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## The Association Between Patient Complexity and Primary Care Visit Length and Composition

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Citation	Lichtenstein, Morgan R.L. 2016. The Association Between Patient Complexity and Primary Care Visit Length and Composition. Doctoral dissertation, Harvard Medical School.
Accessed	October 13, 2017 9:26:01 AM EDT
Citable Link	<a href="http://nrs.harvard.edu/urn-3:HUL.InstRepos:27007752">http://nrs.harvard.edu/urn-3:HUL.InstRepos:27007752</a>
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## Abstract

**Importance:** Our research examines the duration and content of primary care visits with a focus on whether visit length or composition differs for highly complex patients as compared to non-complex patients. This comparison elucidates the potential for primary care practices to provide more appropriately tailored outpatient care to meet the needs of complicated patients.

**Objective:** We hypothesized that physician-defined complex (PDC) patients would spend more time with their primary care physicians in each visit based on their increased medical, psychosocial, and mental health issues. With similar reasoning, we predicted that a physician-defined complex patient appointment would have different composition than a non-complex appointment.

**Design, Setting and Participants:** This study was a prospective cohort study conducted at a large hospital-based primary care practice at Massachusetts General Hospital. Seven volunteer primary care physicians were recruited and data was collected from a total of 635 visits, all but several with different patients (average of 91 visits per physician). Participating physicians had a full-time equivalent range of 0.26 to 0.95 and patient panels ranging from 404 to 1525. Of the 635 patients enrolled, 250 (39.4%) were physician-defined complex. Data collection took place from January through April, 2014.

**Main Outcomes and measures:** The primary outcome of our study, visit length, was defined as the total amount of time (in minutes) the patient was with the physician in the exam room. The secondary outcome, visit composition, was defined by a list of primary care visit activities and topics of conversation.

**Results:** The study results regarding total visit length conflicted with our initial prediction by showing that physician-defined complex patients and non-complex patients spend the same amount of time in any given primary care appointment. We also found that visit composition differs significantly between physician-defined complex and non-complex groups; in complex patient visits, more time is spent discussing medications (average of 11.9% for PDC complex and 9.8% for non-complex,  $p < 0.002$ ), specialty care coordination (average of 6.4% for PDC complex and 4.7% for non-complex,  $p < 0.005$ ), and mental health (average of 0.5% for PDC complex and 0.2% for non-complex,  $p < 0.003$ ). In complex visits, physicians spend relatively less time on the following topics with their complex patients: education and care planning (0.9% for PDC complex and 2.0% for non-complex,  $p < 0.005$ ), cancer screening guidelines (average of 0.5% for PDC complex and 0.8% for non-complex,  $p < 0.005$ ), logistics (6.3% for PDC complex and 7.1% for non-complex,  $p < 0.05$ ), and social discourse (1.6% for PDC complex and 2.5% for non-complex,  $p < 0.002$ ). Notably, the three topics that occupied the most visit time overall did not significantly differ in length between complex and non-complex groups. These topics included the medical interview, such as history of present illness and past medical history (13.8% for PDC complex and 15.0% for non-complex,  $p < 0.16$ ), physical exam (11.3% for PDC complex and 12.0% for non-complex,  $p < 0.24$ ), and indirect care, which describes tasks with no physician-patient conversation (13.8% for PDC complex and 13.6% for non-complex,  $p < 0.74$ ).

**Conclusion and Relevance:** The study results regarding visit length showed that physician-defined complex patients and their non-complex counterparts spend the same amount of time in a

single medical appointment. Within this standard visit length, we found that visit composition differs significantly between physician-defined complex and non-complex groups. In complex patient visits, more time is spent discussing medications, specialty care coordination, and mental health. These patients receive relatively less time on education, care planning, screening guidelines, logistics, and social discourse. These care content differences raise questions about whether standard visit length provides adequate time for patients with increased medical needs. Given that physician-defined complex patients struggle with relatively compromised health outcomes, these patients likely need more, not less, emphasis on the elements of conversation currently lacking in their care. Though complex patients have a greater number of appointments over time, less focus on the same subset of topics in each visit may ultimately compromise care in those areas. Thus complex patients may benefit from standardized supplemental outpatient care tailored to meet their advanced needs.

## **Introduction**

Extensive literature reports a correlation between diagnosis-based risk stratification, acute care utilization, and health care costs.<sup>1</sup> Predictive complexity models show potential to reduce healthcare costs by prospectively identifying those at high risk, thus allowing for standardized, targeted care for a subset of patients.<sup>2,3</sup> Developing evidence-based reform in this realm requires a clearly defined complex population and a record of current practices to help us assess patient need and identify specific areas for improvement. At present, there is no universally accepted measure to define patient complexity. Furthermore, to our knowledge, no formal research compares the visit length or composition of complex and non-complex primary care patients.

