB and NCQA PCMH certification requirements highlight the urgent need for quantitative research into interpersonal continuity, towards the goals of establishing optimal benchmark continuity rates and identifying associated practice characteristics.

Appendix B. De-identified copy of monthly UPC report

Usual Provider Continuity (UPC)
Center = Clinic 1
For Patients Seen 7/1/2009 - 12/31/2009
 Report ID: FM010



PCP	# Visits w/PCP	% Visits w/ PCP	# Visits w/o PCP	% Visits w/o PCP	# Visits w/Team (PCP Visits Excluded)	% Visits w/Team (PCP Visits Excluded)	Continuity (Vst Prov= PCP or Team)	Total # Patients	Total # Visits	Avg #
										Visits per Patient
Team A	2,546	51.8%	2,372	48.2%	674	28.4%	65.5%	2,100	4,918	2.34
PCP 1	170	29.7%	403	70.3%	178	44.2%	60.7%	217	573	2.64
2	278	43.3%	362	56.7%	115	31.8%	61.3%	304	638	2.10
3	106	43.4%	138	56.6%	27	19.6%	54.5%	95	244	2.57
4	69	48.6%	73	51.4%	24	32.9%	65.5%	77	142	1.84
5	286	51.7%	267	48.3%	77	28.8%	65.6%	241	553	2.29
6	5	31.3%	11	68.8%	4	36.4%	56.3%	14	16	1.14
7	170	53.1%	150	46.9%	37	24.7%	64.7%	118	320	2.71
8	479	63.4%	276	36.6%	69	25.0%	72.6%	331	755	2.28
9	111	54.1%	94	45.9%	11	11.7%	59.5%	81	205	2.53
10	317	64.8%	172	35.2%	39	22.7%	72.8%	191	489	2.56
11	61	43.9%	78	56.1%	21	26.9%	59.0%	77	139	1.81
12	496	58.8%	348	41.2%	72	20.7%	67.3%	354	844	2.38
Team B	2,817	52.3%	2,571	47.7%	838	32.6%	67.8%	2,345	5,388	2.30
1	700	45.3%	846	54.7%	302	35.7%	64.8%	688	1,546	2.25
2	126	51.9%	117	48.1%	50	42.7%	72.4%	100	243	2.43
3	129	47.3%	144	52.7%	46	31.9%	64.1%	112	273	2.44
4	672	58.5%	476	41.5%	121	25.4%	69.1%	514	1,148	2.23
5	52	41.9%	72	58.1%	28	36.1%	62.9%	65	124	1.91
6	145	53.9%	124	46.1%	48	38.7%	71.7%	79	269	3.41
7	2	18.2%	9	81.8%	4	44.4%	36.4%	9	11	1.22
8	232	71.2%	94	28.8%	31	33.0%	80.7%	140	326	2.33
9	300	47.8%	327	52.2%	92	28.1%	62.5%	304	627	2.06
10	268	65.0%	144	35.0%	48	33.3%	76.7%	169	412	2.44
11	191	46.7%	218	53.3%	70	32.1%	63.3%	165	409	2.48
Team C	3,304	61.5%	2,066	38.5%	659	31.9%	73.7%	2,204	5,370	2.44
1	83	43.7%	107	56.3%	44	41.1%	66.8%	93	190	2.04
2	303	64.6%	166	35.4%	53	31.9%	75.9%	147	469	3.19
3	594	72.4%	227	27.6%	59	26.0%	79.5%	297	821	2.76
4	338	51.4%	320	48.6%	117	36.6%	69.1%	287	658	2.29
5	148	61.4%	93	38.6%	22	23.7%	70.5%	99	241	2.43
6	218	62.6%	130	37.4%	28	21.5%	70.7%	150	348	2.32
7	266	42.4%	362	57.6%	125	34.5%	62.3%	282	628	2.23
8	691	67.3%	336	32.7%	100	29.8%	77.0%	444	1,027	2.31
9	420	69.3%	186	30.7%	44	23.7%	76.6%	258	606	2.35
10	243	63.6%	139	36.4%	67	48.2%	79.8%	147	382	2.60
Clinic 1	8,667	55.3%	7,009	44.7%	2,171	31.0%	69.1%	6,649	15,676	2.36

