Endogenous policy design in healthcare: a case study of emergency department crowding

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Endogenous Policy Design in Healthcare:  
A Case Study of Emergency Department Crowding

Katrina Hull

A Dissertation
Submitted to the University at Albany, State University of New York
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Abstract

The United States’ health care system has faced growing per capita use, and subsequent crowding, of the emergency department since the 1990’s, evidenced by longer wait times and the institution of ambulance diversions. Emergency departments are but one element of a complex system, with difficulties which persist despite policy efforts.

This dissertation asserts the endogenous point of view is a useful and practical approach. The initial proposition is there exists an endogenous mechanism contributing to ED crowding. A specific mechanism was proposed after a thorough review of the literature. This mechanism proposed primary care physicians were using the ED as a backdoor for hospital admissions to avoid barriers raised by payers created to reduce unnecessary hospitalizations.

Disconfirmatory interviews with ED doctors, recruited via connections with colleagues, were used to evaluate the initial model. Participants rejected the specific proposed mechanism, but all offered an alternative endogenous mechanism: the rise of hospitalists leading the ED becoming the front-door for hospital admissions. This resulted in patients who would have been admitted directly under their PCP in the old model to instead be directed to the ED.

Participants cited many advantages of this method, such as faster testing in the ED, shorter stays under hospitalists and PCPs avoiding travel. All of these may support a hospital administrator encouraging the use of hospitalists. Administrators should be aware, however, of the increased load this will create for the ED. The hospital must be prepared for the additional patients and would benefit from considering how to best streamline admission through the ED.

The process worked wonderfully to elicit not just a disconfirmation, but alternate proposals, driving the research forward naturally.
The interview results provoked a return to the literature for links between hospitalists and the ED. A new model was created based on the participants’ feedback and the literature review. Future research should make a new interview booklet and conduct further interviews with hospitalists and hospital administrators to challenge and flesh out the new model.
Acknowledgements

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1.0 Endogenous Explanations of Health Care Policies: Overview of this Dissertation

1.1. *Crisis in the Emergency Department*

Emergency department crowding was chosen because it has been a persistent problem despite decades of research and public policy attempts to address it. The United States’ health care system has faced growing per capita use, and subsequent crowding, of the emergency department since the 1980’s, with the American College of Emergency Physicians issuing a statement on the subject in 1990 (Physicians, 1990). The most common measure is wait times (Wilper et al., 2008). There has been some debate on what overcrowding in the ED actually consists of, but the consensus is overcrowding occurs when the demand for ED services exceeds the supply (U. Hwang & Concato, 2004).

The per capita use of EDs has risen at twice the rate which would be expected from population growth, as can be seen in *Figure 1* (Cunningham & May, 2003). At the same time, emergency rooms have been closing and capacity has decreased (Lambe et al., 2002). The result is increased wait times at EDs across the country (Pitts, Pines, Handrigan, & Kellermann, 2012).
Related concerns included the expense of increased ED visits, excessive wait times and the question of whether patients were misusing the ED. Emergency departments are but one element of a complex system, with difficulties which persist despite policy efforts, making the problem an excellent candidate for modeling.

There are many possible causes and related solutions which have been suggested and researched with varying success, as described in chapter 2.0. These include a shortage of primary care physicians (PCPs) leading to patients using the ED as their primary care, a decline in the health of the population leading to more health emergencies and a need to improve the efficiency of the ED and hospitals to cope with higher patient volumes. Most research approaches the problem from the perspective of an incomplete set of stakeholders and participants, creating fragmented and sometimes contradictory seeming findings. There are likely many contributing causes to ED crowding. Patients, physicians and hospital administrators all have a strong stake in the ED functioning effectively and efficiently.

Figure 1 Historical emergency department visits per capita from 1990 to 2011 (Health, 2013)
G. P. Richardson (2011) envisions an endogenous point of view as “a set of tools, habits of thought, and skills enabling the discovery and understanding of endogenous sources of complex system behavior”. More specifically, these include a closed boundary around the system, the use of stock and flow variables and feedback loops.

A closed boundary around the system should contain the smallest set of variables necessary to produce the behavior being studied. The closed nature of the system is what makes it an endogenous viewpoint. The key behavior must not be exogenously driven by any variable. This is a habit of thought which sees how a system’s behavior is created within the system boundary instead of looking to outside forces for causes of behavior. For example, URBAN1, by Forrester, modeled the growth and decline of cities as an interaction solely between its amount of housing, business structures and population rather than as a result of any external forces such as shifts in the economy of the country (Forrester, 1969).