In current practice, many different methods exist to identify complex patients. Most methods define complexity in terms of chronic medical conditions, number of medications, or previous health care costs. For instance, the commonly used Charlson model utilizes age and a weighted algorithm of 16 medical conditions (including cerebrovascular disease, congestive heart failure, and dementia) to identify complex patients.<sup>4</sup> Arguably, a more accurate definition of patient complexity incorporates medical, behavioral, and psychosocial factors, which have interdependent effects on health.<sup>5</sup> To identify our patient cohorts in this study, we chose the Physician-Defined Complexity (PDC) model, a predictive algorithm derived from asking primary care physicians to identify patients on their panels with increased healthcare needs.<sup>6</sup> Our study utilizes the PDC model in combination with time-motion analysis to assess visit length and composition for physician-defined complex patients as compared to non-complex patients.

Over the past decade, research has shown mixed data regarding the trend of primary care visit length. While the National Ambulatory Medical Care Survey (NAMCS) shows an increase

in visit duration over the years,<sup>7</sup> records of actual visit time question the accuracy of that data.<sup>8</sup> Concurrent research shows that primary care physicians do not have enough time in their daily schedule to meet national guidelines for providing preventive care counseling or chronic care management.<sup>9, 10</sup> The concept of limited visit time in primary care raises the possibility that appointment composition may vary across patient populations and thus result in the omission of important topics for certain groups. Decreased time spent on any given topic during a visit has potential to shift focus away from that element of the patient's care. Recently, several studies analyze the actual content of primary care visits; one publication concludes that discussing medical conditions, record keeping, and the physical examination occupy the greatest percentage of the visit, while relatively little time is spent during appointments on preventive care or care coordination.<sup>11</sup>

Initially, we predicted that Physician-Defined Complexity would correlate with longer visit length based on two assumptions: (1) that physician-defined complex patients require more face-to-face time and (2) that primary care physicians associate patient complexity with a greater in-person time demand. The unique ability of the PDC model to incorporate medical diagnoses, mental illness, and psychosocial factors fed the hypothesis that complex patient visits last for longer and differ in composition from non-complex patient visits.<sup>12</sup> With similar reasoning, we predicted that a complex patient appointment would have different composition than a non-complex appointment, such as a greater percentage of time spent on medications, mental health assessment and treatment, psychosocial issues, nutrition/weight/lifestyle, and care coordination. Our study adds to this literature by analyzing visit length and composition in relation to patient complexity. Ultimately, this work aims to improve our understanding of the care we provide to complex patients and to locate potential areas for improvement.

## **Methods**

### *Study Setting and Population*

Primary care physicians were recruited from Internal Medicine Associates (IMA), the largest primary care practice affiliated with Massachusetts General Hospital (MGH). When the data was collected, the practice employed 39 staff physicians who saw patients between 1 and 7 half days with an average patient panel size of 531 patients. A convenience sample of 7 volunteer attending PCPs was recruited from amongst the attending physicians in the practice.

Participating physicians had a full-time equivalent range of 0.26 to 0.95 and patient panels ranging from 404 to 1525. Participants and nonparticipants did not significantly differ in demographic characteristics or clinical productivity.

At the time of data collection, primary care teams at IMA included a physician, medical assistant, registered nurse, and nurse practitioner to provide outpatient and follow up care. The non-physician staff was often shared amongst several physicians. Prior to each PCP appointment, a medical assistant obtained vital signs and completed a brief medication reconciliation. Only several patient subjects interacted with a nurse on the day of their physician appointment during the course of the study. Of note, a subset of physician-defined complex patients (43 individuals, 6.6% of all subjects or 17% of PDC subjects) had been identified by a separate comorbidity-based model and were assigned case managers who followed and supported their care, but those providers did not attend any appointments in this study.

### *Data Collection*

Data collection involved three iterative phases: deconstructing the primary care visit and defining measurable components, designing an electronic platform to capture visit time and content, and training research staff to use the platform accurately.

First, based on published sources and physician input, we generated a list of primary care visit activities and topics of physician-patient conversation.<sup>13, 14</sup> Primary care activities fell into three broad categories: conversation (new or existing conditions, medication, care coordination, social discourse, etc.), physical exam, and indirect care. We defined indirect care as time spent in silence during the visit without conversation or physical exam (note writing, for instance). In case of multiple activities occurring at once (physical exam and medical conversation, for example), verbal communication was prioritized with the exception of social discourse, which was only prioritized when it coincided with indirect care tasks (note-writing, test ordering). Within the broader category of conversation, the list of specific topics included: medical conditions, medications and medication review, cancer screening, nutrition/weight/lifestyle, mental health, psychosocial issues, care coordination, and social discourse (Appendix A).

