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Time is Up: The Increasing Shadow Price of Time in Primary Care Office Visits

Preliminary Version: comments very welcome!

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Abstract

A physician's own time is a precious resource in primary care, and the physician must constantly evaluate the gain from spending more time with the current patient against moving to address the health care needs of the next. We formulate the physician's decision problem and characterize two rules for deciding about when to end a visit. The first rule, which we label "efficient," has the physician end a visit when the estimated value of more time falls below a shadow price. Following the second, "behavioral" rule, the physician terminates a visit when "time is up" and a target number of minutes have expired. We test for the behavioral rule against the alternative using video recordings of 385 visits by elderly patients to their primary care physician. We structure the data at the "topic" level and find evidence consistent with the behavioral rule. Specifically, we find that time elapsed within a visit is a very strong determinant of whether the physician decides this is the "last topic" to be discussed, thereby effectively ending the visit. We consider whether dislodging a target-time mentality from physicians (and patients) might contribute to more productive primary care practice.

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1. Introduction

Primary care physicians are expected to form partnerships with patients, address a wide range of acute and chronic biomedical and psychosocial issues, provide preventive care, coordinate care with specialists, and ensure informed decision-making that respects patients' needs and preferences (Fiscella and Epstein in press). In the course of a typical workday, an internist in private practice sees 20-25 patients (Murray, Davies et al. 2007), and it is clear from anecdotal and research reports that doctors do not get done all they would like or are instructed to do by standard-setting bodies (Yarnall, Pollak et al. 2003) Scheduled visits present an unpredictable range of demands on time. Unscheduled, urgent care visits must also be accommodated (Murray and Tantau 2000) along with phone calls and emails from patients, other physicians, and health plans. Record keeping and other administrative and office management tasks must be done daily. Doctors report "feeling rushed," often attributing the increased pressure from economic forces such as "productivity standards" imposed by managed care (Lin, Albertson et al. 2001; Virtanen, Oksanen et al. 2007).

Regimented clinical schedules may exacerbate the effects of time limitations (Tai-Seale, McGuire et al. 2007). Physician-educators have argued that cogent thinking, clear communication, and problem solving in primary care cannot be conducted in a highly structured fashion (Groopman 2007). This is particularly true with the older patients who populate primary care practices and who commonly have multiple chronic and complicated problems.

This paper studies how physicians allocate the resource of their own time in caring for patients. With time so scarce, physicians have powerful incentives to allocate it

efficiently. We begin by formalizing a simple model of efficient time allocation in which the marginal value of time is equalized across patients. Frank and Zeckhauser (2007), in the spirit of papers in behavioral economics, propose a different characterization of physician behavior: instead of optimizing, the physician may follow preset rules for treating patients. We apply this general approach to the question of time allocation and formulate a simple "behavioral" model as an alternative to a model based on efficient time allocation. The data we use to test these alternatives are videotaped encounters between primary care physicians and their elderly patients. We test whether physicians end visits as if they have a rapidly rising subjective shadow price of time around a target amount of time they have for each patient against an alternative hypothesis in which expected benefits from incremental time determine when a visit ends. We find strong evidence in favor of the target-related rule.

Several studies have examined how much time physicians spend with patients, reporting an average of around 16-18 minutes per visit (Mechanic, McAlpine et al. 2001; Bindman, Forrest et al. 2007; Tai-Seale, McGuire et al. 2007). Mechanic and colleagues (2001) analyzed data from the National Ambulatory Medical Care Survey (NAMCS) the American Medical Association's Socioeconomic Monitoring System (SMS) to examine the trends in visit lengths from 1989 through 1998, a period when managed care expanded rapidly. In the NAMCS, the duration of visit was based on report from the physician or a member of the physician's staff who provided the information. The SMS-derived average visit duration was obtained by dividing the average number of hours the physician reported spending with patients in his or her office each week by the average number of patients the physician reported seeing per week. The authors found that the average duration of an office visit was 16.3 minutes according to NAMCS and 20.4 minutes according to SMS in 1989. In

addition, and surprisingly, they reported an upward trend in the average visit duration over these years. Also using NAMCS data (from 1993 to 1996), Glied and Zivin reported similar visit durations averaging 17.82 minutes. When comparing visit duration by insurance status in general, they found significant differences across payer groups: FFS at 18.28 minutes, versus HMO at 16.95, Medicaid at 16.10, and Medicare at 18.52 minutes. Bindman et al. (2007) compared office visit durations, the diagnostic scope of primary care physicians, and patients' annual exposure to primary care physicians (calculated as the product of visit duration and number of visits per year) in Australia, New Zealand, and the United States. The US data came from 2001 and 2002 NAMCS which showed that the average visit length was 16.5 minutes compared with 15.0 minutes in New Zealand and 14.9 minutes in Australia. The average number of annual primary care visits per capita was greater in New Zealand (3.7) and Australia (5.2) than the US (1.8), however. As a result, the mean time per year in primary care per capita was 29.7 minutes in the US, 55.5 minutes in New Zealand, and 83.4 minutes in Australia (Bindman, Forrest et al. 2007).

Relatively few studies have cast the time problem within an explicit economic approach. One exception is Glied and Zivin (2002) who propose that visit length is an element of practice style that a physician decides about in some fashion based on the overall composition of demand and revenue at the practice. They find that visit length for an individual patient is affected by the patient's insurance status as well as the payer mix at the practice level. Some rigidity or "fixed cost" associated with altering visit length is part of their story and compatible with our approach.

A finding from Tai-Seale, McGuire et al. (2007) stimulated our interest in the current paper. The 2007 paper studied physician and patient talk time associated with health care,

employing the empirical concept of a "topic" which pertains to individual issues addressed during a visit. A visit then consists of a set of topics to which time and effort are allocated. We found that factors that increased *topic length* did not increase *visit length*. For example, if a "major topic" (as we defined it in the paper) was concerned with a mental health issue, the length of time talking about this topic was 37% longer in comparison to a traditional medical topic. The total length of the visit was, however, not affected. This is curious since total time for a visit is just the sum of time spent on topics. It must be that the physician cuts back on time available for other topics for this patient in response to a time-intensive mental health issue. This would of course hold true exactly if a physician allocated a fixed amount of time to each patient independently of the patient's health care needs. Our data show that visit lengths are skewed and range from 7.0 to 62.4 minutes in the academic medical center, from 5.2 to 35.7 minutes in the managed care group, and from 5.3 to 27.3 minutes in the inner city solo practices. Physicians must only average (say) 18 minutes per patient, any patient can have more or less than this according to what needs to be done. It is an empirical matter the degree to which extra time early in a visit comes out of the time of the patient in question or is allocated among all the patients during the course of the day. This empirical question is the core of the test we propose to distinguish our alternative theories.