Focus Group Script

Intro: Our research group is utilizing data from monthly performance reports generated for each provider and clinic in the OHSU Family Medicine Department to analyze the impact of several provider practice parameters on interpersonal continuity of care, as measured by the Usual Provider Continuity Index (UPC). We will analyze data from July 1, 2009 to June 30, 2010 to account for a full academic year. Residents and faculty will be addressed separately. The specific parameters we are assessing are panel size, clinic absences and duration in current practice. The purpose of these focus groups, which we are holding at all four OHSU FM clinics, is to introduce our hypotheses and predictor variables to providers to generate expert opinion regarding our proposed methods. I will introduce each of our variables individually, followed by a response period. I will limit the response period for each question to 3-4 minutes to stay within the 20 minutes allotted. At the end of the question session there will be an opportunity for general comments. Are there any questions before we begin?

- 1) Our outcome variable is the Usual Provider Continuity Index (UPC). This is generated monthly for each provider, based on the proportion of clinic visits in which their patients (based on PCP field in EPIC/OCHIN) are able to see them instead of an alternate provider. Is this an appropriate and accurate measure of interpersonal continuity?
- 2) Our first predictor variable is a “panel-to-half-day” ratio, in which we are normalizing each providers panel size by dividing by the total number of half days spent in clinic in a given month. Is this an appropriate and accurate measure of a given providers patient load?
 - What, if any, association do you predict relative to UPC?
- 3) Our next predictor variable is a measure of absence. We will calculate the mean number of monthly half-days in clinic for each provider, then assess variation from that mean in a given month relative to UPC. Is this an appropriate and accurate measure of clinical absence trends?
 - What, if any, association do you predict relative to UPC?
- 4) Our final predictor variable measures duration in practice, categorized as 0-1, 1-3, 3-10 and >10 years in practice (R1, R2, R3 for residents) within the OHSU FM Department. Will these intervals appropriately capture trends in panel development?
 - What, if any, association do you predict relative to UPC?
- 5) Are there any other variables that you think may have a greater impact on UPC than those specified in our study, or any sources of bias or confounding that would limit the validity of our findings?

Any general comments before we close?

Appendix D: Supplemental Analysis

D.1. Descriptive analysis by gender

Variable	Type	Mean	Std. Dev.	Min	Max	P-value*
UPC	Female	61.1	13.2	37.3	87.4	0.139
	Male	65.5	8.1	48.7	79.0	
Half-Days	Female	17.0	7.2	5.3	31.3	0.834
	Male	16.6	7.5	4.9	31.1	
Panel Size	Female	570.2	320.4	65.0	1199.0	0.829
	Male	587.8	315.2	106.0	1377.0	
Panel-to-Half-Day	Female	37.3	20.2	2.4	75.0	0.685
	Male	39.4	20.0	3.6	93.7	
Attendance Ratio	Female	97.2	23.5	56.3	165.6	0.168
	Male	106.5	29.6	63.3	214.3	
Duration	Female	5.1	4.9	0.5	19.9	0.059
	Male	8.2	7.8	0.4	24.9	

* 2-sample t-test for difference in variable mean by provider gender

Summary: There were no observed differences in UPC or predictor variables between male and female providers.