Using this structure, we designed an electronic platform to efficiently record the timing and content of primary care visits and trained a medical student to collect visit data in real time. To maximize consistent use of the platform, the student first participated in a pilot trial with five

nonparticipant IMA physicians, who provided feedback about the data collection tool and process.

Data was collected over four months, from January through April of 2014 by one medical student working as a full-time research assistant. Written consent was obtained from all physician participants prior to initiating data collection. Verbal consent was obtained from each patient at the time of his/her visit after a brief review of the written document provided upon arrival. If a patient gave consent, the medical student observed the full appointment and gathered data on visit time and content. If the patient declined, the medical student recorded only the overall time of the visit from outside the exam room. Before each visit, the medical student recorded a de-identified code to connect each patient with his or her visit data. The student had no knowledge of patient medical history or complexity data and PCP had no knowledge of physician-defined complexity data. In total, data from 635 visits was recorded, all but several with different patients.

Institutional Review Board approval was obtained from Massachusetts General Hospital in 2013 prior to data collection and analysis.

#### *Physician-Defined Complexity and Patient Characteristics*

Physician-defined complexity (PDC) was defined using a previously developed and validated algorithm.<sup>15</sup> Hong and colleagues established a cohort of patients in which PCPs reviewed a list of their own randomly selected adult patients and subjectively identified patients as complex in response to the question, “In your view, do you consider this patient a ‘complex patient’?” Candidate variables used to develop the predictive model included patient demographic, diagnostic, procedure, medication, laboratory, and prior primary care and acute care utilization data. The PDC covariate was then dichotomized based on a threshold that reflected the highest overall agreement between the predictive model and the PCP’s qualitative assessment. Hong and colleagues identified a risk score threshold of 14.5% complex as reflective of maximal model accuracy, and thus, this threshold was used as the cutoff for dichotomization in our analysis.

Other characteristics of the patients included age, gender, race, primary language spoken, insurance status, patient-PCP linkage status and number of primary care clinic visits made within the previous 3 years. Linkage status was defined based on a previously validated patient-

physician attribution algorithm.<sup>16</sup> Patients identified as being linked or attributed to a specific PCP were labeled as “MD-linked.” Compared to alternative algorithms, the PDC model more effectively captures complexity stemming from psychosocial and mental health needs.<sup>17</sup> Moreover, recent analysis by Hong et al. indicates that the PDC algorithm can prospectively categorize patients at increased risk for suboptimal preventive care outcomes and incomplete cancer screening more accurately than alternative risk-adjustment models.<sup>18</sup>

### *Visit Length and Composition Outcomes*

The primary outcome of our study, visit length, was defined as the total amount of time (in minutes) the patient spent with the physician in the exam room. If the physician left the room in the middle of a visit and then returned, the time outside of the room was subtracted from the total. The secondary outcome, visit composition, was defined using published sources and physician input in order to generate a list of primary care visit activities and topics of conversation.<sup>19,20</sup> This list was grouped, a priori, into the following categories: 1) the medical interview, 2) medications and medication review, 3) medical testing, 4) physical exam, 5) cancer screening, 6) nutrition/weight/ lifestyle, 7) mental health, 8) psychosocial issues, 9) care plan/patient education, 10) care coordination, 11) logistics, 12) social discourse, and 13) indirect care (Appendix A). The visit composition outcome variable was measured based upon the amount of time (in seconds) the PCP spent talking about, or doing, each of the thirteen activities during the appointment.

### *Statistical Analysis*

Using  $\chi^2$  tests for categorical variables and *t*-tests for continuous variables, we compared the baseline characteristics of physician-defined complex patients with the characteristics of patients who were not complex. We report means and standard deviations for continuous variables and percentages for categorical variables. We also examined patient characteristics for the broader population of patients.

We used a hierarchical linear mixed-effects model to examine the relationship between PDC status and total visit length. The effect of the physician was included as a level-2 random effect, and all patient characteristics were included as fixed effects. This hierarchical modeling approach allowed us to take into account the fact that patient visit length may be correlated

within a physician, and allows us to examine differences in total visit length among patients clustered within physicians.

