

# **Personal Statement**

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## **I. RESEARCH**

My research uses state-of-the-art theoretical and empirical methods to study how individuals, firms, and regulators interact in health care markets. Since I joined Wharton as an Assistant Professor in the Health Care Management Department in 2004, I have been intrigued by the economics of increasingly important but little studied health care industries such as emergency medical services, home health services, specialty hospitals, and ambulatory surgery centers. I have found the careful analysis of these industries very rewarding, in that it has yielded insights into the complex organization of health care delivery and also into deeper questions of firm behavior, regulatory design, and human capital formation.

In this endeavor, I offer novel theoretical contributions that feed back into empirical analysis. Since I am committed to theory-driven empirical research, it is important that my models suggest what evidence to look for, separate the endogenous from the exogenous variables, and highlight the hypotheses to be tested. I have been able to draw on large and detailed datasets that had not been used by academic economists to date. Analyzing these data has allowed me to shed new light on persistent questions in labor economics, industrial organization, and public finance. For instance, why do for-profit and nonprofit hospitals co-exists in the same markets? Does competition increase quality? Does shift structure affect performance? Do hospitals cross-subsidize unprofitable services? Or why does organizational knowledge depreciate? In other cases, I study new phenomena in health care delivery by using rigorous economic analysis. For instance, what explains privatization of emergency medical services? Why did specialization in hospital medicine emerge? Or what are the consequences of physicians' division of labor across outpatient facilities? My research encompasses all tiers along the health care continuum (pre-hospital care, outpatient and inpatient care, and post-acute care) as well as cross-tier studies on integration, ownership structure, and coordination. In this regard, I have helped open new research areas as well offered new insights into existing ones.

My research also contributes to the field of health economics and to economics more broadly in a number of ways: I have adapted a number of central theories in labor economics, industrial organization, and public finance to fit the complex regulatory environment of health care markets. In doing so, I have advanced knowledge in ways that generalize beyond health care markets. For instance, my research on the determinants of organizational forgetting, advertising under regulatory uncertainty, and the role of antitrust in achieving social goals, provide valuable insights into non-health care markets as well.

Finally, for the past seven years, I have been studying how patients, providers, and insurers respond to changes in regulation and payment mechanisms, by looking across settings and actors and emphasizing the role of linkages in the provision of health care. In this regard, my research is germane to the ongoing Health Care Reform debate, as it pertains to both clinical and financial integration of various segments of the health care continuum, as exemplified by the concept of Accountable Care Organizations.

My work has been very well-received to date. Since coming to Wharton, I have published 22 peer-reviewed papers, 4 book chapters and entries, and I have 8 papers currently under review (4 of which have been invited for revisions). These articles have appeared in top economics and health economics journals, including the *American Economic Journal–Economic Policy*, *American Economic Journal–Microeconomics*, *American Economic Journal–Applied Economics*, *The Journal of Health Economics*, *The Journal of Human Capital*, *The Journal of Legal Studies*, *Health Economics*, *Health Services Research*, and others. A central aim of my research is to understand and quantify the extent to which incentives embedded in reimbursement and regulatory systems affect the functioning of health care markets. As a result, my approach and findings have the potential for informing policy. To achieve this ancillary goal, I have sought to publish not only in economics journals, but also in leading policy journals in health services research. My contribution to the field has been recognized by the National Bureau of Economic Research which elected me a Faculty Research Fellow in 2010.

My goal in this Personal Statement is to describe the three main study streams that unify my research agenda: **1)** Hospital behavior and the functioning of health care markets; **2)** Human capital and the organization of health care delivery; and **3)** The role of regulation in shaping health care delivery. My contributions highlight novel methods, perspectives and findings that are not only important for understanding health care markets functioning, but are also relevant outside the field of health

economics. These papers also highlight my pursuit of detailed datasets, uniquely suited for addressing my research questions and testing the predictions of my models. I conclude the research portion of this statement by briefly describing my current research projects and outlining the future directions I plan to take my research. Next I describe my specific research contributions in detail.

## **I.1. HOSPITAL BEHAVIOR AND THE FUNCTIONING OF HEALTH CARE MARKETS**

This section addresses a fundamental question in industrial organization: how does the behavior of hospitals influence the organization and performance of markets? I begin by discussing my work on the boundaries of the firm, which analyzes hospitals' cross-subsidization and vertical integration decisions, and then describe my work on hospitals' ownership choice.

### ***Hospitals' cross-subsidization decisions***

With more than 46 million Americans lacking health insurance, and many more underinsured, hospitals nationwide face financial challenges that detract from their ability to provide emergency and regular care. Therefore a fundamental decision made by hospitals is the extent to which they rely on internal financing mechanisms for achieving organizational and social goals, including the provision of unprofitable care. Cross-subsidies are often considered the principal mechanism through which hospitals provide unprofitable care.<sup>1</sup> However, this practice is not transparent from an accounting perspective, and therefore direct observation of this behavior and its extent is not possible. Evidence of cross-subsidization in the hospital industry remains largely anecdotal and its extent is not well documented. My study "**Do Hospitals Cross-Subsidize?**"<sup>2</sup> is the first to present systematic evidence of cross-subsidization by exploiting entry by cardiac specialty hospitals as an exogenous shock to incumbent hospitals' profitability, and in turn, to their ability to cross-subsidize unprofitable services. Using patient-level data from general short-term hospitals in Arizona and Colorado before and after entry, we find that the hospitals most exposed to entry reduced their provision of services considered to be unprofitable (psychiatric, substance-abuse, and trauma care) and expanded their admissions for neurosurgery, a highly profitable service.

The difficulty in identifying hospital cross-subsidization practices stems from two sources. First, one must identify a shock to the source of the subsidies that is plausibly independent of the unprofitable

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<sup>1</sup> Federal regulations also play a role in the persistence of profitable and unprofitable services. For example, the Emergency Medical Treatment and Active Labor Act (EMTALA) limits the ability of a hospital to discriminate among emergency patients based on ability to pay.

<sup>2</sup> David, Guy, Richard Lindrooth, Lorens Helmchen and Lawton R. Burns. 2011. "Do Hospitals Cross Subsidize?" NBER Working Paper #17300.

activities that are being subsidized. Second, one must credibly identify the reaction to the shock in the data. Since entry by single-specialty competitors raises the bargaining power of physicians providing contested services (e.g. these groups may credibly threaten the incumbent hospitals with defecting to the entering specialty facilities), its deterrence is likely to claim resources from incumbent hospitals. A failure to distinguish between markets that are not entry targets and those that are, may mask the true effect of entry on the provision of uncontested services by incumbent hospitals.<sup>3</sup>

Beyond the importance of our findings, an essential contribution of the paper stems from jointly addressing the two issues above. First, single-specialty entrants are unlikely to consider explicitly the incumbents' provision of uncontested and unprofitable services in particular. Furthermore, unprofitable services offered by incumbent hospitals will be affected if they rely financially on the profitable services contested by the entrant.<sup>4</sup> To address the second issue, we directly measure the degree to which an incumbent hospital's services are substitutes for the entrant's. This enables us to exploit within-market variation in the exposure to entry and thereby increase the efficiency of our estimates. Specifically, we construct a measure of exposure to entry that takes into account the degree of service overlap and the physical location of the incumbent hospital vis-à-vis the entrant.

Our findings corroborate the conjecture that hospitals adjust downward their offerings of unprofitable care in response to an adverse shock to services considered to be profitable enough to encourage entry by single-specialty hospitals. Our results also suggest that a comprehensive welfare analysis of entry by single-specialty hospitals should include not only its effects on contested services but also consider its market-wide effects on uncontested services which rely on general hospitals' cross-subsidization efforts.

### ***Hospitals' vertical integration decisions***

Little is known about how hospitals determine the scope of services along the care continuum. In particular, I study the impetus for vertical integration between hospitals and post-acute entities and its effect on the timing of patient transitions across settings.