A feedback loops is how the variables in a system are connected and reinforce or balance each other. In the population example, the number of births depends on the size of the population; this feedback loop is what creates exponential growth. Another feedback would exist between the stock of population and the resources needed to support this population. For example, a population of deer would consume green vegetation. This vegetation would grow over time and if the deer consume it faster than it grows it would decline. With insufficient food more deer would die, reducing the population. This is an example of a balancing feedback loop; it prevents the population of deer from growing forever.

An endogenous viewpoint is empowering in the area of public policy. Placing causes outside the system limits what can be done to address problems. By thinking endogenously, we create an opportunity to make changes and control what is happening, rather than merely
reacting to outside forces. For example, G. P. Richardson (2011) describes the problem of flood damage. He states when floods are viewed from an exogenous viewpoint there is nothing to be done but “recover and rebuild” when a flood occurs. In contrast, an endogenous viewpoint recognizes “damage occurs when hazard meets vulnerability” and “vulnerability is a result of people policies.”

Ghaffarzadegan, Lyneis, and Richardson (2011) argue system dynamics simulation models are ideal for use in a public policy setting because policy problems have the characteristics of “policy resistance, the need for and cost of experimentation, the need to achieve consensus between diverse stakeholders, overconfidence, and the need to have an endogenous perspective.” Such social systems are often huge and complex, which may raise the fear a closed boundary would need to contain an infeasibly vast number of variables. However, they demonstrate small models yield accessible, insightful lessons.

Indeed, several policy scholars, especially scholars using formal system dynamics models as a policy analytic tool, have cited or incorporated such an endogenous point of view into their own work. For example, Martinez-Moyano, McCaffrey, and Oliva (2014) used these tools to examine the “regulatory pendulum” in financial markets, which is the phenomenon in which periods of tight regulatory control over financial markets is followed by periods of looser regulation in which financial institutions take greater risks and break more rules until a large incident spurs regulations to tighten again and the cycle repeats.

Yong, Yalin, Li, and Jianping (2016) used system dynamics modeling to explore the impacts of fiscal and tax policy on the development of geothermal power in China. Their model revealed several feedback loops which cause this cyclical behavior. In the first feedback loop, compliance with regulations slows production for firms, while the second loop is as firms grow,
they face increasing pressure to produce and this pressure generates corner-cutting and rule violations. On the enforcement side, there is an erosion of rule enforcement standards. The perceived impact of rules violations declines as time goes on with no incidents, while what is considered a normal number of violations increases as firms’ behavior gradually worsens. This model shows the pattern of financial crises as an endogenous result of the regulatory system rather than as a series of independent events caused by external factors such as bad actors. Viewed as independent events, policy makers are powerless but when seen as an endogenous outcome, the regulatory system could be adjusted to prevent these negative events.

In another example, Ghaffarzadegan and Andersen (2012) created a model of the impact of warning systems on public safety. The effectiveness of warnings is affected by two feedback loops. One in which the public becomes inured to repeated warnings if nothing happens. The other in which attackers change their targets or plans in response to heightened awareness on the part of the public or officials.

Especially in the area of health care design, a simulation-based endogenous perspective on policy design has become an increasingly important tool for analyzing and making sense of the complexity associated with modern health care delivery. (Taylor & Lane, 1998) propose system dynamics as powerful additional tool for health policy because of its holistic nature and support of discussion of how underlying factors impact the behavior of the system. For example, the ReThink Health initiative, sponsored by the Rippel Foundation, built a system dynamics model designed to help communities with long-term planning around health concerns. The model helps users understand the connections between many aspects of the community including demographics, crime, the economy, the environment and health insurance (J. Homer, 2016).
Gary Hirsch and Jack Homer have both done extensive and varied research on the US health care system. Their models have covered issues including healthcare planning (Hirsch & Howell, 1973), chronic illness prevention and treatment (Jack Homer, Hirsch, & Milstein, 2007), the effects of varying levels of antibiotic use on anti-biotic resistant bacteria (Jack Homer et al., 2000) and the spread of HIV through intravenous drug use (J. B. Homer & St. Clair, 1991).

Peter Checkland applied systems thinking in the form of the Soft Systems Methodology to the National Health Service in Great Britain (Checkland, 2000). Eric Wolstenholme utilized a system dynamics model of the NHS to address concerns about wait times (Wolstenholme, 1999). The system approach revealed adding “intermediate care” services could do more to alleviate wait time for hospital beds than simply adding hospital capacity.