D.2. Descriptive UPC analysis by clinic and team

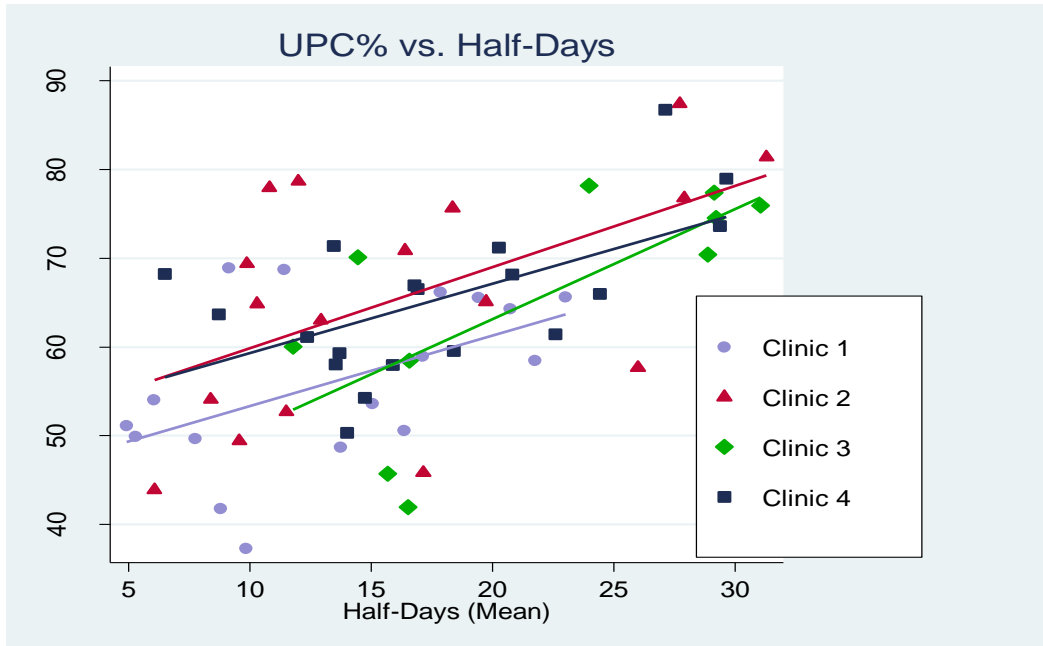
Clinic #	Mean UPC	sd	n*	Team #	Mean UPC	sd	n*
1	56.079	9.503	17	1	51.46	10.56	6
				2	55.31	8.51	5
				3	61.35	7.74	6
2	65.562	13.245	17	4	71.62	12.86	4
				5	58.03	9.93	5
				6	73.07	6.50	4
				7	61.42	18.84	4
3	65.269	13.175	10	8	60.81	16.35	3
				9	77.06	1.61	2
				10	67.94	13.36	2
				11	60.09	14.39	3
4	65.4384	8.704	19	12	67.80	7.89	5
				13	66.89	3.60	5
				14	64.39	7.98	4
				15	62.46	14.00	5

* Number of providers in a given clinic or team

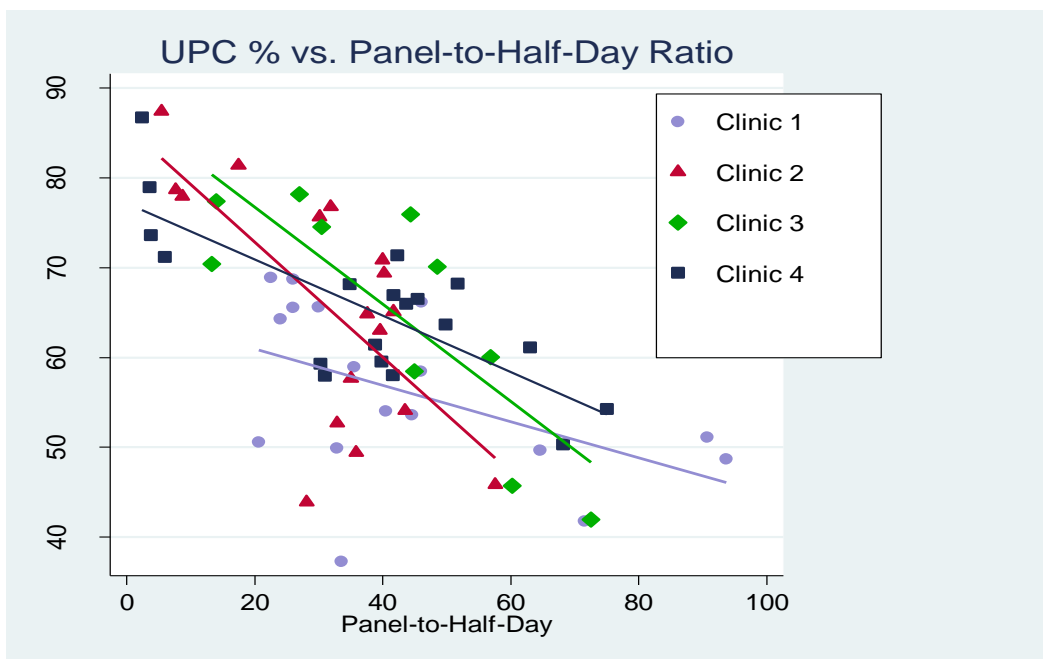
Summary: ANOVA with Bonferroni adjusted pairwise comparisons demonstrated that UPC for Clinic 1 was significantly ($p < 0.05$) less than UPC for each of the other clinics, while there were