We performed analyses to determine whether visit composition was related to PDC status, where we calculated the proportion of time spent on each composition category by taking the category time and dividing it by total visit time. Proportion of time spent on each visit category was modeled as a fractional outcome using a hierarchical generalized linear mixed-effects model. There are numerous methods one may utilize to model a fractional outcome, the most popular being ordinary least squares (OLS) regression with a Gaussian distributional assumption. Despite the simplicity of OLS, there are several major conceptual flaws with its use in the case of modeling proportions. First, the distribution is bounded between 0 and 1, violating the assumption of normality. Second, the variance is not independent of the mean, and shrinks as the mean approaches the 0 or 1 bounds of the distribution, violating the assumption of homoscedasticity. In our study, we use a fractional logit model with a logit link and binomial distributional family in order to fit the proportional outcome, and overcome the violations stated. Such a model provides a simple interpretation of the estimates, as it is a one-part model, and makes no distributional assumptions.<sup>21</sup>

A *P* value of less than .05 was considered statistically significant for all tests. All analyses were performed using SAS software version 9.4 (SAS Institute, Cary, North Carolina).

## **Results**

### *Baseline Characteristics*

Of 635 patients, 250 (39.4%) were complex. Complex patients were more likely to be older (mean age: 71.1 vs. 57.4;  $P < 0.0001$ ), to have greater numbers of primary care clinic visits (mean number of clinic visits: 12.1 vs. 6.1;  $P < 0.0001$ ), and to be MD-linked (100% vs. 94.8%;  $P = 0.0003$ ) compared with non-complex patients. Complex patients were less likely to be commercial-insured (37.6% vs. 78.7%;  $P < 0.0001$ ). There were no significant differences between complex and non-complex patients with regard to gender, race or primary language spoken (Table 1).

### *Visit Length*



In the adjusted model with all visit appointment lengths included, we found that for every 10 year increase in age, there was a 0.78 minute increase in appointment length ( $P = 0.003$ ), and females had shorter visit times ( $\beta = -2.52$ ;  $P < 0.001$ ) compared with men. In the adjusted model for 30-minute appointment lengths, we found that for every 10-year increase in age, there was a 1.30 minute increase in appointment length ( $P < 0.0001$ ). Females had shorter visit times ( $\beta = -3.62$ ;  $P < 0.0001$ ) compared with men, and MD-linked patients had shorter visit times ( $\beta = -4.33$ ;  $P = 0.01$ ) compared with non MD-linked patient. Visit times were not shown to be significantly different between physician-defined complex and those who were non-complex. Similar visit length analysis with the Charlson model, a more commonly used risk-adjustment algorithm, produced the same null result. Actual visit times were not different among any of the variables included in the 15-minute appointment length model (Table 2).

### *Visit Composition*

In adjusted models, among all visit lengths, we found that physicians spent a greater proportion of time with complex patients, discussing and reviewing medications (11.9% vs. 9.8%;  $P = 0.002$ ), mental health concerns (0.5% vs. 0.3%;  $P = 0.003$ ), and care coordination (6.4% vs. 4.7%;  $P = 0.005$ ) compared with non-complex patients. Physicians spent a lesser proportion of time with complex patients, discussing preventive care issues (0.5% vs. 0.8%;  $P = 0.005$ ), a care plan or education (0.9% vs. 2.0%;  $P = 0.005$ ), logistics (6.3% vs. 7.1%;  $P = 0.05$ ), and small talk (1.6% vs. 2.5%;  $P = 0.002$ ) compared with non-complex patients (Table 3). Notably, the three topics that occupied the most visit time overall did not significantly differ in length between complex and non-complex groups. These topics included the medical interview, which includes history of present illness and past medical history (13.8% for PDC complex and 15.0% for non-complex,  $p < 0.16$ ), physical exam (11.3% for PDC complex and 12.0% for non-complex,  $p < 0.24$ ), and indirect care, such as computer tasks and paperwork with no physician-patient conversation (13.8% for PDC complex and 13.6% for non-complex,  $p < 0.74$ ).

## **Discussion**

Minimal literature exists on how primary care physicians spend their visit time, with only a few studies examining care content<sup>22, 23</sup> and analyzing the outpatient decision-making process.<sup>24</sup> To our knowledge, this work provides the first attempt to analyze primary care visit

length and composition stratified by patient characteristics. Specifically, we focus on high-risk, high-utilization patients identified by the Physician-Defined Complexity model in an effort to inform supplemental care for this population.<sup>25</sup> In our initial hypothesis, we predicted that complex patients would spend more time in a single primary care visit compared to non-complex patients. In contrast, our study reveals that complex patients and their non-complex counterparts spend the same amount of time in any given primary care visit (Tables 4, 5). To confirm these results, we repeated our analysis using the Charlson model, a more commonly used risk-adjustment algorithm, which produced the same null finding, supporting the conclusion that patient complexity does not correlate with individual visit length.