While evidence for a time-based behavioral rule may not be surprising, the implications of this behavior may be significant. Changing physician practice so as to give patients "more time" with their doctor cannot be done without putting more resources into health care. If our interpretation of the findings is correct, reallocating scarce time physicians have can increase the benefits to patients at the practice level.

2. The Decision to End a Visit

This section sets out a simple model of a physician deciding about concluding a visit. As in our earlier paper, we make use of the concept of a topic. A visit ends when the physician decides no more topics will be admitted. A visit continues if the doctor allows the patient to raise a new topic to be discussed. In general terms, the physician makes this decision on the basis of expected benefits and costs, where benefits are how much the physician expects to be able to help the patient regarding the new topic and costs are the subjective costs of the time involved. We assume that revenue (and profit) are unaffected by the decision about the marginal topic within an office visit. Neither the visits nor the topics we consider involve procedures that generate extra payment.[1] We return to the issue of revenue incentives and consequences associated with changing rules for time allocation in Section 5 below.

We posit that the physician treats a given number of patients during a work day. Patients have appointments and are scheduled such that the physician can always move to the next patient without delay. Patients' medical problems are referred to as "topics." As an example, a topic might be hip pain, or trouble with sleeping, or questions about medications. Assume for purposes of this discussion that each topic takes the same fixed amount of time,

[1] Some information about physicians' coding practice pattern supports this assumption. Specifically, the primary payer for all patients in our data is Medicare. For purpose of reimbursement, an office visit for any established patient is coded with one of five levels of CPT codes, from 99211 to 99215. At the lower end of the continuum, 99211 is for the evaluation and management of a minimal problem in an established patient that may not require the presence of a physician and the office or other outpatient visit takes no more than 5 minutes. At the higher end, 99215 is for taking comprehensive history, conducting comprehensive exam, making high complexity medical decision, for moderate to high severity problem, and takes at least 40 minutes of physician time. While payments for these codes vary, physician coding practices are not very sensitive to the actual content of office visits (Calahan 2006). Physicians reportedly practice "median coding," i.e., predominantly using 99213, the median effort level CPT code (Calahan 2006; Seiber 2007).

say two minutes, for the physician to handle.[2] Although each topic takes the same amount of time, the value (benefit) of the physician dealing with each topic varies according to the nature of the topic and characteristics of the patient. Topics are more or less serious, and the physician may have more or less to contribute to patient welfare depending on the problem and the patient's situation. We assume that the physician makes a series of sequential decisions during the visit about whether to bring it to an end based on whether to admit a new topic.

2.1 Efficient Use of the Physician's Time

The physician's time is used efficiently when she deals with the topics that have the highest value to the patients she sees that day. A patient with many serious health problems would benefit from receiving more of a physician's time than a patient with few problems or with problems the physician can help little besides expressing empathy. It is clear that the efficient allocation of the physician's time can be described by a threshold value or shadow price, call it λ, such that any topic with value greater than λ is dealt with by the physician, and any topic with value less than λ is not. The value of λ is set so as to just use all of the time the physician has available. Another interpretation is that the physician has another activity with a constant value of λ. This other activity might, for example, be "administrative work," that can be squeezed in during the day or handled at the end of the day.

This formulation of efficient use of the physician's time ignores any other costs and benefits of health care. We can regard the value of the physician handling a topic as net of any social costs of other health care resources. We address patient waiting time, the time between showing up at the physician's office and being seen, in 2.4 below.

[2] In Tai-Seale, McGuire et al. (2007), the median time on the longest topic of each visit was five minutes, and one minute on the remaining topics during the visit. The median time on all topics was two minutes. The median number of topics was six per visit.

2.2 Expected value of a new topic

The expected value of a new topic is affected by patient factors, such as the health state of the patient, the nature of the patient's medical conditions, how long it has been since the physician has seen the patient, how well the physician and patient communicate with each other, and what have already been discussed in the visit. Some of these factors the physician might know at the beginning of the visit (e.g., the health care history of the patient), but some information about the current health status of the patient will only emerge during the visit. The expectation the physician has about the value of an additional topic will thus be conditioned on characteristics of the patient, denoted X, as well as the nature of the medical problems involved in all of the topics discussed by the patient up through the current topic.

Suppose a physician is considering whether to admit consideration of a new topic after t topics have already been discussed with the patient. Z_t is the information describing topic t. When deciding about whether to admit topic t+1 the physician knows all of the information about topics 1 through t. The expected value of admitting topic t+1, $\hat{V}_{t+1}$, can be thus expressed as follows:

$$\hat{V}_{t+1} = E(V_{t+1} | X, Z_t, Z_{t-1}, \ldots, Z_1) \quad (1)$$

We next discuss the factors affecting the physician's estimate of the value of a new topic and the physician's shadow price of time. We propose two hypotheses about the determinants of the shadow price of time, and formulate an empirical test that distinguishes these hypotheses.

2.3 Hypotheses about time allocation

H_0: Physicians maximize the sum of the expected net benefits of their time to patients. Our null hypothesis is that physicians maximize the expected net benefit of their time with patients, in other words, allocate their time efficiently. Maximizing total expected benefit over all patients subject to an hours-in-the-day constraint (or a value of an alternative activity) will lead to the rule that a physician will thus admit a new topic if and only if $\hat{V}_{t+1} \geq \lambda$.

This rule would require modification if after topic t +1, a patient might bring up topics with higher values; in other words, if the patient at least sometimes brings up topics of lower value ahead of topics with a higher value. While this seems very likely to occur, our rule remains correct if "reverse priorities" are used early in a visit during which the threat of termination is low. Physicians are aware of the "hand-on-the-doorknob" phenomenon where patients in a by-the-way fashion drop mention of a serious problem they may be having but for some reason have been reluctant to mention during the normal course of the visit.[3] Formally, our condition on admitting a new topic could be restated as saying a physician will admit a new topic if and only if there is some number of new topics to be admitted for which the average value of the topics exceeds λ.