no significant differences in UPC between clinics 2, 3 and 4. There were no significant differences in UPC between teams within a given clinic.

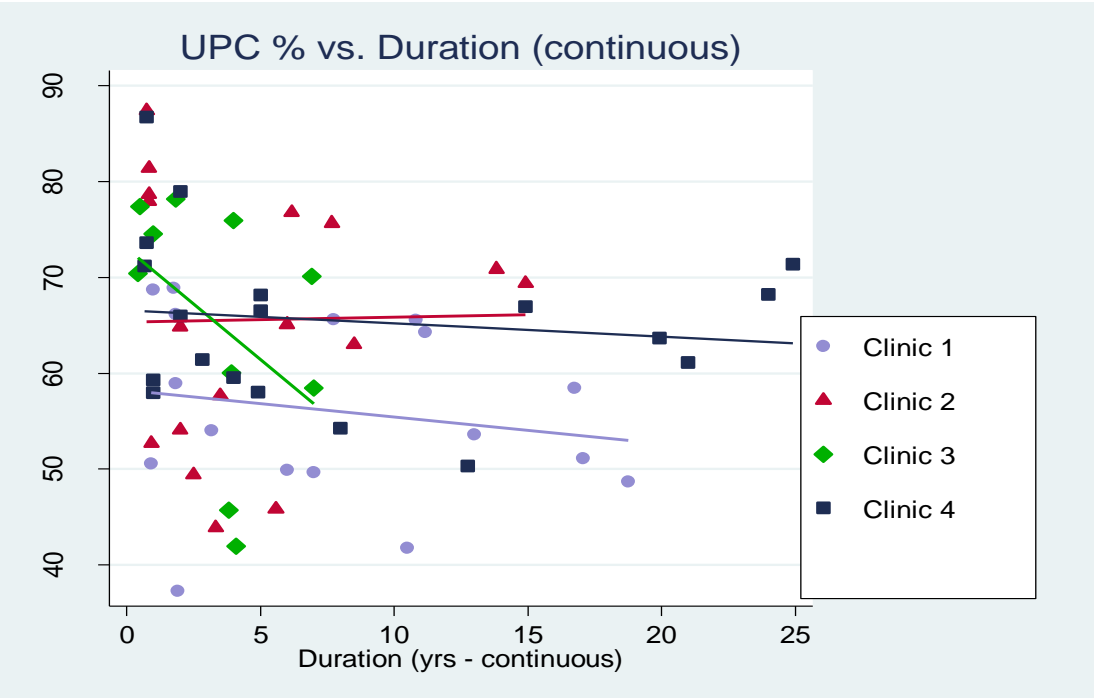
D.3. Regression of UPC on predictor variables by clinic assignment



Summary: Trends in UPC by clinic frequency are essentially the same for all clinics.