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<sup>3</sup> The differential reactions to entry attempts by specialty providers are discussed in Burns, Lawton, Guy David and Lorens Helmchen. 2011. "**Strategic Response by Providers to Specialty Hospitals, Ambulatory Surgery Centers, and Retail Clinics.**" *Population Health Management*, Vol. 14(2) pp. 69-77, which relies on interviews with both incumbents and entrants in a field study of several urban markets.

<sup>4</sup> Since this notion does not eliminate potential biases to our results, we include an Instrumental Variable that measures the cross-sectional pre-entry susceptibility of a hospital to entry and the attractiveness of each hospital's catchment area to a potential specialty entrant.

Vertical integration of hospitals and post-acute care entities (e.g., skilled nursing facilities, rehabilitation centers, and home health agencies) increased dramatically during the 1990s, with approximately three-quarters of hospitals integrated with some post-acute care entity. To better understand this fundamental “boundaries of the firm” question, “**Integration and Task Allocation: Evidence from Patient Care**”<sup>5</sup> introduces a theoretical framework, in which misallocation of tasks is the primary source of transaction costs. Put differently, non-cooperative equilibria under market exchange leads to a distortion in the allocation of tasks across sites. In the context of our application, vertical integration allows hospitals to shift patient recovery tasks downstream to lower-cost delivery entities (e.g. skilled nursing facilities or home health agencies) by discharging patients earlier. Since integrated hospitals fully control the post-acute tier, they can ensure that patients discharged earlier and in poorer health receive greater post-hospitalization service intensity. To test our model’s predictions, we constructed detailed data from a variety of sources on over 860,000 patient transitions from hospitals to either home health or skilled nursing care,. We find that vertically integrated hospitals tend to discharge patients to their own home health agencies sooner, with poorer health at the time of transition out of the hospital, yet with similar overall health outcomes. The evidence suggests that by improving the allocation of tasks to sites of care, vertical integration solves coordination problems that arise in market exchange. This is especially important in markets characterized by regulatory restrictions on side-payments, which represent a strong form of contractual incompleteness in health care markets.

### ***Hospitals’ ownership choice***

Private hospitals in the United States can organize as either nonprofit or for-profit institutions. Hospitals of different ownership type are subject to different regulatory rules. In particular, nonprofit hospitals are eligible for exemptions from property, sales, and income taxes. According to the American Hospital Association, 58% of all 5,008 community hospitals were nonprofit (in 2010). These hospitals account for approximately 70% of inpatient beds. The reasons for the dominance of nonprofit hospitals, and more fundamentally, their objectives are not well understood and present an important challenge for the economics discipline as well as for public policy.

Much of the literature to date either advances theories of nonprofit behavior or provides empirical studies questioning whether and to what extent nonprofit and for-profit hospitals differ on various

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<sup>5</sup> David, Guy, Evan Rawley and Daniel Polsky. 2011. “Integration and Task Allocation: Evidence from Patient Care.” NBER Working Paper #17419 (and Under Revision for *Journal of Economics and Management Strategy*).

dimensions. By and large, nonprofit theories suggest that differences in behavior result from differences in objectives, implying that conventional neoclassical models of firms are not appropriate. On the other hand, the bulk of empirical studies to date have detected few or no behavioral differences between the two types of hospitals. My work entitled “**Theories of Firm Behavior in the Nonprofit Sector: A Synthesis and Empirical Evaluation**”<sup>6</sup> synthesizes a number of the dominant theories of nonprofit firms into a common framework. We show that existing theories generate different predictions for nonprofit behavior with respect to a common set of observable outcomes and demonstrate how empirical work can determine which theory best describes nonprofit behavior.

One such theory suggests that the nonprofit status serves as a signal for quality. In “**Does Nonprofit Status Signal Quality?**”<sup>7</sup> we offer a simple empirical test of this theory. The idea is that if nonprofit status signals quality, nonprofit firms would want to indicate their status in their advertising. To evaluate this idea, we conducted a survey of over 2,800 firms in the hospital, nursing home, or child-care industries in order to determine whether nonprofit firms communicate their status to consumers on their websites or yellow pages listings. We find little support for the hypothesis that nonprofit status is a signal of quality, as fewer than 7.5 percent of nonprofit firms signal their status in yellow pages listings and only 25 percent do so on their home pages.

While my research speaks to both the role of nonprofit objectives and the similarity between the two ownership types, my main focus has been on an issue receiving far less attention to date: why do for-profit and nonprofit hospitals coexist in the same markets?

Despite the fact that nonprofit market share is persistent, my study “**Trends in Hospital Ownership Type and Capacity: A Decomposition Analysis**”<sup>8</sup> is the first to draw attention to the growing similarity in capacity across the two ownership types. In 1960, nonprofit hospitals maintained, on average, more than three times as many beds per hospital as their for-profit counterparts, yet, following a monotonic decline in relative size, by 2000, the average nonprofit hospital was only 32%

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<sup>6</sup> Malani, Anup, Tomas Philipson and Guy David. 2003. “Theories of Firm Behavior in the Non-Profit Sector: A Synthesis and Empirical Evaluation” in *The Governance of Not-for-Profit Firms*, Edward L. Glaeser, Editor, National Bureau of Economic Research, pp. 181–216.

<sup>7</sup> Malani, Anup and Guy David. 2008. “Does Non-Profit Status Signal Quality?” *Journal of Legal Studies*, Vol. 37 (2) Part 1, pp. 551-576.

<sup>8</sup> David, Guy. 2010. “Trends in Hospital Ownership Type and Capacity: A Decomposition Analysis.” *Nonprofit and Voluntary Sector Quarterly*, Vol. 39(2), pp. 356-370.

larger than the typical for-profit hospital. The study also shows that this convergence in capacity is replicated by the growing similarity between nonprofit and for-profit hospitals in the number of admissions and patients' lengths of stay. Furthermore, we show that this convergence was driven primarily by entry, exit, and ownership switches, rather than expansions or downsizing of existing hospitals. My study "**The convergence between for-profit and nonprofit hospitals in the United States**"<sup>9</sup> proposes a novel model of the U.S. hospital industry in which firms, in effect, choose their ownership type and, hence, the regulatory and tax regimes under which they function. As a thought experiment, firms are assumed to have identical objectives but differ in their ability to benefit from a given ownership form. Changes in the economic environment alter firms' incentives to maintain a given ownership type and, in turn, induces firms to modify their capacity and encourages some firms to switch ownership type. Analysis of hospital level data at the state and Metropolitan Statistical Area (MSA) levels indicates that the declining presence of government hospitals, population growth, suburbanization, and increasing government intervention in the healthcare market accounts for much of the convergence in size. The results suggest that the convergence in size is consistent with changes in regulatory, tax and demographic factors that affect choice of hospital ownership and capacity, rather than differences in organizational objectives.

The body of research discussed in this section, which studies hospitals' ownership, scope, and internal financing choices, provides important insight into health policy. By combining theory and empirical investigation, this research suggests that legislation designed to achieve a variety of social goals influences the fundamental way in which hospitals organize and operate. More concretely, my research provides systematic evidence of hospital cross-subsidization, yet cautions that cross-subsidies are most likely an undesirable way to finance indigent care. Important for the design of tax policy, my research provides evidence of growing similarity between for-profit and nonprofit hospitals as well as highlights its determinants. In addition, my research discusses why government reimbursement and regulation is a potentially important facilitator of vertical integration in health care markets. These contributions add to our understanding of health care markets functioning and are of particular interest to policymakers and health care business leaders looking to reform the way health care is financed and organized in order to improve the performance of health care delivery in the U.S.

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<sup>9</sup> David, Guy. 2009. "The Convergence between Nonprofit and For-Profit Hospitals in the United States." *International Journal of Health Care Finance and Economics*, Vol. 9(4), pp. 403-428.