H_A: A behavioral rule about visit length. Our alternative hypothesis is that physicians have a "target" amount of time that they desire to spend with each patient.[4] If patients are scheduled

[3] References to doorknob topic.

[4] Interestingly, these two rationing devices for a physician's time are analogous to the two ways in which managed care rationing have been modeled in the literature. Beginning with Keeler, Newhouse and Carter (Keeler, Carter and Newhouse 1998), papers including the literature on optimal risk adjustment (Glazer and McGuire 2000) use the shadow price approach analogous to the null hypothesis where physicians ration time to maximize patient net benefit. Pauly and Ramsey (Pauly and Ramsey 1999) is an example of a quantity rationing approach to managed care which conceives of the plan as setting quantity targets for treatment of a condition without regard for variation in the value of services to particular patients. This is analogous to our behavioral approach based on time targets per visit.

four per hour, for example, that target would be 15 minutes One way to model a "target" is to regard the shadow price of time to be zero up to the target and infinite after the target. More generally and more realistically, we could characterize the physician as being subject to a rapidly rising shadow price of time around the target. Three possible shadow price of time functions are depicted in Figure 1: the two extremes of a constant shadow price implied by H_0 and the literal target time shadow price corresponding to the step function, and third the rapidly rising shadow price around a target time. If we let τ be the time elapsed during a visit, the shadow price of time for a physician under H_A is $\lambda(\tau)$, with $\lambda' > 0$.

Testing H_0 versus H_A. Under H_A the physician admits a new topic if and only if $\hat{V}_{t+1} \geq \lambda(\tau)$. The difference between the rule for H_A and the rule for H_0 is the presence of elapsed time during the visit, τ, in the decision rule. H_0 implies an estimated coefficient of zero on τ in a model explaining whether a new topic is admitted, and H_A implies τ will be negatively related to the likelihood of admitting a new topic. In the empirical section of this paper we estimate a model of whether a physician admits a new topic and test for the effect of τ on this behavior.

2.4 Patient Waiting Time

In the model of efficient time allocation, the opportunity cost of spending more time with the current patient was represented as λ, essentially constant over the time associated with a typical visit. In this section we consider how a physician concerned about the costs imposed on patients waiting in the waiting room might alter the analysis. We argue that physician concern about patient waiting time is not a likely explanation for an observed sharply increasing subjective cost of time during the course of a visit.

Patients coming to a physician's office expect to wait. Some amount of patient waiting is optimal for the physician who would like to have the next patient ready as soon as she is ready for him. Around the optimal wait, there would thus be no subjective cost to the physician for spending more time with the current patient. Only when a waiting room "backs up" and the incoming patients waiting too long from the physician's point of view might there be an additional time-related factor to consider. If we assume that patients have a cost of time that the physician takes into account, even if not fully, the physician's subjective cost of time would go up in proportion to the number of patients backed up in the waiting room. During the course of a visit of average length one more patient shows up; if there is too much waiting go on from the physician's point of view, this will increase the patient-side cost of time by a factor of $(1 + N)/N$ where N is the number of patients already waiting. This is at most 2 assuming the physician wants at least one patient ready at all times. The physician's subjective cost of patient wait time is likely to be relatively small in relation to her valuation of the opportunity cost of her own time. A doubling of patient wait time cost over the course of the visit is therefore not likely to account for very large increases in subjective shadow prices over the course of a the few minutes between 10 and 20 during an encounter with a physician.

Although the subjective cost of patient wait time might not account for an increase in the physician's shadow price during a visit, the overall level of that shadow price may be affected by how far "behind" she is in her schedule. In this study, we do not know the time of day of the visits in question nor do we know where a physician stands in relation to her schedule in order to be able to investigate these effects. Our videotape data contain visits

during which the physician was and was not behind; the effect of time since visit start we study is the average over the course of all such visits.

3. Data

3.1 Physician and Patient Participants

We analyze videotapes that focused on elderly patient-physician communications based on a convenience sample of office-based physicians and their patients (Cook 2002). The aim of the original study collecting the data was to test the Assessment of Doctor-Elderly Patient Transactions (ADEPT) system and to examine the relationship between physician communication behavior and patient outcomes (Cook 2002). The medical practices included an academic medical group in the Southwest, a private managed care group in a Midwest suburb, and a number of fee-for-service solo practitioners in a Midwestern inner city. As part of the informed consent, physicians were told that the purpose of the study was to test the ADEPT system and to examine the relationship between physician communication behaviors and patient outcomes. Physicians who expressed an interest in participating were then contacted by the site program coordinator who described the study in detail and obtained written consent. Physicians and patients were informed that the videotapes would be used to study and improve patient-physician interaction, and that the videotapes would be archived for use by future researchers.

The recruitment effort resulted in a sample of 35 physicians, all of whom had completed their training at the time of the initial study. Patients had to be at least 65 years of age to be eligible for the original study, identify the participating physician as their usual source of care, and provide informed consent. Specifically, patients were identified from

their primary care physicians' patient panels provided by office managers of the participating clinics. When these patients came to the participating clinic for a visit, regardless of the nature of the visit (e.g., acute upper respiratory infection, or for routine checkup for diabetes or hypertension), they were invited to participate in the study. If they expressed willingness to participate, informed consent was obtained and their visits were taped. The visits were recorded between 1998 and 2000. The final sample contained 385 videotaped visits. Nineteen of the visits were multiple visits between a few patient-physician dyads. Sensitivity analyses excluding these visits obtained similar results as the full sample. We used the full sample in this paper.

Human subject protection protocols for the original study were approved by all relevant institutional review boards. The current paper conducts secondary analyses of the data to address a set of research questions that are different from the original study.