Effectively, these null results set a constant visit time for complex and non-complex patients, which in turn strengthens our subsequent finding: looking within each appointment, we found that visit composition differs significantly between physician-defined complex and non-complex groups. This distinction confirms our second hypothesis, that complex patients receive different visit content than their non-complex counterparts. With results showing a constant visit length, greater focus on certain topics for physician-defined complex patients means reduced time spent on other issues during a single primary care visit.

Our results indicate that physician-defined complex patients spend more visit time than non-complex patients on the following topics in a primary care appointment: medications, specialist care, and mental health issues. In these complex patient appointments, PCPs spend roughly 18% more visit time discussing medications (average of 11.9% for PDC complex and 9.8% for non-complex), 27% more visit time reviewing or recommending specialist care (average of 6.4% for PDC complex and 4.7% for non-complex), and 60% more time discussing mental health issues compared to non-complex patients (average of 0.5% for PDC complex and 0.2% for non-complex) (Table 6). This likely reflects the unique needs of the physician-defined complex population, as these individuals take more medications and see more specialists, on average, than non-complex patients. Physician-defined complex patients are also more likely to struggle with mental health issues, which likely accounts for extended conversations in that realm.<sup>26</sup> Nevertheless, it is noteworthy that the total time spent on mental health issues is strikingly low for both cohorts despite the known prevalence of mental health diagnoses in the United States.<sup>27</sup>

More time spent on these topics results in less time for other issues during each primary care appointment. Our results show that physicians spend relatively less time per visit on the following activities with physician-defined complex patients: educating patients, establishing a care plan, discussing cancer screening, reviewing logistics, and engaging in social discourse. Given that physician-defined complex patients have inferior health outcomes relative to non-complex patients, shifting the focus away from certain topics within each visit may compromise patient care and reinforce persisting health disparities.

Our study revealed that physician-defined complex patients spend less time per visit on patient education and care planning. In a recent publication, Hong et al. describes that physician-defined complex patients are more likely to have elevated  $HbA1C \geq 9$  and elevated  $LDL \geq 130$  in addition to more chronic diagnoses than non-complex individuals.<sup>28</sup> Despite the increased medical complexity of these patients, physicians spend 55% less time on education and care planning (0.9% for PDC complex and 2.0% for non-complex) in each complex patient appointment. For these complex individuals, less time spent learning about their medical conditions and reviewing a care plan during each visit may compromise patient understanding and follow through. Furthermore, decreased time on these topics in each appointment translates to fewer opportunities for shared decision-making whereby physicians provide medical information and patients communicate their personal preferences in order to develop an individualized treatment plan.<sup>29, 30, 31</sup>

Physician-defined complex patients not only receive less chronic care management, but also less preventive counseling during each visit. Specifically, physicians spend 37.5% less time talking with these patients about cancer screening recommendations (average of 0.5% for PDC complex and 0.8% for non-complex) per appointment. On this topic, Hong et al. found that physician-defined complex patients have longer periods of time in which cervical, breast, and colon cancer screenings remain incomplete.<sup>32</sup> Though we cannot definitively attribute this outcome to lack of physician conversation, we can infer that physician-defined complex patients would likely benefit from more focus on screening guidelines. Multiple studies have reinforced the importance of counseling and education in achieving higher levels of cancer screening, particularly in vulnerable populations.<sup>33, 34, 35, 36, 37</sup> Moreover, conversations about mammogram and PSA testing present opportunities for shared-decision making around controversial guidelines. Given these factors, complex patients would likely gain from more time spent on

screening, whether that counseling is provided by physicians, patient navigators, or other members of the care team.

Differences between physician-defined complex and non-complex visit content are not limited to medical topics. Our research shows that complex patients engage in less conversation about the logistics of their care and less social discourse in each primary care visit. We found that physicians routinely provide patients with care logistics, such as where to send prescriptions, when to refill medications, or how to get to the breast imaging center for a mammogram. With physician-defined complex patients, physicians spend 11% less time (6.3% for PDC complex and 7.1% for non-complex) per visit clarifying logistics to ensure that patients can fulfill their healthcare needs. Reduced knowledge about how to follow through with treatment goals may present another barrier to care for these patients, as those without specific instructions for follow up may be less likely to comply with medical recommendations. Additional support around logistics from patient navigators or case managers may increase the likelihood that complex patients have the necessary information to follow through with their treatment plans.