## I.2. HUMAN CAPITAL AND THE ORGANIZATION OF HEALTH CARE DELIVERY

My second stream of research analyzes the role of human capital in creating different institutional and organizational phenomena in the health care sector. Physicians' decisions such as choosing the appropriate setting for surgery, specializing along the care continuum, or adopting a new technology, shape the way in which health care is organized and delivered. In one set of papers I investigate the role of division of labor across sites of care on both individual and organizational behavior and study the determinants of specialization in hospital medicine. In a second set I explore the extent of human capital accumulation and depreciation in various organizational settings.

### *Division of labor across sites of care*

In the context of outpatient procedural care, the emergence of freestanding ambulatory surgery centers (ASCs) as alternatives to hospital-based outpatient departments (HOPDs) creates a unique opportunity to study physicians' division of labor across sites of care. In particular, little is known about the ability of incentives to influence decisions by physicians regarding choices of settings for care delivery. My work entitled "**Physician division of labor and patient selection for outpatient procedures**"<sup>10</sup> advances a model where physicians' division of labor between ASCs and HOPDs affects the medical complexity of patients treated in low-acuity settings (i.e. ASCs). Analyses of outpatient surgical procedure data show that physicians working exclusively in low-acuity settings (i.e. ASCs) treat patients of significantly higher medical complexity than do physicians who also practice in higher-acuity settings (i.e. HOPDs). However, this discrepancy shrinks with the level of procedural risk and with a greater distance between ASCs and acute care hospitals.<sup>11</sup>

Our results are consistent with the notion that physicians working exclusively in ASCs must out-refer patients deemed to have elevated surgical risk, while physicians with a split practice can self-refer these patients. This element of division of labor creates financial incentives that seem to encourage physicians working exclusively in ASCs to treat riskier patients rather than referring out, and in turn expose those patients to greater surgical risk by treating them in an ASC.

These findings are important because the growth of ASCs as a setting for care in the United States has the potential of raising unique safety concerns. In contrast to HOPDs, ASCs offer care at varying

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<sup>10</sup> David, Guy and Mark Neuman. 2011. "Physician Division of Labor and Patient Selection for Outpatient Procedures." *Journal of Health Economics*. Vol. 30(2), pp. 381-391.

<sup>11</sup> Our results are robust to using negative binomial models, zero-inflated models, instrumental variable analyses treating physician splitting status as endogenous and a matching strategy to balance our sample across high and low surgical risk patients.

distances from hospital with emergency capabilities and are ill-equipped to treat serious complications. My study “**Changing Access to Emergency Care for Patients Undergoing Outpatient Procedures at Ambulatory Surgery Centers: Evidence from Florida**”<sup>12</sup> describes changes over time in the accessibility to outpatient procedural services, by examining 4.3 million discharges between 2005 and 2007 for seven outpatient procedures frequently performed at ASCs and HOPDs. We find a 12.4% increase in the distance between patients (treated in either setting) and emergency departments. This increase in distance resulted from both an increase in the share of procedures performed at ASCs and an increase in the distance between new ASCs and emergency departments.

### *Division of labor along the care continuum (Hospitalists)*

A related line of research focuses on physician specialization; here I study the emergence, growth and benefits of hospitalists in the U.S. Hospitalists are physicians whose primary professional focus is the general medical care of hospitalized patients and who provide continuity of hospital care from admission to discharge. Whereas existing medical specialties are largely defined by disease, organ, patient age, or patient gender, hospitalists are defined by the setting where they provide care – the hospital. Hospitalists in the U.S. were first introduced in the mid-1990s. By 2010, 30,000 hospitalists cared for more than a third of all hospitalized patients and practice in nearly all large hospitals and half of all community hospitals. The rapid diffusion of the hospitalist model of medical care provision represents a substantial and large-scale change in the way health care is delivered in the U.S., and allows us to identify the determinants of specialization in medicine.

Delegation of the responsibility for hospitalized patients to hospitalists represents a shift from the traditional model where primary care physicians supervise inpatient care. In essence, hospitalists trade off better coordination of care *within* the hospital, by ensuring continuity of care from admission to discharge, against potentially worse coordination of care *between* the referring physician’s office and the hospital. My paper “**The Role of Task Adhesion in Limiting Specialization along the Medical Care Continuum**”<sup>13</sup> represents the first attempt to characterize this trade-off within a rigorous economic model of physician decision-making and to isolate its principal determinants. Specifically, we develop a model of specialization under vertical restraints,

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<sup>12</sup> Neuman, Mark, Guy David, Jeffrey Silber, Sanford Schwartz and Lee Fleisher. 2011. “The Changing Geography of Outpatient Procedures: Evidence from Florida.” *Medical Care Research and Review*, Vol. 68(2), pp. 247–258.

<sup>13</sup> David, Guy and Loren Helmchen. 2011. “The Role of Task Adhesion in Limiting Specialization along the Medical Care Continuum.” *LABOUR*, Vol. 25(1), pp. 24-44.

which prevent monetary transfers between physicians, and where payment for one task is contingent on carrying out another, which we label as “task adhesion”. We show how trends in hospitalization rates, trends in relative reimbursement for primary and secondary care, and site specific investment in hospitals affects the division of labor in the presence of task adhesion, and why skill complementarities may not be necessary to inhibit specialization. The model suggests that deepening specialization along the health care continuum is hampered by the prohibition and prosecution of kickbacks and fee-splitting practices.

These results imply that a regulator, who sets prices without considering the disincentives to specialize, inherent in the demand complementarities described by our concept of “task adhesion”, may fail to maximize welfare. We study this issue further in “**The Choice of Employment Arrangement in the Market for Hospitalist Services**”<sup>14</sup> which is the first paper to examine the underlying economic forces responsible for the diversity in employment arrangements for hospitalists. Hospitalists are employed by hospitals, physician groups, or self-employed through hospitalist-only groups. There is a substantial diversity in employment arrangements for hospitalists despite the uniformity of worksites, educational backgrounds, and tasks. We reconcile these observations by noting that the two principal players on the health care continuum – primary care physicians who refer their patients and hospitals who admit them – have strong but differing motives for using hospitalists. We show how strategic interaction between the two players may give rise to multiple equilibria, in which either the primary care physician group or the hospital ends up being the sole employer of hospitalists. We also show how the set of equilibrium employment arrangements evolves with the declining frequency of hospitalization and variation in the cost of setting up a hospitalist program.

As inpatient medical care increasingly encompasses the use of expensive medical technology, one hypothesis for the emergence of hospitalists centers on the idea that hospitalists protect hospitals against the overuse of expensive diagnostic and therapeutic technologies. I analyze this question empirically in “**Does Advanced Medical Technology Encourage Hospitalist Use and their Direct Employment by Hospitals?**”<sup>15</sup> In the production of inpatient medical care services, hospitalist services can be viewed as complements to sophisticated and expensive medical equipment. We investigate the causal relationship between a hospital’s adoption of three types of sophisticated diagnostic and therapeutic medical equipment – intensity-modulated radiation therapy, gamma knife,

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<sup>14</sup> David, Guy and Lorens Helmchen. 2007. “The Choice of Employment Arrangement in the Market for Hospitalist Services.” *Southern Economic Journal*, Vol. 73 (3), pp. 604-622.

<sup>15</sup> David, Guy, Lorens Helmchen and Robert Henderson. 2009. “Does Advanced Medical Technology Encourage Hospitalist Use and Their Direct Employment by Hospitals?” *Health Economics*, Vol. 18(2), pp. 237-247.

and multi-slice computed tomography – and its likelihood of using hospitalists. To rule out omitted variables bias and reverse causality, we use technology-specific Certificate of Need regulation to predict technology use. The use of technology is regulated in some states but not in others, while the use of hospitalists is not regulated.<sup>16</sup> We find a strong positive association yet no causal link between access to medical technology and hospitalist use.