3.2 Data From Direct Observations

Video recordings of the visits allow us to examine not only the length of visits, but more importantly, the content of visits in terms of units of clinical decision making we refer to as "topics," operationalized as clinical issues raised by either participant. Our approach was in the spirit of the multidimensional interaction analysis (MDIA) system, which codes an interaction directly from an audiotape of the visit based on topics sequentially introduced by patient or physician. The MDIA lists 36 categories of topics (Charon, Greene et al. 1994). We partitioned a visit into similar topics, with some modification of the grouping of 36 MDIA topics into 21 topic groups for this study (Table 1). Coding of the videotaped visits mainly consisted of identifying topics that emerged, the time a topic was introduced, and the initiator of the topic. Details of the coding procedures have been reported elsewhere (Tai-

Seale, McGuire et al. 2007). The analysis file consists of 2,502 topics in 385 visits. We partition the visit into 4 time components during which a topic may be initiated: in the first 5 minutes since the beginning of the visit, between 5 and 10 minutes into the visit, between 10 and 15 minutes, and after 15 minutes into the visit. The effective length of the visit, i.e., the time the physician spent interacting with the patient face-to-face, was also recorded. That is, if a physician left the room to respond to a page or speak to a nurse, the time of the absence was subtracted from the total length of visit.

Direct observation of office visits using video data offers a number of advantages for our purposes. First, it does not rely on a report by either physicians or patients therefore it is not subject to recall bias, self-perception bias (Dunning, Heath et al. 2004), and reporting error (Stange, Zyzanski et al. 1998; Gottschalk and Flocke 2005). Second, they provide a comprehensive representation of the patient-physician encounter, unlike a chart review which can be influenced by physicians' charting patterns and their tendency to underreport delivery of some services or over-report other services (Stange, Zyzanski et al. 1998).

Examining topics as sequential discrete events unfolding over time enables us to test whether physicians hold a rising shadow price of time over the course of the visit. The transition of patient-physician interaction from having a low shadow price to a higher shadow price is illustrated by the following exchange in one visit. At the start of the visit, when asked how she was doing, this 77 year old woman responded that she had "mixed emotions." The physician returned to this phrase 5 minutes, 35 seconds into the visit with an open-ended question:

Physician: So, what's the mixed emotion about?

Patient: Well, I'm unsteady. I fall into things. I did this one other time, but it wasn't that bad. But it's gotten to the point that every day this happens. I can get up and turn into a chair.

Physician: You get dizzy when you turn?

Patient: Not necessarily dizzy; I'm just off balance.

Physician: Off balance. Why don't you stand with your back to the wall; let's see you walk here.

Patient: Ok.

Physician: I just want you to walk heel-to-toe over to me.

Patient: Ho, Ho, you've got to be kidding.

Physician: No, try again. Can't do that? You're doing pretty good.

The physician continued pursuing the topic of difficulties with keeping balance potentially associated with the side effects of psychotropic medications, for a total of 10.5 minutes (physician spoke for 7.1 minutes, patient spoke for 1.6 minutes) spent on this topic alone.[5]

Twelve minutes later, at 17:15, after the physician has reviewed the patient's medication with her, the physician is trying to wrap up the visit.

[5] In total, this visit contained six topics. Their contents and length of time (minutes) spent on them are: (1) anxiety over difficulties with balancing and memory loss potentially related to side effects of psychotropic medications, 10.53 minutes; (2) thyroid function tests, 0.82 minutes; (3) cholesterol and triglycerides test results, 1.25 minutes; (4) follow-up on blood pressure, 2.95 minutes; (5) review of medications, 1.03 minutes; and (6) chest pain and medication for controlling it, 1.12 minutes.

Physician: The girls are going to set up a follow-up appointment in two weeks and we will see how we're doing. You're going to stop the Lorazepam, stop Lorazepam,[6] take Vitamin E, water pill, …

Patient: [Raising her hand as though to signal she has something to say] Now, …

Physician: [Taking her hand, shaking it, and continues talking] … everything else stays the same, including the Wellbutrin and we're going to see you back in two weeks.

Patient: But now, you said on that Vitamin E, 1000 twice a day, 2000[7]?

Physician: Yes, ma'am.

Patient: Ok.

Physician: That's what the study states. It's written down here. Ok?

Patient: Yeah, sure.

Physician: [Moving to help patient down from exam table and starts walking towards the door] There you go. We'll try a little 'addition by subtraction' and hope that by stopping the Lorazepam that will stop your coordination difficulties and maybe the Wellbutrin we can continue.

Patient: You can talk to John[8] about that. I've gotten bad.

Physician: [Both now walking out door] Your memory or your coordination?

Patient: Both.

Physician: Well, we'll see; that's why we're bringing you back here.

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[6] Stopping Lorazepam (a Benzodiazepine drug) so suddenly without careful tapering could exacerbate anxiety.
[7] The current United States dietary guidelines do not recommend vitamin E supplementation; however, the guidelines do set an upper tolerable intake limit of up to 1,500 IU (international units) per day. There is report that use of high-dose vitamin E supplements, in excess of 400 IU, is associated with a higher overall risk of dying. (Miller, Pastor-Barriuso, Dalal, Riemersma, Appel and Guallar 2005)
[8] Pseudonym for patient's husband.

An economic interpretation of this interaction is that seventeen minutes into the visit, the shadow price of the physician's time was elevated. He ignored her raised hand, or more accurately, transformed it into a good-bye hand shake, and escorted her from the room. It seems likely that the patient had something she wanted to bring up, but the physician, at that point, was not prepared to hear it. During the same encounter, this physician is by turns patient and inquisitive (minute 5), and brisk and dismissive (minute 17).

3.3 Survey Data

Surveys of patients and physicians complement the video data in this study. Variables from the surveys were chosen for analysis based on research about how patient-physician interaction is influenced by patient health (Bertakis, Callahan et al. 1993), gender and race (Roter, Hall et al. 2002; Balsa, McGuire et al. 2005) education (Waitzkin 1985), and physician gender (Roter, Hall et al. 2002; Roter and Hall 2004)**.** Patient's health status was measured by normed SF-36 scores (Ware, Kosinski et al. 2000). The length of the patient-physician relationship was measured by the number of years the patient had seen the physician (Waitzkin 1985).