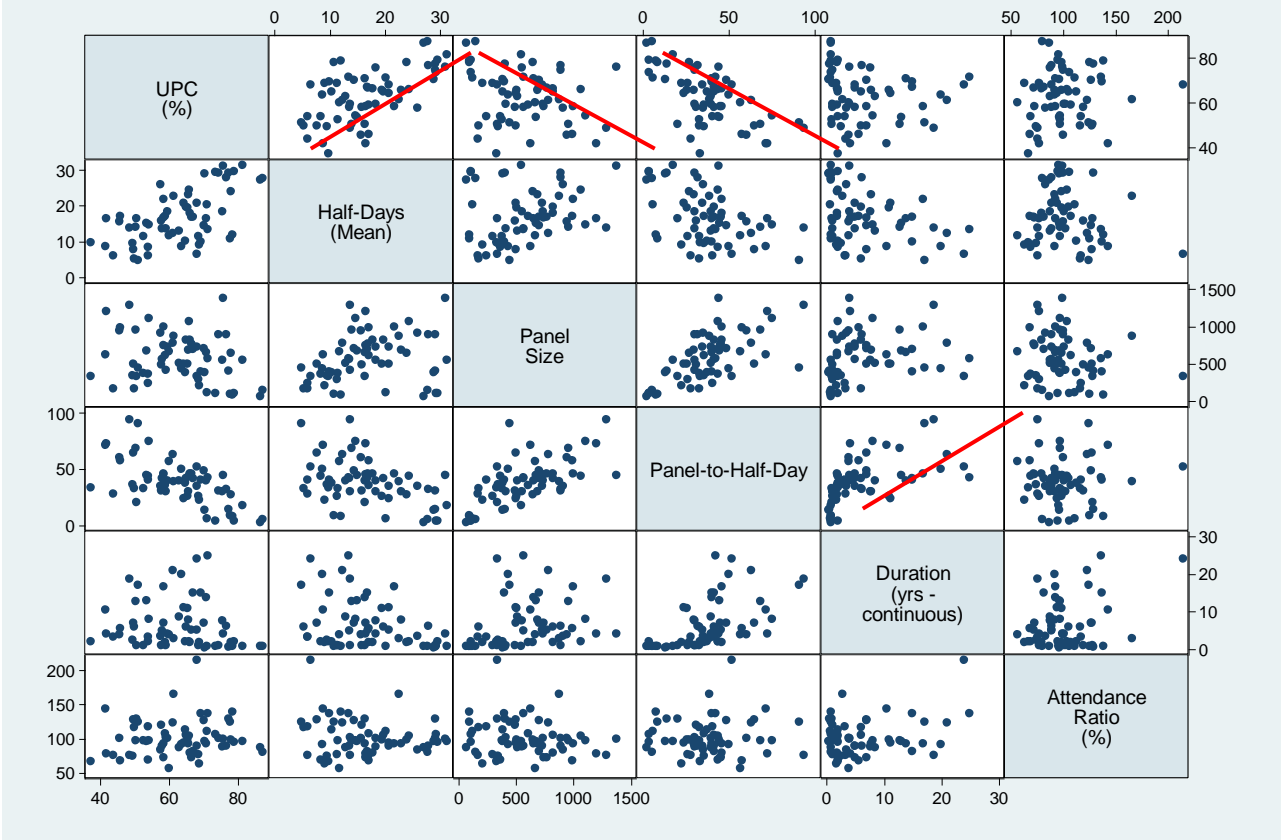
Summary: Trends in UPC by patient load are essentially the same for all clinics.



Summary: UPC does not vary in a predictable linear fashion by duration in practice, regardless of clinic assignment.

D.4. Simple linear regression of UPC on predictor variables

Graph Matrix of UPC on Predictor Variables



Summary: Trend lines (in red) denote statistically significant linear associations between variables. There were significant linear associations between UPC and clinic frequency, panel size and patient load. There was a significant (non-linear) association between duration and patient load.