This dissertation answers this call for applying an endogenous perspective to complex health care problems. This dissertation asserts, as its core proposition, applying the endogenous point of view is a useful and practical approach which can yield more insightful analyses and approaches to managing a complex health care system by applying the tools, habits of thought, and skills outlined by Richardson to the applied problem of increasing overcrowding in the Emergency Department in US Hospitals over the past several decades.

1.2. Purpose and Structure of the Dissertation

This dissertation started with a challenge to develop a novel hypothesis of a mechanism contributing to the increase in emergency department visits utilizing this endogenous viewpoint and system dynamics methodology. The original proposal was a multi-method research proposal using system dynamics, expert interviews and econometrics. It was envisioned as being circular in nature, as illustrated in Figure 1. After one round the new proposed mechanism would almost
certainly benefit from expansion or elaboration of the model boundaries or detail to improve usefulness for informing policy interventions.

The initial hypothesis was in the form of a system dynamics model and was to be refined with disconfirmatory expert interviews and then translate the refined hypothesis for testing using econometrics. It proposed there exists an endogenous mechanism causing increased ED use. The formal model also offered the hypothesis of a proposed specific mechanism of primary care physicians (PCPs) sending patients to the ED rather than admitting them directly to avoid insurance paperwork and delays.

The disconfirmatory interviews disconfirmed the specific hypothesis but did support the existence of an endogenous mechanism in general. Rather than a simple rejection of the specific causal mechanism proposed, all interviewees instead offered insight into an alternative endogenous mechanism. As a result, this dissertation has an unusual structure, split into Part I and Part II. Part I covers the process up until the specific dynamic hypothesis was rejected. Part II picks up where the dissertation pivoted to explore an alternate hypothesis proposed by the interviewees.
In part I, the first task was a thorough review of the literature. This served a dual purpose; firstly, to become acquainted with current research and find any gaps in the literature which could be filled. Particular attention was paid to the stakeholders identified in existing research and the variations in problem definition. Secondly, it provided a good starting point to identify key stocks and other variables in the system as well as some preliminary casual relationships.
This work contributes to the published literature by identifying an endogenous mechanism driving increased visits to the ED.

The proposed mechanism was elaborated into a formal simulation model. The system dynamics approach emphasizes how feedback structures create unintended dynamic outcomes. This model was challenged using disconfirmatory interviews with experienced ED physicians. An interview booklet was developed for use in the interviews. The first section asked participants about various causal relationships within the model. Another section was directed at the idea of endogenous mechanism leading to more ED visits in general. The final section asked questions about how variables in the publicly available SPARC's dataset might relate to the causal relationships in the hypothesis.

1.4. Preview of Methods Used in Part II

With the specific hypothesis thoroughly disconfirmed in the interview stage there was no reason to test it using econometrics. Fortunately, the interviews offered an alternative endogenous mechanism in the form of the introduction and increasing use of hospitalists. The first step then was to go back to the literature and determine whether any prior research had linked hospitalists with emergency department visits. Prior research had examined how hospitalists affect through-put and efficiency in the ED but not any connection between the use of hospitalists and why those patients came to the ED. This revealed a gap in the literature which this new mechanism is poised to fill.

Data was pulled from the SPARC's dataset audit report for each of the hospitalists the interview participants worked at. Additionally, a senior admissions department worker was interviewed about the paths of admission available and her experience of trends in admissions. This data collectively formed the basis of reference mode behavior for a new formal model of the
hospitalist mechanism. This second system dynamics model was built based on the collective wisdom of the literature and interviews and calibrated to the data. The model simulated the adoption of the hospitalist model by PCPs due to the advantages of efficiency and a predictable schedule.

Future research should develop a second interview booklet based on the second formal model for a new round of interviews. If not disconfirmed during the interview phase, the new hospitalist hypothesis would then be translated into a statistical hypothesis(es) for econometric testing. The mechanism of hospitalists driving admissions from the admissions department to the ED has significant impacts for hospital administrators. An administrator at a hospital which plans to hire additional hospitalists or encourage more admissions through hospitals must maintain awareness this necessitates additional work for the ED. They should consider whether the ED can handle the additional patient load and whether the process of transferring patients from the ED to inpatient beds is efficient and has enough capacity to keep up with demand.
Part I: Exploring Cost Pressures as an Endogenous Explanation of Emergency Department Crowding

2.0 Classic Explanations of Emergency Department Crowding: A Survey of the Literature

A broad swath of the literature was reviewed to obtain grounding in the current research. This provides an understanding of the stakeholders and actors considered important in health care policy by current researchers. The goal of this literate review was to broadly understand the theory and policy around emergency department use rather than to critique any individual study or theory.