4. Specification and Estimation

Our unit of observation is the "topic," and we study the determinants of whether a given topic is the last one admitted by the physician. Our data contain multiple observations (i.e., topics) for each patient-physician dyad (visit). Table 1 provides descriptive information on the definition of topics, the number of observations in each of the twenty one topic categories, the percent contribution of each topic to total topics, the percentage that each

topic was the first topic of the visit, and the last topic of the visit. The most frequent topics are related to history, symptoms, and medical conditions (Topic 1, 24.66%) and they are most often the first topic of a visit (31.77%). Physical aches and pains (Topic 2) ranked second in being the first topic of a visit (13.54%). While Topic 1 was also the most common last topic of the visit (14.03%), the second most likely topic to be the last in the visit was discussion of medications (11.95%).

We conducted several logit analyses using a random effects model approach, where a patient-physician dyad random effect is included to account for the repeated measures of topics discussed during a visit. The basic model contained key explanatory variables for shadow price of time which are the time of initiation of the topic in a visit measured by four binary variables: initiation within 5 minutes of the beginning of the visit (serving as the control group), between 5-10 minutes, between 10-15 minutes, and after 15 minutes. A physician brings a visit to a close when the last topic has been discussed. Under the null hypothesis, the coefficients for the topic initiation time variables would be zero. Under the alternative hypothesis, the coefficients for the topic initiation time variables would increase with time.

As we discussed above around (1), our expression for the expected health value of admitting a new topic, the physician forms that expectation on the basis of what has happened up to that time in the visit and on the characteristics of the patient. We include in the model the number of topics that have occurred prior to the current topic (CT), and a binary variable on whether the current topic was initiated by the patient. We also account for the influence of the heterogeneity of interactional dynamics (e.g., content of discussion and extent of patient involvement) during the topic discussed to this point in the visit. We expect

that the nature of the current topic and prior topics play a role in physician's decision about how much new information is still potentially there after what has already been discussed. We further examine the effect of the nature of the discussion by including 20 binary variables on the nature of topics for which Topic 1 (history, symptoms, and medical conditions) serves as the comparison group.

In subsequent models, we add information about other topics discussed. The nature of prior topics could influence the physician's expectation about what could happen next if a new topic is admitted. For example, discussion on a prior topic could give the physician some information on patient's overall current health status hence enabling her to better gauge the costs and benefits of ending the visit on a particular topic. We first add information on the nature of the first topic in the visit. We next include information on the nature of the topic immediately prior to the current topic (CT-1) in the last model. We document and compare the odds ratios on the topic initiation time variables in each of these models.

We recognize that topic, particularly the last topic, might be endogenous, so we estimate some models without information about the last topic or any topic.

Additional explanatory variables control for the site of practice (the academic medical center versus managed care, or inner city). We also include patient's age, gender, education, perceived wealth, and general health status using SF36 (Ware et al. 1995). Physician's experience is controlled by the number of years in practice. We further control for physician's gender and specialty (family medicine=1, others=0), and the length the patient had seen the physician to account for the familiarity between the patient and physician. Analyses were performed in STATA, version 9 (Stata Corp, College Station, TX, 2005). The Hosmer-Lemeshow Chi-square test of goodness of fit suggests that the fit of the

model was good in the second and third models but poor in the basic model. We report the results from all three models in Table 3 and discuss them below. RZ says to explain better.

The main problem with our empirical strategy is that "time" may be correlated with unmeasured severity. This would be the case, for example, if patients prioritize the topics they wish to speak about and the most important ones are covered first. Our informal observation of the visits leads us to question whether patients regularly prioritize in the same way a physician would. An early topic may be introduced to establish rapport. A major topic could be introduced later when patients are ready to bring it up. We have seen one visit in which an extensive discussion about depression and suicide ideation (2nd topic) was carried out after an acute bronchitis (1st topic) was addressed. It was then followed by a brief discussion of osteoporosis (3rd and a far more minor topic given the circumstance) (Tai-Seale, McGuire et al. 2007). There are also folkloric cases involving the hand-on-the-door knob ploy: "by the way, doctor, my chest has been hurting lately." Patients grab extra time by saving the most severe issue for the last, when the doctor thought the visit was over.

Explain fixed effect models. Models of time instead of last topic. [not in this draft.]

We test for the presence of an upward sloping shadow price of time during the visit on an empirical basis. We estimate a series of sequential models including more and more of the X variables a physician would use to forecast the health value of allowing an additional topic. Adding these to our model does not affect the estimated effect of time, which is very powerful throughout. Were time a proxy for severity, adding direct measures of severity should diminish the time effect. Such a pattern does not appear in our data.

4. Results

We intend to add some descriptive information about topics, including about the order of topics in terms of a measure of priority. [Not in this draft.]

Figure 2 displays the probability for a topic to be the last topic of a visit across the three types of practice settings. The pattern suggests a low probability in the beginning of the visit followed by a much higher probability after a time which can be viewed as consistent with the "target" time. The target time seems to vary across the practice types. The target in Academic Medical Center might have been near 12 minutes into the visit. The targets in the managed care group and the inner city practices seem quite a bit shorter though they are harder to pin-point. Table 2 provides the descriptive statistics on the key right-hand-side variables.

Table 3 displays the results of the logit analysis with odds ratios. The first column shows odds ratios of variables in the basic model. Topic initiation time played an increasingly larger and statistically significant role for topics initiated in each consecutive blocks of time: between 5 and 10 minutes (OR=4.011, $p<0.01$), between 10 and 15 minutes (OR=5.507, $p<0.01$), and later than 15 minutes (OR=6.402, $p<0.01$). Patient initiation of the topic (OR=1.321, $p<0.05$) and number of the topics before the current topic (OR=1.208, $p<0.01$) significantly increase the odds of a topic being the last of the visit. Out of the 21 types of topics, twelve of them are more likely to be the last topic of the visit than topic 1 which pertains to history, symptoms, and medical conditions. Specifically, in the order of magnitude, topic 21: small talk, intellectual exchange, other (OR=5.532, $p<0.01$); topic 17: depression (OR=5.511, $p<0.01$); topic 11: living will, death, bereavement (OR=3.689, $p<0.05$); topic 13: health care system, money and benefit (OR=3.503, $p<0.01$); topic 15, activity of daily living, age (OR=3.365, $p<0.01$); topic 19, physician's personal life

(OR=2.928, p<0.05); topic 9: prevention (OR=2.665, p<0.01); topic 8: medications (OR=2.453, p<0.01); topic 14, work and leisure activities, religion (OR= 2.165, p<0.01); topic 12, care-giver, home, significant others (OR=2.138, p<0.05); topic 6, appointment, referrals (OR=2.012, p<0.05); and topic 7, findings from exams and test results (OR=1.764, p<0.05).