Finally, my study entitled “**Determinants of Hospitalist Efficiency: A Qualitative and Quantitative Study**”<sup>17</sup> uses patient level data to test hypotheses about the impact of hospitalists on efficiency and quality of care relative to teaching teams. We focus on a site of care that operated a hospitalist team and a teaching team in parallel, which had patients randomly assigned to different teams. We find that hospitalists are more efficient diagnosticians and have relatively lower charges, through reductions in testing and length-of-stay, compared with teaching teams.

### *Physicians’ adoption of new medical technologies*

Another important choice made by physicians is the timing of adoption of new diagnostic and therapeutic technologies and the extent of their use. In “**The Formation of Peer Reputation among Physicians and Its Effect on Technology Adoption**”<sup>18</sup>, we advance a model in which physicians synthesize signals for outcome quality into a stock of peer reputation, characterized by patient volume and difficulty of surgical cases. The model predicts that physicians with high peer reputation choose a lower average case difficulty relative to those with low peer reputation, and that a new technology that improves the probability of success is adopted more rapidly by high peer reputation physicians than by low peer reputation ones. We test the model’s predictions by studying Florida-based surgeons who treated abdominal aortic aneurysms (AAAs) between 1992 and 2006. In September 1999, a minimally invasive technique (endovascular aneurysm repair using AAA stent grafts) was introduced and constituted an alternative to open surgery. Adoption of the new technology not only required substantial investment but also influenced the mechanism for peer reputation building.

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<sup>16</sup> Certificate of Need regulation is discussed in more detail in my third research stream “The role of regulation in shaping health care delivery”.

<sup>17</sup> Dynan, Linda, Rebecca Stein, Guy David, Laura Kenny, Amy Short and Mark Eckman. 2009. “Hospitalist Efficiency Decomposed: A Qualitative and Quantitative Study.” *Medical Care Research and Review*, Vol. 66(6), pp. 682-702.

<sup>18</sup> Navathe, Amol and Guy David. 2009. “The Formation of Peer Reputation among Physicians and its Effect on Technology Adoption.” *Journal of Human Capital*, Vol. 3(4), pp. 289-322.

We find that high patient census led physicians to actively manage their surgical case mix. Moreover, successful surgeries (particularly for difficult cases) raise future volume, whereas failed surgeries (particularly for easy cases) deplete it, highlighting the role of rare events (i.e., success on difficult cases or failure on easy ones) in forming a signal for quality. Consequently, physicians with a high patient census and a low-severity case mix adopted the new technology more rapidly. These findings highlight the role of peer reputation for growing practice size and the timing of technology adoption.

### ***Human capital and the organization of emergency medical services***

The last set of papers in this stream focus on emergency medical services (EMS), an understudied industry with numerous features that allow for investigating fundamental questions in labor economics, industrial organization, and management. The papers I discuss here measure the effects of shift structure and learning on performance, as well as study the determinants of organizational forgetting. All three studies analyze 15 years of EMS data from the state of Mississippi spanning more than 743,000 incidents. In all studies, both the analysis and findings extend beyond the realm of EMS.

Shift work is common in many industries and is universal in those operating around-the-clock. While receiving increasing attention from regulatory bodies in health care and other industries, the impact of shift schedules and its length on performance is not well understood. My work “**The Effect of Shift Structure on Performance**”<sup>19</sup> represents the largest observational study to estimate the effect of shift structure on workers’ performance, using a dataset that is collected in real time by paramedics responding to calls. We adopt a *within* paramedic difference-in-differences approach isolating fatigue as the key contributing factor in the deterioration of paramedic performance toward the end of longer shifts (e.g. a 24 hour shift).<sup>20</sup> We provide a number of robustness checks, including within shift analysis, quantile regression analysis, and matching analysis, that serve to complement the within-paramedic one. We find evidence that performance deteriorates towards the end of long shifts. Our calculations imply that such deterioration may result in a 0.76% increase in 30-day

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<sup>19</sup> Brachet, Tanguy, Guy David, and Andrea Drechsler. “The Effect of Shift Structure on Performance” forthcoming in *American Economic Journal – Applied Economics*.

<sup>20</sup> Performance measures track time markers for response, on-scene activity and transport as well as the number of interventions performed on-scene and minutes-per-procedure. These measures are discussed in more detail in Carr, Brendan, Tanguy Brachet, Guy David, Reena Duseja and Charles Branas. 2008. “**The Time Cost of Prehospital Intubation and Intravenous Access in Trauma Patients.**” *Prehospital Emergency Care*, Vol. 12 (3), pp. 327-332.

mortality. These findings have implications for workforce organization, calling attention to regulation designed to limit extended work hours.

In a companion paper, I provide an important contribution to the literature on the volume-outcome relationship in health care delivery. While there is considerable evidence that high patient volume is associated with better patient outcomes across a variety of medical conditions, the source of this positive correlation is not clear. Learning-by-doing is one channel through which skills are acquired. Nevertheless, the causality may run in the opposite direction, through a selective referrals channel, whereby better performers command greater demand for their services. On the whole, the pre-hospital emergency medical services setting allows us to interpret any volume-outcome relationship as learning-by-doing, uncontaminated by reputation-based referrals, because ambulance units are dispatched based on proximity. In **“Retention, Learning by Doing, and Performance in Emergency Medical Services”**<sup>21</sup> we examine the strength of the volume-outcome relationship among paramedics by identifying the effects of individual learning on performance. We find that greater individual volume is robustly related to improved performance. In addition, we find that the benefit of learning operates through both recent and past experiences, accrues differentially across tenure groups, and operates on both mean performance and the upper quantiles of the performance distribution. Our study is the first to use detailed data on experience accumulation in addition to tenure to document the performance gains from higher volume. The results also highlight the cost of poor retention rates in EMS and suggest that policy and managerial implications regarding volume–outcome relations in this industry should be directed toward limiting turnover.

The importance of turnover is further investigated in a third paper on EMS performance, which focuses on the role of human capital in inducing depreciation of the firm’s production experience over time. This depreciation effect is often referred to as *organizational forgetting*. Empirical studies of organizational learning and forgetting find sizable depreciation effects and suggest potential channels through which organizational forgetting occurs. While the ability to distinguish between these channels has implications for efficient resource allocation within the firm, to date, their relative importance has largely been ignored. **“On the Determinants of Organizational Forgetting”**<sup>22</sup> is the

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<sup>21</sup> David, Guy and Tanguy Brachet. 2009. “Retention, Learning by Doing, and Performance in Emergency Medical Services.” *Health Services Research*, Vol. 44(3), pp 902-925.

<sup>22</sup> David, Guy and Tanguy Brachet. 2011. “On the Determinants of Organizational Forgetting.” *American Economic Journal – Microeconomics*, Vol. 3(3), pp. 100-123.

first research study to develop a framework for eliciting the contributions of the two most salient channels, labor turnover and human capital depreciation, to organizational forgetting.

Organizations can forget the know-how gained from learning-by-doing through the deterioration of workers' acquired skills, as well as via turnover, where seasoned workers are replaced by inexperienced ones. The two channels imply different strategies to mitigate organizational forgetting. For instance, retention policies to reduce labor turnover may include improved compensation packages or working conditions. On the other hand, skill decay may be slowed by limiting periods of inactivity or introducing frequent refreshers. Due mostly to data limitations, previous studies resorted to measuring firms' experience stock as the accumulated experiences of all workers, whether currently employed or not. Since we have data on the employment histories of approximately 2,400 workers over 15 years, we are able to determine the relative importance of the two channels. We apply our framework to ambulance companies and their workforce, and find evidence of organizational forgetting, which is consistent with findings in this literature. The added insight from this paper is our finding that labor turnover accounts for about two thirds of organizational forgetting.