2.1. Stakeholder Perspectives

A larger number of visits per ED each year could be viewed as good business for the hospital because they represent higher revenue for the fixed cost of running an emergency department. Given it is not viewed this way, it is clear there are other problems a crowded emergency department is believed to cause or signal.

A broad search of the literature was undertaken to uncover the themes, stakeholders and outcome variables driving research into ED crowding. The purpose was not to evaluate the strength of any individual study or the overall support for any given hypothesis. The EBSCO complete database was searched using the terms “emergency department crowding” and “emergency department overcrowding” in any field.

Four unique perspectives were uncovered as summarized in Table 1. The first perspective is of the ED and the hospital. The focus is on organizational efficiency and how well the ED adapts to increased loads. The second outcome of concern is the high cost associated with increased per capita use of the ED because the ED is the most expensive setting in which to
receive care. These concerns are focused on the problems of the payers: insurance companies, the government and society in terms of expenses.

The third approach is from the perspective of ED patients, asking questions about their quality of care and health outcomes when faced with long waits to receive care, boarding in the ED prior to hospital admission or ambulance diversions. The final approach is from the perspective of the population health. This view asks whether people are sicker and/or whether preventative care is failing patients elsewhere in the healthcare system causing increased ED visits.

<table>
<thead>
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<th>Approach</th>
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<tr>
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<td>Crowding reduces health outcomes for patients</td>
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<td>Improve efficiency of ED</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Improve capacity of EDs</td>
</tr>
<tr>
<td>Population Health</td>
<td>ED is symptom of lower population health</td>
<td>Society</td>
<td>Improve preventative/routine care</td>
</tr>
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Table 1: Four Areas of ED Crowding Research

2.2. Internal Process Approach

One approach to the problem of ED crowding considers the problem from within the system, either the ED and host hospital alone, or the larger healthcare infrastructure system. A key outcome variable measured is how long patients spend in the ED, both in the waiting and while receiving treatment (Locker & Mason, 2005). From this perspective, the goal is to make the ED more efficient, better able to handle peak patient loads and balance supply and demand.

Statistical studies in this category focus on the balance of supply and demand in health services. They examine relative changes in ED capacity compared to the changes in the number
of patient visits, as well as changes in how hospitals provide services (Burt & McCaig, 2006). Solutions recommended from this view of the problem include offering government subsidies to hospitals with a high percentage of ED patients who cannot afford to pay to incentivize increasing capacity (Moskop, Sklar, Geiderman, Scheers, & Bookman, 2009b). These studies have also considered the impact on patient health and return hospitalization of intervention to reduce the time patients spend in the ED (Cardin et al., 2003).

Additionally, there has been focus on the throughput of patients and the effect of hospital occupancy rates on ED crowding due to patient boarding. Patient boarding is the practice of holding patients in the emergency department until an appropriate inpatient bed is available; which results in long stay times for ED patients and ties up beds that would otherwise treat more ED patients. Hospital occupancy rates are correlated with ED crowding (Forster, Stiell, Wells, Lee, & van Walraven, 2003; Graham, Aitken, & Shirm, 2011; Moskop, Sklar, Geiderman, Scheers, & Bookman, 2009a; Rathlev et al., 2007). One study found ED doctors were more likely to admit minor stroke patients when the ED was crowded (Ben-Yakov et al., 2015). Schull MJ (2001) used hospital restructuring as an intermediate measure, because it often results fewer inpatient beds and closed EDs or hospitals. They found restructuring was correlated with increased ED crowding. Proposed solutions include a process described as “reverse triage” for safe, early discharge of patients from the hospital to prevent boarding in the ED (Moskop et al., 2009b). Slow throughput has also been correlated with the execution of diagnostic tests. Computed tomography and blood tests were both shown to increase length of stay in the ED (Kawano, Nishiyama, & Hayashi, 2014).

Discrete event simulations have been used to predict how long patients will remain in the ED based on the severity of their illness or injury (Hoot et al., 2008; Hurwitz et al., 2014). Such a
model was created with the ED/hospital as the primary stakeholder; creating a tool to manage resources and patient flow more efficiently (Hoot et al., 2008; Jun, Jacobson, & Swisher, 1999). These models may extend to managing the hospital admissions process, as well as balancing elective admissions with anticipated ED admissions, as one study suggests reserving beds exclusively for ED admissions (Colak Oray, Yanturali, Atilla, Ersoy, & Topacoglu, 2014). Jun et al. (1999) focused on the cardiology department specifically in one case (Levin et al., 2008). These types of solutions target efficiency within the ED, via focus on improved patient throughput, rather than the number of ED visits as in other approaches. Some papers arrive at this perspective after finding disconfirmatory evidence of inappropriate use (Sommers, Boukus, & Carrier, 2012).