The second model builds upon the basic model by adding the nature of the first topic of the visit. Results from the second model show that topic initiation time played an increasingly larger and statistically significant role for topics initiated in each consecutive blocks of time: between 5 and 10 minutes (OR=4.556, p<0.01), between 10 and 15 minutes (OR=5.840, p<0.01), and later than 15 minutes (OR=7.860, p<0.01). Patient initiation of the topic (OR=1.456, p<0.01) and number of the topics before the current topic (OR=1.232, p<0.01) are also significant factors. Regarding the effects of the nature of the current topic, in the order of magnitude of the odds ratios, all of the statistically significant factors have odds ratios that are greater than 1. In this model, depression (topic 17) has the highest odds ratio for being the last topic (OR=5.021, p<0.05), followed by small talk, intellectual exchange, and other (topic 21, OR=4.843, p<0.01), living will, death, and bereavement (topic 11, OR=3.780, p<0.05), health care system, money, and benefit (topic 13, OR=3.618, p<0.01), and physician's personal life (topic 19, OR=3.170, p<0.05). why do some things come early and some late? A few variables for the nature of the first topic also have significant effects on the odds of the current topic being the last of the visit. If the first topic was about test and diagnostic procedure, the OR for the current topic to be the last increases more than 3-fold (OR=3.577, p<0.01). If the first topic small talk (topic 21), however, the OR for the current topic to be the last is reduced by 48% (OR=0.516, p<0.01). explain this.

Similarly, if they started the visit by talking about work and leisure activities or religion (topic 14) the current topic is 51% ($p<0.01$) less likely to be the last topic.

The last model accounts for the nature of the topic that was discussed prior to the current topic (CT-1). The remarkably similar results with respect to the effects of the initiation time which suggest that the effects of these factors are fairly robust. The magnitudes of these effects increased as more information about prior topics are added, suggesting the impact of information on physician's decision making. Specifically, the OR for initiation between 5 and 10 minutes is 3.968 ($p<0.01$), between 10 and 15 minutes is 5.437 ($p<0.01$), and later than 15 minutes is 7.214 ($p<0.01$). It is worthwhile to note that the effects of practice setting were statistically non-significant, as were the effects of the usual socio-demographic characteristics of the patients and physicians.

5. Discussion

Link to medical home, concierge medicine, and behavioral approaches in health economics.

Primary care doctors switching their practice to "concierge medicine" -- where doctors' income includes a monthly enrollment fee and they serve a limited case load -- cite time pressure per patient in routine primary care as a major reason they make the shift (Forester 2008). Waiting times, accessibility, services provided, and attention from the staff and the physician are all elements of health care that patients value and are able to directly

observe (Scott, 2000). Informal reports on concierge practice forms indicate high levels of patient satisfaction (Kirkpatrick, 2002).

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Table 1. Topic Definition, Numbers of Observation, Frequency of Being the First Topic of the Visit, and Frequency of Being the Last Topic of the Visit

Topic #	Definition	N	% All topic	% First topic	% Last topic
1	History, symptoms, and medical conditions	617	24.66	31.77	14.03
2	Physical aches and pain	284	11.35	13.54	9.09
3	Gynecological and genitourinary problems	35	1.40	1.56	0.52
4	Prognosis, health status	38	1.52	2.86	0.26
5	Test and diagnostic procedure: refer to specific test	93	3.72	1.04	4.68
6	Appointment, referral	88	3.52	4.17	3.9
7	Findings from exam, test results	209	8.35	7.55	8.05
8	Medications	263	10.51	4.17	11.95
9	Preventive medical measures	133	5.32	1.04	7.79
10	Personal habits	177	7.07	2.08	5.19
11	Living will, death, bereavement	23	0.92	0.52	1.82
12	Care-giver, physical home, environment, family and significant others	90	3.60	4.17	5.19
13	Health care system, money and benefits	94	3.76	6.77	5.97
14	Intellectual exchange, small talk	112	4.48	6.51	5.45
15	Work and leisure activities, religion	64	2.56	2.86	4.16
16	Activity of daily living, age	28	1.12	1.3	1.56
17	Psychological pain, suffering, concerns regarding patient's own physical conditions	17	0.68	1.3	1.3
18	Depression: not limited to clinically diagnosed depression	37	1.48	1.3	1.82
19	General anxiety and worries, emotional distress, or other mood disorders	35	1.40	2.08	1.56
20	Physician personal life	40	1.60	2.6	2.6
21	Physician -patient relationship	25	1.00	0.78	3.12
	Total	2502	100		

Adopted from the multidimensional interaction analysis (MDIA) system (Charon, Greene et al. 1994)