Moreover, to better understand how forgetting by individual paramedics come to bear, we test two potential mechanisms for skill decay: production breaks through periods of inactivity (measured in days off between subsequent shifts) and task interference (measures as the extent of participation in non-trauma events). We find both mechanisms to contribute to paramedic skill decay, albeit the effects are small. In addition, we find little evidence of transferability across incident types, which may result from EMS protocols being more well-established for medical events relative to trauma ones.<sup>23</sup>

While most studies of organizational learning and forgetting have focused on large scale industrial settings, we study this phenomenon in the service sector. This is important because the nature of production in service industries relies heavily on individual performance, yet it is similar to manufacturing in that hiring, training, scheduling and strategic planning are the responsibility of the organization.

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<sup>23</sup> Transferability relies on the notion that greater experience with medical incidents may confer some benefits at the scene of trauma if mechanically similar tasks are performed in both types of incidents or learning about patient management accrued over medical scenes is transferable to trauma scenes.

The body of research discussed in this section, which broadly focuses on workforce issues, such as specialization, scheduling, labor turnover, peer reputation and human capital accumulation, provides important insight into health workforce management practices. By combining theory and empirical investigation, my work discusses the role of turnover in affecting both learning and organizational forgetting in health care; speaks to the performance deficits associated with long shift structures; highlights how management of peer reputation affects patient demand and the timing of technology adoption; and highlights the unintended consequences of restrictions on gain-sharing across sites of care and other regulation of health professionals, which tend to hinder further specialization and alters patient risk selection. These contributions add to our understanding of the central role that human capital plays in the organization of health care delivery and is of particular interest to health care leaders and administrators interested in improving the efficiency and performance of health care organizations.

### **I.3. THE ROLE OF REGULATION IN SHAPING HEALTH CARE DELIVERY**

My third stream of research is focused on the regulatory oversight of health care professionals, institutions, and markets in the U.S. In the previous sections, I discussed the role of restrictions on revenue sharing and kickbacks in slowing the pace of specialization in generating inefficiencies, and in inducing vertical integration. While there are obvious reasons for regulating the health care industry, there is much debate regarding the proper role and extent of such regulation. Moreover, health care regulation in the U.S. includes a broad range of regulatory tools that apply in different ways to different aspects of the industry, from professional conduct all the way to market failures.

My research in this area focuses on the role of regulation in shaping health care entities' choices and market structure by analyzing three major regulatory domains: tax exemptions and the application of antitrust to nonprofit hospitals, entry regulation of post-acute care entities, and the FDA regulatory oversight after drug approval. In addition, I have studied local government procurement of emergency medical services, which I describe at the end of this section. While all papers in this section (as in the previous sections) are concerned with the description and explanation of economic phenomena, some discuss the acceptability of the economic policies under study.

#### ***Tax exemptions and the application of antitrust to nonprofit hospitals***

The original criterion for nonprofit tax exemption was the provision of charity care (“relief to the poor”). Nevertheless, after the introduction of Medicare and Medicaid, with the bulk of hospital

revenue coming from private insurance and public programs, the hospital industry successfully prompted the Internal Revenue Service (IRS) to revise its definition. In 1969, the IRS created the "community benefit standard" for exemption, allowing hospitals to demonstrate other ways, beyond the provision of charity care, in which they offered community benefits.

Decades after this vague standard was introduced, there still remains a debate about whether it is serving its intended purpose. The typical approach to answering this question involved evaluating whether the value of community benefits provided by nonprofit hospitals exceed the value of the community's foregone tax revenue. In my study "**An Uncertain Prescription: Are Tax Exemptions for Nonprofit Hospitals an Efficient Way to Fund Indigent Care?**"<sup>24</sup> we suggest that the right question to ask is a different one, namely whether the value of community benefits exceeds the value of all alternative health care delivery options the community could purchase with the tax revenue it would collect if the nonprofit hospital paid taxes like a for-profit hospital. Thus, the net contribution of a nonprofit hospital to the community (i.e. the "community benefit standard") should be assessed by examining whether the community would be better off if the nonprofit hospital were stripped of the legal provisions that differentiate it from its for-profit counterparts.

Combining my interest in evaluating the extent to which nonprofits benefit their communities with my research on cross-subsidization (described in section I.1), my paper "**Antitrust Treatment of Nonprofits: Should Hospitals Receive Special Care?**"<sup>25</sup> extends the rationale for the favorable tax treatment by suggesting that nonprofit hospital mergers should be evaluated differently than mergers of for-profit hospitals, because suppression of competition may also allow nonprofits to cross-subsidize care for the poor. Put differently, to produce a socially desirable outcome such as the redistribution of wealth among different segments of the population, nonprofits are likely to exercise market power. When this occurs, the relevant policy question is whether collective action that achieves this result should be given any consideration under the antitrust laws. This paper is the first to analyze the tension between the favored treatment of nonprofits under the tax code and their treatment under the antitrust laws. It develops a theoretical model that demonstrates that in contrast to competition among for-profit firms, competition among nonprofits can sometimes be undesirable, which means that the question whether a particular merger or action that increases market power is

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<sup>24</sup> David, Guy and Lorens Helmchen. 2006. "An Uncertain Prescription: Are Tax Exemptions for Nonprofit Hospitals an Efficient Way to Fund Indigent Care?" *Regulation*, Vol. 29 (2), pp. 14-16.

<sup>25</sup> Capps, Cory, Dennis Carlton and Guy David. "Antitrust Treatment of Nonprofits: Should Hospitals Receive Special Care?" Under Revision for *American Economic Journal – Economic Policy*.

undesirable is ultimately an empirical one. Using detailed California data, we find no evidence that nonprofit hospitals are more likely than for-profit hospitals to provide greater levels of charity care or offer unprofitable services in response to an increase in market power. Therefore, we find no empirical justification for different antitrust standards for nonprofit hospitals, as some courts have suggested.

### ***Entry regulation of post-acute entities***

Certificate of Need (CON) laws impose restrictions on both incumbent firms and potential entrants, by giving state governments the authority to restrict major capital investment such as the construction of new facilities, expansions to existing ones, and the purchasing of expensive technology.

When states universally adopted CON for hospitals in the 1970s, 38 states also applied CON regulation to the home health care sector. When the federal mandate was repealed in 1987, only 18 states continued active CON regulations for home health care. Unlike hospitals, skilled nursing facilities, or physician offices, where location provides a degree of market power, home health agencies deliver services at the patient residence. Similarly, unlike hospitals and other facilities that require major capital investments in order to become operational, home health care is labor intensive. Without both location and large capital investments as natural barriers to competition, we might expect home health markets to be highly competitive absent of entry regulation.<sup>26</sup> Not surprisingly, CON regulation of home health leads to concentrated markets with about half the number of agencies per-market compared with states where entry is not regulated using CON. My work “**The Effect of Entry Regulation: the Case of Home Health**”<sup>27</sup> is the first study to determine whether there is a significant difference in home health utilization, hospital readmission rates, and health care expenditures in states with and without entry regulation by analyzing the universe of hospital discharges during 2006 for publically insured beneficiaries (about 4.5 million) and a subset of 522,232 transitions from hospitals to home health agencies.

We identify these effects by looking across regulated and non-regulated states *within* Hospital Referral Regions, which characterize well-defined health care markets and frequently cross state boundaries. We find entry regulation in home health to result in lower resource intensity, yet similar

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<sup>26</sup> For a detailed discussion of the nature of competition and regulation in home health care see David, Guy and Daniel Polsky. 2011. “**The Economics of Home Health Services**” *forthcoming* in the Encyclopedia of Health Economics, Anthony Culyer, Editor, Elsevier Inc.

<sup>27</sup> Polsky, Daniel, Guy David, Jianing Yang, Bruce Kinosian, and Rachel Werner. 2011. “The Effect of Entry Regulation: The Case of Home Health” Under Revision for *Journal of Public Economics*.

rates of hospital readmission for patients admitted to home health. Nevertheless, entry restrictions substantially lowered the use of home health and increased overall hospital readmissions with little or no effect on overall health care expenditures.