Social discourse is another non-medical topic that serves an important purpose in providing quality health care.<sup>38, 39</sup> Our study reveals that physician-defined complex patients spend 36% less time per visit in social conversation relative to non-complex patients (1.6% for PDC complex and 2.5% for non-complex). In a medical appointment, seemingly casual conversation can provide interpersonal bonding and medically relevant details about a patient's life through his interests, social circumstances, or behavioral patterns.<sup>40</sup> Furthermore, studies suggest that provider communication skills increase patient satisfaction and can impact quality of care.<sup>41</sup> A shift away from social exchange in each visit may limit opportunities for more informed medical decision-making and interpersonal connection for physician-defined complex individuals in their overall care.

In reviewing our work, it is critical to note that complex patients have more medical visits over time when compared to non-complex patients, indicating that complex individuals may spend more total time discussing any given subject over multiple visits. However, the altered focus within each complex patient appointment may negatively impact overall patient care in the areas of omission and thus contribute to persistently compromised health outcomes. In this regard, our research raises questions about whether higher visit frequency for complex patients amounts to more effective care or whether the current system contributes to inferior care for

complex patients. One existing study shows a correlation between visit frequency and quality of care for patients with multiple comorbidities,<sup>42</sup> but no research directly compares increased visit length versus increased frequency to determine whether one approach correlates with superior quality or improved outcomes. Using the current model of care delivery, physician-defined complex patients continue to have compromised outcomes and increased utilization. The differences we uncovered in visit content may contribute to this disparity, as the focus of each physician-defined complex visit skews away from topics that these patients likely need to discuss.

Prior research concludes that providing additional, supplementary care to complex patients improves their health outcomes and lowers associated medical costs.<sup>43</sup> Our work raises the question of whether complex populations would benefit from more support in the content areas currently lacking in their care and suggests that more research is needed to determine the potential advantages of providing targeted care to these vulnerable patients. Whether additional support is delivered by physicians or alternative providers in the future, our research allows for more informed decisions about the type of supplemental care needed to improve quality and outcomes for a highly complex population.

## **Limitations**

Several important limitations warrant consideration. Our study examines the content of a single primary care visit for each patient and thus captures the focus of individual physician-patient interactions. However, our data does not account for cumulative care content across multiple visits. This single-visit approach limits our understanding of patient care content over time, particularly given that complex patients see their physicians more frequently over the course of years. Nevertheless, a closer look on the single-visit level provides insight about how physicians use time differently with different groups of patients, which may ultimately impact overall quality of care and health outcomes.

In addition to limited data collection, we recognize that our work may not be generalizable to all primary care providers or patient populations. Internal Medicine Associates is a large primary care teaching practice in a tertiary care hospital. Our research provides insight into the care content of primary care physicians, many of whom are not full time providers at a

large hospital practice. We chose this population, in part, based on an increasing number of part-time primary care physicians in the United States, which extends generalizability.

Another study limitation involves number of physician and patient subjects. We followed 7 physicians on 635 primary care visits, all but several with different patients. Physicians were recruited based on willingness to participate, which may have biased the results. Though we adjusted our analysis for physician differences, the small number of subjects limits our ability to analyze physician behavior.

Patient sample size also serves as a limiting factor in our work; a higher number of patients may have resulted in more significant differences between physician-defined complex and non-complex cohorts. In addition, the patients at Internal Medicine Associates are 81% Caucasian, 95% English speaking, and 66% privately insured, which limits our results to an English-speaking subset of patients. Repeating this study in a non-English speaking population that requires translation during the visit has potential to highlight important differences in appointment time and patient care content across language barriers.

## **Summary**

Predictive complexity models show potential to reduce healthcare costs by prospectively identifying patients at high risk, thus allowing for targeted supplemental care.<sup>44,45</sup> To provide evidence-based interventions, we need to establish a clearly definable population of complex patients and a record of current practices. At present, there is no universally accepted measure to define patient complexity. Furthermore, to our knowledge, no formal research compares the visit length or composition for complex and non-complex primary care patients.

Our study utilizes the Physician-Defined Complexity model, a predictive algorithm that captures complexity stemming from psychosocial and mental health needs and prospectively identifies patients at increased risk for suboptimal health outcomes and incomplete cancer screenings.<sup>46</sup> The unique ability of the PDC model to incorporate medical diagnoses, mental illness, and psychosocial factors fed the hypothesis that complex patient visits last for longer and differ in composition from non-complex patient visits.<sup>47</sup>

The study results regarding total visit length conflicted with our initial prediction by showing that physician-defined complex patients and their non-complex counterparts spend the same amount of total visit time in a medical appointment. Given a constant visit time, we found

that visit composition differs significantly between physician-defined complex and non-complex groups. In complex patient visits, more time is spent discussing medications, specialty care coordination, and mental health. Given a constant visit length, physicians spend relatively less time with complex patients on education and care planning, screening guidelines, logistics, and social discourse.