Figure 1. Graphic Depiction of the Null and Alternative Hypotheses

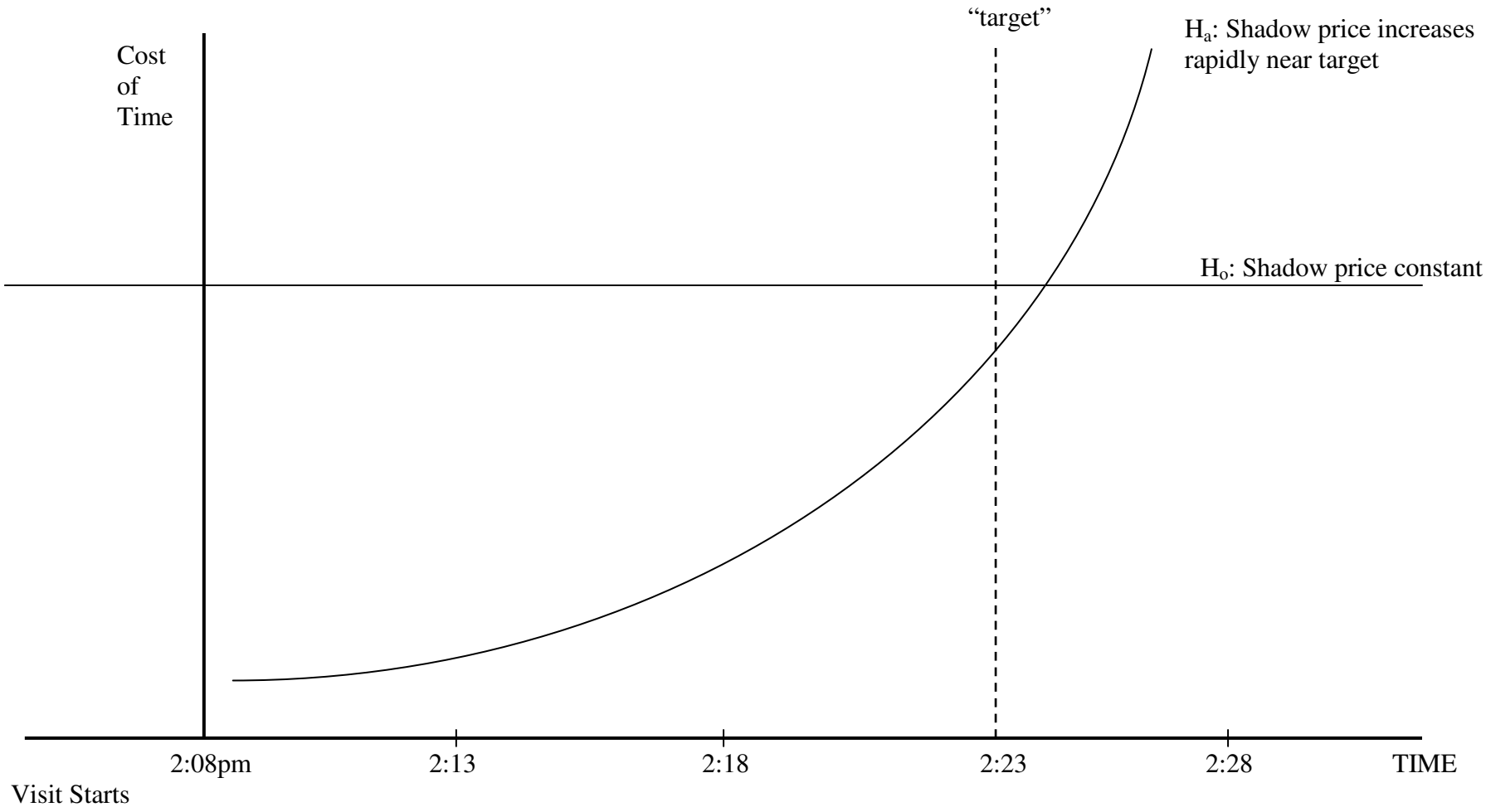
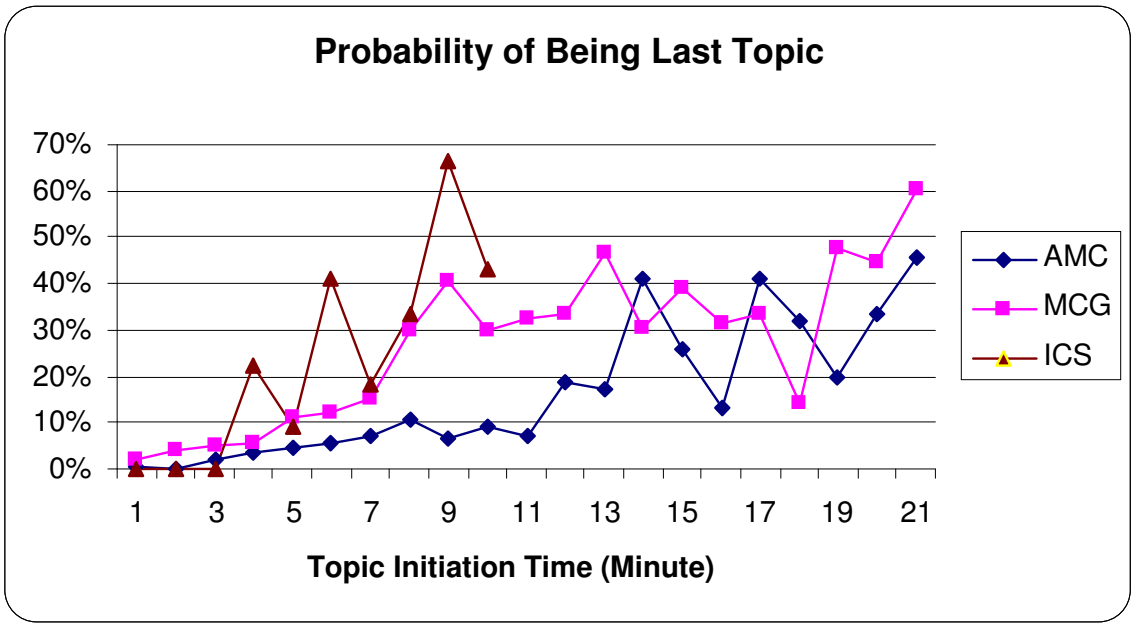


Figure 2. Probability of A Topic to be the Last Topic across Practice Settings



AMC: Academic medical center, MCG: Managed care group, ICS: inner city fee-for-service solo practitioners.

Note: due to the small number of observations for visits lasting beyond 10 minutes at the Inner City Solo (ICS) practices, we aggregated the data to 10 minutes or more.

Table 2. Descriptive Statistics on Right-Hand-Side Variables

Variable	Mean	S.D.
Visit length (in minutes)	19.19	8.92
Number of topics before current topic	3.32	2.68
Patient age	74.51	6.56
Patient female (1 if female)	.67	
Patient had more than enough income (1 if more than enough)	.43	
Patient had more than high school education (1 if more than high school)	.44	
Patient SF36 general health score	44.25	5.83
Physician years in practice	20.91	13.19
Physician in family medicine (1 if in family medicine)	.24	
Physician female (1 if female)	.23	
Physician in Academic Medical Center (AMC) (1 if in AMC)	.36	
Physician in managed care group (MCG) (1 if in MCG)	.58	
Physician in Inner City FFS Solo (ICS) (1 if in ICS)	.06	
Years of patient-physician relationship	6.12	7.54
Topic initiated less than 5 minutes into visit (1 if <5 min)	.51	
Topic initiated between 5 and 10 minutes after visit began (1 if so)	.25	
Topic initiated between 10~15 minutes after visit began (1 if so)	.12	
Topic initiated after 15 minutes into visit (1 if so)	.12	
Patient initiated topic (1 if patient initiated topic)	.44	