CON laws may not reduce the performance of agencies among the patients seen at home, but because home health in CON states is used less frequently following hospital admission, CON has negative implications for the broader health care system. Notably, while there are no overall differences in total Medicare expenditures, patients are unlikely to be indifferent between the two models of care, as a system with fewer hospitalizations would seem preferable, all else equal.

### ***FDA regulatory oversight after drug approval***

The market for pharmaceuticals is one of the most highly regulated markets in the nation. The U.S. Food and Drug Administration (FDA) interacts with pharmaceutical manufacturers to ensure the safety and efficacy of drugs from pre-approval drug testing and development through post-approval activities. While the relationship between manufacturers and the FDA in the pre-approval stage has received much attention in the literature, the nature of these interactions in the post-approval stage are not well understood and are likely to impact welfare.

This project is motivated, in part, by recent high-profile safety lapses that led to severe regulatory actions against approved drugs. Between 1997 and 2005, eighteen drugs were withdrawn from the market. As a result, the Institute of Medicine published a series of policy recommendations to improve the oversight abilities of the FDA. To some extent, these concerns come from the fact that after receiving FDA approval, manufacturers have strong incentives to expand the population of users by advertising and promoting their new drugs. In 2010, approximately \$28 billion were spent on promotional activities aimed at health professionals and consumers. Such promotional activities may generate new uptake among patients who are potentially not a good match for the drug.

In my paper entitled “**The Effects of Pharmaceutical Marketing and Promotion on Adverse Drug Events and Regulation**”<sup>28</sup> we analyze the relationship between post-marketing promotional activity and reporting of adverse drug reactions by modeling the interaction between a regulator (the FDA) and a pharmaceutical firm, and by empirically testing the model’s predictions using a combination of

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<sup>28</sup> David, Guy, Sara Markowitz and Seth Richards-Shubik. 2010. “The Effects of Pharmaceutical Marketing and Promotion on Adverse Drug Events and Regulation.” *American Economic Journal – Economic Policy*, Vol. 2(4), pp. 1-25 (lead article).

commercial data on pharmaceutical promotion and FDA data on regulatory interventions and adverse drug reactions. The paper addresses an important yet understudied policy area of FDA monitoring of drug safety.

This work is the first to put a theoretical foundation around the interactions between the FDA and pharmaceutical firms in terms of promotion and safety activities. We assume the FDA attempts to maximize welfare conditional on initially approving a drug, while the firm maximizes expected profits by expanding the number of prescriptions filled. We begin by specifying utility over two dimensions: safety and benefit. We relate this to a demand function for the drug which is mediated by physicians and influenced by promotional activities. We then turn to the FDA problem and derive the welfare maximizing regulatory rule, which relies on safety signals from persons taking the drug. The firm, in turn, chooses promotion to maximize expected profits incorporating the FDA's regulatory rule. In essence, increasing promotional activities trades off a higher likelihood of (profit-lowering) regulatory actions, with higher profits in the case that such regulatory action is not taken.

Unlike existing models of promotion under uncertainty, the firm's choice of promotional activity affects the risk exposure to unprofitable regulatory interventions. Thus, the firm faces uncertainty which it can mitigate or reinforce with its choice of price and promotion level. A crucial aspect of the model is that regulation depends on distorted information about the utility impact of a drug, and allows for a comparison between the effect of an overemphasis on drug safety and the effect of enhancing appropriateness of use (i.e. a balance between safety and benefit).

We empirically examine aspects of this model using an innovative combination of data on promotion, regulation, and adverse reactions, by testing whether higher levels of pharmaceutical promotion and advertising lead to a worsening match with patients as reflected by increased reporting of adverse drug reactions, and whether adverse events do, in fact, translate into regulatory actions. A total of 65 distinct active ingredients for high cholesterol, allergies, arthritis pain, and depression are considered.

We find that the FDA responds to high numbers of reported adverse drug reactions with a greater probability of regulatory action, and that advertising and promotion increase the rate of reported adverse drug reactions for certain conditions. The differential results by condition likely arise from two sources. The first is the differential ability of physicians to function as effective gatekeepers across conditions. The second stems from the degrees of severity of known side effects across drugs.

Our estimates show that promotional activity is associated with a reduction in the adverse event rate for high cholesterol and allergy drugs, but is associated with an increase in the rate for arthritis pain and depression, which in turn, led to several regulatory actions. Conceptually, drug promotion can be beneficial or detrimental, and we believe the net effect depends critically on the role of physicians as mediators between promotion and use. In the case of cholesterol and allergy medications, the existence of more accurate diagnostic tools allows physicians to perform their role as mediators more efficiently, reducing concerns about inappropriate use due to promotion.

My analysis entitled “**Side Effects of Competition: the Role of Advertising and Promotion in Pharmaceutical Markets**”<sup>29</sup> extends the previous paper by considering the strategic interactions among firms producing drugs within the same class. We argue that the balancing act between profitable demand expansions and potentially unfavorable subsequent regulatory actions may depend on market concentration. We introduce a model of firm behavior under different competitive scenarios and test the model’s predictions using a combination of sales, promotion, advertising, and adverse event reports data on the market for erectile dysfunction drugs. This market is ideal for analysis as all drugs are branded, associated with adverse health events, and have extensive advertising and promotion. Most importantly, this market is characterized by an abrupt shift in market structure. Viagra (Pfizer) held a monopoly position since its introduction in March 1998 until Levitra (Bayer) and Cialis (Lilly) were introduced in August and November of 2003. We find that advertising and promotion expenditures increase own market share but also increase the share of adverse drug reactions.

### *Local government procurement of emergency medical services*

I conclude this section with a discussion of my research on local governments’ choice of system configuration for the provision of Emergency Medical Services (EMS), a socially important service that benefits from infrastructural synergies as well as technological improvements. Competition for the provision of local public services often involves mixing private firms and public agencies. Predicting competitive outcomes therefore requires identifying the productive and strategic advantages of different organizational configurations: public, private or public–private mix.

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<sup>29</sup> David, Guy and Sara Markowitz. “Side Effects of Competition: the Role of Advertising and Promotion in Pharmaceutical Markets.” *NBER Working Paper #17162*.

The 1990s witnessed a significant increase in the percentage of municipalities incorporating private providers for EMS. This trend coincided with widespread consolidation among local private providers, which resulted in the creation of a few nationwide firms that now serve a large number of urban and rural areas.<sup>30</sup> My work entitled “**The Determinants of Public versus Private Provision of Emergency Medical Services**”<sup>31</sup> advances a theoretical conceptualization that identifies the productive and strategic advantages of different organizational configurations: pure public, pure private or a public–private mix. We consider a make-versus-buy decision in a government procurement context by identifying two dimensions along which private and public entities differ fundamentally. Private firms often provide services to multiple cities and communities, while a public agency is restricted to its particular city of operation. As private firms can serve a larger population, they can reduce their average cost of capital, technological research, and other scale-invariant investments. On the other hand, public agencies have relative advantages in accessing existing infrastructure, which determines the time from call to arrival at the scene. Specifically, fire departments generally face a lower cost of transportation infrastructure because they are already providing first response and hence benefit from existing synergies arising from continuity of provider type, which reduce transport preparedness costs and streamline service.

Thus, the choice of EMS delivery modality given the potential tradeoff between infrastructure and scale advantages depends on characteristics of the individual city. In particular, this conceptualization yields three key testable predictions: cities with smaller population, reduced access to hospitals, and large and proximate neighboring cities will favor the mixed public–private configuration in the provision of EMS. We test these predictions on a panel data set of the 200 largest U.S. cities and find that smaller cities and cities exhibiting poorer access to hospitals have higher propensity to employ a mixed public–private configuration in the provision of EMS.