Given that physician-defined complex patients struggle with relatively compromised health, these patients likely need more, not less, focus on the elements of conversation currently lacking in their care. Whether this additional support is delivered by physicians or alternative providers, our research allows for more informed decisions about the type of supplemental care needed to improve quality and outcomes for a highly complex population.

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## Tables

Table 1. Participant Demographic Characteristics by PDC Status

Characteristic	PDC Status		
	Complex (N=250)	Non-Complex (N=385)	p-value*
Age, mean (SD), y	71.1 (13.2)	57.4 (14.0)	< 0.0001
Female	149 (59.6)	222 (57.7)	0.63
Caucasian	225 (90.0)	340 (88.3)	0.51
English is Primary Language	246 (98.4)	381 (99.0)	0.54
Commercially Insured	94 (37.6)	303 (78.7)	< 0.0001
Primary Care Clinic Visits (3 yr period), mean (SD)	12.1 (6.5)	6.1 (7.7)	< 0.0001
MD-Linked	250 (100.0)	365 (94.8)	0.0003
Diabetes	85 (33.6)	19 (4.9)	< 0.0001
Hypertension	205 (81.0)	144 (37.0)	< 0.0001
CAD	67 (26.5)	18 (4.6)	< 0.0001

Data are presented as number (percentage) of patients, unless stated otherwise

\* $\chi^2$  Test for binary variables, analysis of variance for continuous variables

23 participants are missing demographic information

Table 2. Participant Demographic Characteristics by Charlson Score

Characteristic	Charlson Score		
	Complex ( $\geq 2$ ) (N=397)	Non-Complex ( $< 2$ ) (N=238)	p-value*
Age, mean (SD), y	67.6 (13.9)	54.7 (14.0)	< 0.0001
Female	221 (55.7)	150 (63.0)	0.07
Caucasian	355 (89.4)	210 (88.2)	0.64
English is Primary Language	390 (98.2)	237 (99.6)	0.14
Commercially Insured	202 (50.9)	195 (81.9)	< 0.0001
Primary Care Clinic Visits (3 yr period), mean (SD)	10.2 (9.0)	5.6 (4.1)	< 0.0001
MD-Linked	393 (99.0)	222 (93.3)	< 0.0001
Diabetes	97 (24.0)	7 (2.9)	< 0.0001
Hypertension	291 (72.0)	58 (24.3)	< 0.0001
CAD	85 (21.0)	0 (0.0)	< 0.0001

Data are presented as number (percentage) of patients, unless stated otherwise

\* $\chi^2$  Test for binary variables, analysis of variance for continuous variables

23 participants are missing demographic information

Table 3. Adjusted Models for Visit Length

<b>Characteristic</b>	<b>All Visit Appointment Lengths<sup>a</sup> (<math>\beta</math> (95% Confidence Interval))</b>	<b>15-Minute Appointment Length (<math>\beta</math> (95% Confidence Interval))</b>	<b>30-Minute Appointment Length (<math>\beta</math> (95% Confidence Interval))</b>
Age, per 10-y increase	0.78 (0.27, 1.28) <sup>b</sup>	0.01 (-0.87, 0.89)	1.30 (0.70, 1.90) <sup>b</sup>
Female	-2.52 (-3.82, -1.22) <sup>b</sup>	-1.34 (-3.41, 0.73)	-3.62 (-5.23, -2.01) <sup>b</sup>
Caucasian	1.64 (-0.29, 3.56)	0.49 (-2.72, 3.69)	2.90 (0.54, 5.26) <sup>b</sup>
English is Primary Language	-2.49 (-7.89, 2.91)	-1.57 (-9.23, 6.10)	-4.72 (-12.56, 3.12)
Commercially Insured	1.23 (-0.28, 2.74)	0.30 (-2.12, 2.72)	1.36 (-0.54, 3.26)
Primary Care Clinic Visits (3 yr period), per 1-visit increase	0.01 (-0.07, 0.10)	0.03 (-0.07, 0.13)	-0.08 (-0.27, 0.12)
MD-Linked	-3.27 (-6.62, 0.08)	-0.68 (-0.32, 3.81)	-4.33 (-7.71, -0.95) <sup>b</sup>

<sup>a</sup>Model is adjusted for scheduled visit length (15-min, 20-min, 30-min and 45-min)<sup>b</sup>Significant at  $p < 0.05$ 

Table 4. Adjusted Total Visit Length Means (95% CIs) by Physician-Defined Complexity