Table 3. Logit Analyses: Odds Ratios of a Topic Being the Last Topic of the Visit

Variable		Basic model	Adding 1st topic	Adding CT-1 topic
Topic initiation time▪	Between 5 and 10 minutes	4.011 **	4.556 **	3.968 **
	Between 10 and 15 minutes	5.507 **	5.840 **	5.437 **
	Later than 15 minutes	6.402 **	7.860 **	7.214 **
Initiator	Patient initiated topic	1.321 *	1.456 **	1.442 **
Learning	Number of topics before current topic	1.208 **	1.232 **	1.216 **
Nature of current Topic (CT)◊	Topic 2: Physical ache and pain	1.439	1.448	1.514
	Topic 3: Gynecological and genitourinary	0.421	0.528	0.482
	Topic 4: Prognosis, health status	0.370	0.304	0.291
	Topic 5: Test and diagnostic procedure	1.975	2.289 *	2.446 *
	Topic 6: Appointment, referrals	2.012 *	1.799	2.014
	Topic 7: Findings from exam, test results	1.764 *	1.730 *	1.808 *
	Topic 8: Medications	2.453 **	2.559 **	2.636 **
	Topic 9: Prevention	2.665 **	2.506 **	2.689 **
	Topic 10: Personal habits	0.829	0.913	0.971
	Topic 11: Living will, death, bereavement	3.689 *	3.780 *	3.541 *
	Topic 12: Care-giver, home, significant others	2.138 *	1.944 *	2.135 *
	Topic 13: Health care system, money and benefit	3.503 **	3.618 **	3.711 **
	Topic 14: Work and leisure activities, religion	2.165 **	2.571 **	2.759 **
	Topic 15: Activity of daily living, age	3.365 **	2.917 **	2.772 **
	Topic 16: Psychological pain, suffering, concerns	2.962	2.025	2.047
	Topic 17: Depression	5.511 **	5.021 *	5.924 *
	Topic 18: General anxieties and worries	1.786	2.467	2.757 *
	Topic 19: Physician personal life	2.928 *	3.170 *	3.122 *
	Topic 20: Physician-patient relationship	1.764	1.749	1.654
	Topic 21: Small talk, intellectual exchange, other	5.532 **	4.843 **	5.082 **
Nature Of first topic of visit (FT) ◊	Topic 2: Physical ache and pain		0.680	0.681
	Topic 3: Gynecological and genitourinary		0.455	0.450
	Topic 4: Prognosis, health status		0.856	0.825
	Topic 5: Test and diagnostic procedure		3.577 **	4.810 **
	Topic 6: Appointment, referrals		0.973	1.079

	Topic 7: Findings from exam, test results		0.725		0.706		
	Topic 8: Medications		0.569		0.595		
	Topic 9: Prevention		0.279		0.279		
	Topic 10: Personal habits		0.258	**	0.264	**	
	Topic 11: Living will, death, bereavement		0.334	**	0.310	**	
	Topic 12: Care-giver, home ,significant others		0.441	*	0.435	*	
	Topic 13: Health care system, money and benefit		0.477	**	0.544	*	
	Topic 14: Work and leisure activities, religion		0.491	**	0.520	*	
	Topic 15: Activity of daily living, age		0.823		0.843		
	Topic 16: Psychological pain, suffering, concerns		0.687		0.675		
	Topic 17: Depression		1.477		1.561		
	Topic 18: General anxieties and worries		0.718		0.730		
	Topic 19: Physician personal life		0.462	**	0.517	*	
	Topic 20: Physician-patient relationship		0.372	**	0.385	**	
	Topic 21: Small talk, intellectual exchange, other		0.516	**	0.608	*	
Nature of topic imme-diately prior to the current topic (CT-1) ◊	Topic 2: Physical ache and pain				0.998		
	Topic 3: Gynecological and genitourinary				0.715		
	Topic 4: Prognosis, health status				0.931		
	Topic 5: Test and diagnostic procedure				1.180		
	Topic 6: Appointment, referrals				0.361	*	
	Topic 7: Findings from exam, test results				1.523		
	Topic 8: Medications				0.860		
	Topic 9: Prevention				1.557		
	Topic 10: Personal habits				0.958		
	Topic 11: Living will, death, bereavement				0.385		
	Topic 12: Care-giver, home, significant others				0.731		
	Topic 13: Health care system, money and benefit				0.735		
	Topic 14: Work and leisure activities, religion				1.368		
	Topic 15: Activity of daily living, age				2.082		
	Topic 16: Psychological pain, suffering, concerns				1.100		
	Topic 17: Depression				2.047		

	Topic 18: General anxieties and worries			0.833
	Topic 19: Physician personal life			0.414
	Topic 20: Physician-patient relationship			2.879
	Topic 21: Small talk, intellectual exchange, other			2.615

Note: Controlled for practice setting (managed care group, inner city FFS solo vs. academic medical center), patient's age, gender, perceived income, education, SF36 general health, physician's gender, in family medicine vs. others, years in practice, and the years of patient-physician relationship. None of these effects are statistically significant. $^{\blacksquare}$: topics initiated within the first 5 minutes of the visit are the reference group; $^{\lozenge}$: topic 1, history, symptoms, and medical conditions are the omitted group.

Table 4. Family Physicians' Coding Patterns

CPT code	Brief Description[9]	Face-to-Face Time (Minutes)	# of Times Billed to CMS	% of Total
99211	Level 1, Minimal Problem, With or Without Physician	5	1,414,602	3.73
99212	Level 2, Problem Focused History & Examination; Straightforward	10	4,516,740	11.92
99213	Level 3, Expanded Problem Focused History & Examination; Low Complexity Medical Decision Making	15	23,462,900	61.93
99214	Level 4, Detailed History & Examination; Moderate Complexity Medical Decision Making	25	7,598,084	20.05
99215	Level 5, Comprehensive History & Examination; High Complexity Medical Decision Making	40	895,492	2.36
TOTAL			37,887,818	100.00

Source: Centers for Medicare & Medicaid Services. National coding distribution for family physicians, 2002

[9] MAG Mutual Healthcare Solutions, Inc. 2004.