A local governments’ choice of EMS delivery modality that is based purely on efficiency grounds has the potential to adversely affect other equity dimensions, such as access to EMS. “**Population Density and Racial Differences in the Performance of Emergency Medical Services**”<sup>32</sup> analyzes the existence and scope of possible racial disparities in the speed with which ambulance crews arrive

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<sup>30</sup> In David, Guy, Arthur Chiang and Michael Housman. 2006. “**The Determinants of Urban Emergency Medical Services Privatization.**” *Critical Planning*, Vol. 13, pp. 5-22, we provide an historical overview of the ownership mix and organization of the EMS industry in the US.

<sup>31</sup> David, Guy and Arthur Chiang. 2009. “The Determinants of Public versus Private Provision of Emergency Medical Services.” *International Journal of Industrial Organization*, Vol. 27(2), pp. 312-319.

<sup>32</sup> David, Guy and Scott Harrington. 2010. “Population Density and Racial Differences in the Performance of Emergency Medical Services.” *Journal of Health Economics*, Vol. 29(4), pp. 603-615.

at the scene of a cardiac event. This paper is germane to the debate over the scope of conditioning variables that should be included when testing for racial disparities in health care, by pointing to the potential for misguided conclusions when omitting elements related to health care production. More specifically, we focus our conceptual framework and empirical analysis on the likely effects of population density on the efficient production of EMS as a local public good subject to congestion, and on the need to control adequately for population density to avoid bias in testing for racial differences.

The body of research discussed in this section, which broadly focuses on health care regulation, such as tax and antitrust treatment of nonprofits, FDA regulation, certificate-of-need regulation, and procurement of emergency medical services, provides important insight into the effects of regulation on health care delivery. By combining theory and empirical investigation, my work highlights the tension between the favored treatment of nonprofits under the tax code and their treatment under the antitrust laws; suggests that competition among nonprofit hospitals may obstruct the achievement of social goals; finds no empirical justification for different antitrust standards for nonprofit hospitals; discusses the role of post-marketing FDA regulation in altering firms' advertising and promotional spending and affecting patient safety; highlights the negative implications of certificate-of-need regulation for the broader health care system; and discusses the determinants and implications of emergency medical services privatization. These contributions add to our understanding of the proper role and extent of health care regulation and may be of particular interest to lawmakers and regulators looking to make medical care better, more efficient, and safer by improving the performance of health care delivery in the U.S.

#### **I.4. WORK IN PROGRESS AND FUTURE DIRECTIONS**

I am currently working on several projects extending and building on my research discussed above.<sup>33</sup> Below I briefly describe three efforts underway to provide additional insight into my overall research agenda.

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<sup>33</sup> These projects examine matching between patient severity and physician quality; the effect of initiation of Medicare benefits on healthcare utilization across procedures; the medical and financial outcomes associated with surgery in the elderly obese; the cost and effectiveness of care in long term acute-care centers compared with intensive care units; explaining the differences in physician earnings across specialties; the degree of transferability of experience from open procedures to minimally invasive ones; and the determinants of ownership mix in markets for addiction treatment centers.

In “**Competition and Home Health Utilization Patterns**” Dan Polsky, Mike Punzalan, and I study the effect of competition on geographical coverage of home health services. We developed a spatial theory that captures the unique nature of competition among firms that deliver services at the customer’s residence, such as home health agencies. Classic models of spatial competition suggest that each firm chooses a location such that it attracts the profit maximizing number of consumers. In markets for home health services (or home repair services) the site of activity is the consumer’s home and while proximity to consumers remains the source of market power, it is firms who bear the costs of travel. When introducing this concept into the standard model, the typical notion of a marginal consumer, which is key for solving for the equilibrium in location models, changes radically. By refining the notion of the marginal consumer, we are able to solve the model for the case of free entry. In addition, we introduce two types of patients (relatively sick and relatively healthy) who represent different financial incentives for both agencies and hospitals. Finally, we compare the free entry equilibrium results with the case where entry is restricted by a regulatory limit on the number of competitors. This comparison yields four predictions: 1) the value of discharge planning increases with competition, 2) entry regulation will result in decreased geographical coverage, 3) entry regulation increases the firms’ size, and 4) entry regulation affects the composition of patient types who receive home health services.

We use advanced geocoding techniques to capture geographically delineated areas within home health service regions that are poorly covered by local agencies. Now we are testing these predictions using the universe of patient discharges and patient transitions from hospitals to home health agencies between 2002 and 2008.

In “**The Effect of Emergency Medical Services Privatization on Human Capital Accumulation**”, Seth Richards-Shubik, Andrea Drechsler, and I extend my earlier work on both EMS privatization and on labor turnover for paramedics (discussed in the second and third research streams above), by examining the consequences of EMS privatization on both the performance of individual paramedics as well as resource utilization and labor turnover at the firm level.

We use detailed incident-level EMS data from Mississippi, where EMS is administered by 86 contracting municipalities (counties and cities), and where 56 different EMS providers operate. In the early 1990s only four contracting municipalities employed private EMS ambulance companies, yet by 2005, 45 contracting municipalities did. The privatization trend was gradual, and when municipalities switched from “in-house” provision to contracting out of EMS, the workforce was

hardly disturbed. That is, private entities did not bring in different paramedics and almost universally used the existing local workforce. Unlike my previous work in this area, this project does not investigate the determinants of privatization decisions and therefore does not address endogeneity concerns related to the timing of contractual switches. Rather, our identification strategy is based on the observation of individual paramedics over time and uses the idea that privatization is likely to present these individuals with an exogenous shock (i.e. a paramedic working for a public entity finds herself working for a private one).

We focus on changes in performance before and after privatization as well as paramedics' attrition, using discrete-time duration models. We use individual performance relative to average performance at the firm, which would be consistent with a model where the employer has to learn about the distribution of quality in the population of potential employees. This project's findings will have direct implications outside of EMS, as it explores the reactions of workers to new managerial arrangements.

As a last illustration of work in progress, Seth Richards-Shubik, Jonathan Kolstad, and I have a new project entitled "**Social Networks and Physician Referrals**". This project aims to understand how physicians form social networks and the impact of these relationships on key outcome variables in health care delivery, such as the speed with which patients are seen and the types of specialists to which they are referred. We are able to accomplish this using a unique and highly detailed set of data recently obtained from a major Children Hospital's internal information system.

This research will extend my work on the role of physicians as the suppliers of both advice and services, by highlighting another important dimension: their ability to proficiently refer patients to specialists. The combination of the detailed long panel of data (1998-2009) and rigorous empirical methods to study social networks will allow us to overcome data and computational limitations that have hindered prior work on referrals.<sup>34</sup> We are currently in the process of estimating a matching model between referring physicians and specialists to characterize social networks and social capital as well as the subsequent impact of social capital on referrals.

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<sup>34</sup> For example, we are able to observe the scheduling process by which physicians refer a patient, the timing of a subsequent appointment or a patient being moved to another specialist. Which in turn, allows us not only to recover the match that occurred as a measure of social capital but also the intended match that a referring physician first made and the subsequent rescheduling process.

This project has the potential to make a valuable contribution to the economics, management and health policy literature. While clearly we are interested in issues that impact health care delivery, we also intend to pay close attention to the potential for generalizing our findings to other skilled professional settings. The quality of data on interactions, while hard to find in health care, is virtually non-existent in other industries where such vertical relationships are important.

In addition to this research in progress, I anticipate that my future projects will flow logically from my current interests and fit my career trajectory as a scholar interested in economic efficiency, resource allocation, regulation, public choice, financing mechanisms, and clinical quality. In the coming years, as health care organizations must adapt to an increasingly turbulent environment, I will continue to produce timely, significant, and innovative research at the forefront of highlighting how health care organizations and markets function. Finally, as my career develops, I see myself utilizing my extensive knowledge of the U.S. health care system and my international background to study health care delivery in other countries.