	<b>Complex</b> (Mean Total Visit Length in Minutes)	<b>Non-Complex</b> (Mean Total Visit Length in Minutes)	<b>p-value</b>
15 Minute Visits	22.1 (15.7-28.5)	20.4 (14.1-26.6)	0.1
30 Minute Visits	29.5 (24.9-34.1)	29.3 (24.8-33.8)	0.84
All Visits	32.6 (27.9-37.4)	31.5 (26.8-36.2)	0.12

Table 5. Adjusted Total Visit Length Means (95% CIs) by Charlson

	<b>Complex</b> (Mean Total Visit Length in Minutes)	<b>Non-Complex</b> (Mean Total Visit Length in Minutes)	<b>p-value</b>
15 Minute Visits	21.5 (15.2-27.9)	19.5 (13.0-26.0)	0.08
30 Minute Visits	29.4 (25.0-33.9)	29.3 (24.8-33.9)	0.89
All Visits	32.5 (27.8-37.2)	31.4 (26.6-36.1)	0.12

Table 6. Adjusted Percentage of Time Spent on Visit Content (95% CIs) by PDC

Visit Content Categories	All Visit Appointment Lengths <sup>a</sup>		
	Complex (Percentage of Total Visit (95% Confidence Interval))	Non-Complex (Percentage of Total Visit (95% Confidence Interval))	<i>P</i> Value
Medical Interview (HPI/PMH)	13.8 (9.4, 19.8)	15.0 (9.7, 22.4)	0.16
Medications and Medication Review	11.9 (9.3, 15.1)	9.8 (7.7, 12.2)	0.002
Medical Testing	6.2 (3.7, 10.1)	7.2 (5.1, 10.2)	0.24
Physical Exam	11.3 (8.1, 15.6)	12.0 (8.9, 15.9)	0.24
Cancer Screening	0.5 (0.2, 1.2)	0.8 (0.3, 1.9)	0.005
Nutrition/Weight/Lifestyle	2.5 (1.5, 4.2)	2.4 (1.3, 4.5)	0.71
Mental Health	0.5 (0.2, 1.3)	0.2 (0.1, 0.5)	0.003
Psychosocial Issues	1.9 (0.5, 6.6)	2.0 (0.6, 6.6)	0.63
Care Plan/Patient Education	0.9 (0.7, 1.3)	2.0 (1.1, 3.7)	0.005
Care Coordination	6.4 (4.3, 9.6)	4.7 (2.9, 7.8)	0.005
Logistics	6.3 (4.2, 9.3)	7.1 (4.7, 10.7)	0.05
Social Discourse	1.6 (1.0, 2.6)	2.5 (1.4, 4.3)	0.002
Indirect Care	13.8 (9.5, 19.5)	13.6 (9.2, 19.7)	0.74

<sup>a</sup>Model is adjusted for scheduled visit length (15-min, 20-min, 30-min and 45-min)

## Appendix A

Topics	Definition	Example
Medical Condition	Discussion of new or existing symptoms, medical diagnoses	PCP/patient discusses previously diagnosed hypertension. PCP/patient discusses new onset headache.
Medications and Medication Review	Discussion past, current, or potential future medications	PCP/patient discusses hypertension medication regimen.
Medical Testing	Discussion of medical testing/imaging, including recommendations or result review. Does not include cancer screening.	PCP recommends MRI. Patient inquires about recent lipid screening panel.
Cancer Screening	Discussion of cancer screening guidelines and recommendations.	PCP discusses recommendations for colonoscopy screening.
Nutrition/Weight/Lifestyle	Discussion of weight, nutrition, and lifestyle to support preventive care goals.	PCP discusses BMI with an overweight patient and inquires about nutrition and exercise habits.
Psychosocial Issues	Discussion of a patient's socioeconomic circumstances.	PCP and patient discusses patient's need for safe, subsidized housing.
Patient Education/ Care Planning	Discussion intended to help a patient understand his/her current medical condition(s) and treatment goals.	PCP offers factual medical information about hypertension. PCP and patient summarize treatment plan for losing weight.
Care Coordination	Discussion of patient's past, present, or future involvement with specialists.	PCP explains the role of a patient's cardiologist in helping to manage his heart condition
Logistics	PCP offers non-medical, practical instructions to help a patient obtain his/her medical care.	PCP explains how to get to the hospital pharmacy.
Social Discourse	Discussion of non-medical topics such as family life, personal or professional interests, hobbies, or leisure activities.	Patient talks about his ill mother.
Physical Exam	PCP examines the patient.	PCP takes blood pressure.
Indirect Care	PCP engages in paperwork or typing with no patient communication.	PCP types note without talking to patient.