## **II. TEACHING**

My passion for teaching is one of the most important components of my effectiveness as a teacher. I thoroughly prepare my lectures, continuously evaluate my teaching skills, and always take pleasure in watching my students learn. I view research and teaching as highly synergistic; I constantly revise my lectures to include new and innovative research and many of my research ideas stem from preparation of course materials and class discussions. I strive to be accessible and generous with my time, as well as actively solicit constructive feedback regarding all aspects of my courses. At Wharton I have taught approximately 700 undergraduate, 175 MBA, and 40 PhD students enrolled in three elective Health Economics and Health Care Delivery classes. My teaching scores averaged 3.1 (out of 4) for my undergraduate course, 3.4 for my MBA course, and 3.5 for my PhD course.

In 2005, I developed an intermediate level undergraduate course, “Economics and Management of Health Care Delivery”, which is cross-listed with the Economics Department. The class maintained excellent ratings along with expanding enrollment (from 60 students in 2005 to 140 students in 2010). The course balances the introduction of formal theoretical concepts with real-world applications. I have designed the course to introduce health economics at a technical level on a par with advanced level field courses taught at the Economics Department. One of my long term academic goals is to turn this unique set of notes into a textbook aimed at advanced undergraduate students majoring in economics as well as masters programs (e.g. MHA, MPH, and MPP). In the past four years, three of my students developed a passion for health economics and are now enrolled in the Health Care Management PhD program at Wharton.

In response to a growing demand from MBA students majoring in Health Care Management for a course on the economics of health care, I created a new MBA course, “Healthcare Services Delivery: A Managerial Economic Approach”. The course combines critical thinking using rigorous theories and relevant research with real world applications and focuses on organizational and strategic issues facing hospitals, skilled nursing facilities, home health agencies, emergency medical services providers, physician groups, ambulatory surgery centers, pharmaceutical companies and other institutional providers. The students enrolled in my MBA class come from different backgrounds. While the bulk of students are Wharton Health Care MBAs, some are MBA students outside of the health care program; some are enrolled in the executive MBA program; and others are graduate students from the school of nursing, the medical school, the school for communication, the law school, and the school of social policy and practice. These students lack basic training in economics though they are interested in understanding business institutions, government regulation, and health

policy. Since most of them will greatly benefit from using advanced economic reasoning in their professional lives, I place strong emphasis on making a solid connection between theoretical and empirical tools while addressing the economics/business/policy questions that drew them to my class initially. My hope is that students who take my course not only learn a great deal about how health care institutions operate and behave, but more importantly, that they acquire fundamentals enabling them to more effectively manage in many contexts and organizations.

Over the years, I assembled a cadre of guest speakers, including hospital CEOs and CFOs, leaders in hospital consulting and managers of innovative health care delivery organizations. I put a considerable amount of effort in creating seamless, visible and viable connection between my lectures and those given by outside speakers. Between 2005 and 2010, enrollment in this class grew from 20 to nearly 50 students. Additionally I was nominated by my students twice to Wharton's Anvil teaching award (given to one faculty member per year), and the MBA students have commented on what a difference my course has made not only on their knowledge level of health care institutions but on their ability to think about issues and solutions (these letters, I believe, will be made available by my department upon request).

### ***Student Mentoring***

I feel that student mentoring is an essential component of being an educator, and while time consuming, mentoring is an important part of what defines me as a scholar. In my seven years at Wharton I have mentored over 40 students in various internal school and university wide programs, including LDI's Summer Undergraduate Minority Research program, the Wharton Research Scholars program, the Provost's Undergraduate Research Mentoring Program, Senior Thesis in Bioengineering, Economics Honors Thesis, and Independent Studies for Undergraduate, MBA, Executive MBA, and PhD students. In addition, I have served on the PhD committee for 13 doctoral students.<sup>35</sup> Finally, my willingness and desire to work intensely with my students as research collaborators is reflected in the large number of papers that involved students as co-authors.<sup>36</sup>

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<sup>35</sup> I have served on the PhD committees of Scott Johnson (2006), Niels Rosenquist (2007), Amol Navathe (2008), Michael Housman (2009), Yan Feng (2009), Stacy McMorrow (2009), Andrew Lee (2010), Eric Keuffel (2010), Fredric Blavin (2011), Andrea Drechsler (expected 2012), and Reena Duseja (expected 2012) at the Wharton School and for Svetla Tzenova (2005) and Ellerie Weber (2009) at the Booth School of Business at the University of Chicago.

<sup>36</sup> Undergraduate co-authors: Arthur Chiang, Robert Henderson, Margo Lederhandler and Phil Saynisch. Graduate co-authors: Victoria Acevedo-Perez, Henry Bergquist, Andrea Drechsler, Reena Duseja, Michael Housman, Amol Navathe, Michael Punzlan, and Seth Richards-Shubik.

### III. SERVICE AND PROFESSIONAL ACTIVITIES

An integral part of my professional responsibilities has been service to the discipline, the university, and the community. My contributions to Wharton and the profession are summarized below:

- I participated in a number of recruiting efforts since coming to Wharton. In both 2005/2006 and 2006/2007, I volunteered to serve on a search committee for the Center for Outcomes Research at Penn, in an effort to recruit a health economist. In 2010/2011 I was a member of a search committee for my department.
- I have given over 20 guest lectures in my colleagues' classes at Wharton (including, *Health Care Systems* (HCMG 101), *Strategic Management in Healthcare* (HCMG 213), *Models and Methods in Health Services Research* (HCMG 900), and *The Economics of Health Care and Policy* (HCMG 903)), as well as at Drexel University (Earle Mack School of Law), at Temple University (Fox School of Business), and at the University of the Sciences in Philadelphia (Department of Health Policy and Public Health). I also served as a faculty mentor to a number of Health Care MBA teams participating in Field Application Projects.
- I have served on the Wharton Undergraduate Curriculum Committee between 2005 and 2007, as well as on two departmental committees, including the Health Care MBA awards committee.
- I have been a Senior Fellow of the Leonard David Institute of Health Economics at the University of Pennsylvania since 2004. During that time, I have participated in executive meetings, mentored undergraduate scholars through the LDI SUMR program, introduced key concepts of health economics to all SUMR scholars as part of their orientation week, and finally, participated in grant evaluations for LDI's Pilot Project program.
- I have successfully sought funding in support of research and received 10 research grants from various sources including the National Institute of Health, the National Bureau of Economic Research, the Center for Health Management Research (NSF – funded research center), and the Merck Co. Foundation.
- I have been an active participant in the National Bureau of Economic Research (NBER) meetings since I won the NBER Dissertation Fellowship Award in 2003 and was appointed a Faculty Research Fellow in 2010. The NBER is one of the most prestigious associations in the field of economics and is the nation's leading nonprofit economic research organization.

- I've been actively participating in cross-collaborations with individuals at the University of Pennsylvania Healthcare System, the Treatment Research Institute, the Center for Outcomes Research, the Children's Hospital of Philadelphia, the Nursing school, the Society of Hospital Medicine, the City of Philadelphia Fire Department, the Merck Co. Foundation, and leading physicians at several medical schools across the nation.
- Since coming to Wharton I have reviewed 62 academic papers for various economics, health economics, health policy and medical journals. I see reviewing as one of the most important services that academics provide in order to ensure the success of their field. I also see this activity as an important way to follow new research in health economics, to develop critical thinking and understand the peer review process from a different angle. I take my task as a reviewer very seriously and strive to put myself in the shoes of the authors and provide constructive feedback.
- In the past seven years I have presented my research in more than 60 different departmental seminars and conferences in leading institutions and virtually all major professional conferences in my field. These conferences included the American Society of Health Economists meeting, the International Health Economics Association meeting, the NBER Health Care meeting, the American Economic Association HERO session, the Annual Health Economics Conference, the Southeastern Health Economics Study Group, and the Organizational Economics of Health Care conference.
- While the key channel for disseminating my research is through academic journals, my research finding and opinions regarding health care policy and future trends have appeared in LDI Issue Briefs, Knowledge at Wharton articles, and numerous professional magazines, trade journals and newspapers.