The majority of system dynamics studies which address EDs do so from this perspective, building on the strong history of supply chain and business models. These models simulate EDs and patient flows from the ED through the hospital (Bagust, Place, & Posnett, 1999). The models were developed by observation of real emergency departments and consultation with actual ED physicians and hospital staff. Feedback in the model comes from patients returning to the ED for repeat visits after discharge and increased load on the ED from patient boarding when there are no inpatient beds available (Morrison & Wears, 2011; Wolstenholme, 1999). The problem of patient readmission is supported as a contributing factor from studies which do not use simulation modeling as well (Baer, Pasternack, & Zwemer, 2001; Falvo, Grove, Stachura, & Zirkin, 2007; Jack et al., 2009; Kirby, Dennis, Jayasinghe, & Harris, 2010). Additionally, one model warns decreases in inpatient beds does not increase ED wait time, but does increase cancellations for admissions for elective surgeries; shifting the burden (Lane & Monefeldt, 2000).
Non-dynamic studies have also looked at the impact of crowding on the finances of the hospital. These costs can include the lost revenue associated with redirecting patients and the cost of boarding patients in the ED, lost revenue because the same time in an inpatient bed would be billable (Bayley et al., 2005; Falvo, Grove, Stachura, Vega, et al., 2007; Falvo, Grove, Stachura, & Zirkin, 2007; J. M. Pines et al., 2009).

An inefficient ED is considered detrimental to the hospital in indirect ways as well, such as the ED being many patients’ first impressions of the facility and by impacting patient satisfaction (Knowles, O’Cathain, & Nicholl, 2012). A great number of strategies have been developed to aid EDs in becoming more efficient, by reducing the amount of time a given patient is in the ED. This includes practices such as bedside registration, a fast-track for low-acuity patients and preemptive bed requests (Karpiel, 2004).

Patients boarding has also been studied as a more general phenomenon contributing to ED crowding. Not only were EDs found to board patients, but in many cases when patients were admitted it was to general internal medicine rather than a more appropriate specialty unit such as the cardiac or oncology unit (Henneman et al., 2010; Howell et al., 2008; Schafermeyer & Asplin, 2003; Wong, Morra, Caesar, Carter, & Abrams, 2010).

This perspective has much in common with the ED patient health grouping as they both use some outcome measures. Its primary distinguishing characteristic is the stakeholder perspective. The internal process group examines the issue from the perspective of physicians and administrators. The focus is on how patients move through the ED and hospital and how the process can be optimized. Health outcomes are used only to evaluate simulation runs, not as the primary focus of the research.
2.3. Cost

Popular media articles have been quite open about attributing their concerns with ED crowding to rising health care costs to individuals and the government. A 2013 New York Times article emphasized an example condition seen at the ED as one which could have been “treated at a fraction of the cost by a primary care physician” (Brody, 2013). While the academic literature does not, as a general rule, so explicitly cite rising costs as the primary motivation for interest in the ED, this perspective is nonetheless evident. These papers are distinguished by their focus on identifying variation in use of the emergency department as a pathway to uncovering inappropriate use, such as a survey looking for reasons patients choose to visit the emergency room over other options (Scott et al., 2009).

This viewpoint of cost in some ways oversimplifies the issue. Emergency departments have very high fixed costs and there is a question of what the marginal cost of an additional patient actually is. Fewer ED visits would spread the fixed costs over a smaller number of patients. After all, the ED must be staffed 24 hours a day whether a non-urgent patient presents for treatment at 2am or not, while the cost to open a primary care facility at such an hour could be quite high. Indeed, a 1996 article found the marginal cost for non-urgent patients was actually quite low (Williams 1996).

A major vein in the cost group focuses on the idea of EDs as “safety net” providers for patients without a primary care physician, even describing hospitals who serve predominately low income patients as safety net hospitals (Felland, Hurley, & Kemper, 2008). One study examined the increase in the ED visits by uninsured and underinsured (Tang, Stein, Hsia, Maselli, & Gonzales, 2010). A Canadian study looked at the correlation between whether
patients have a primary care physician and whether they used the emergency department in a given year.

The predominate term in this group is “inappropriate use” to describe patients who needs could have been met in a less intense setting such as at their primary care physician (Glick & Thompson, 1997). Research seeks to establish why patients make these costly decisions. One theory is patients are unable to see their primary care doctor within a sufficient amount of time (Gutherz & Bacon, 2001).

Another study tested whether inadequate capacity contributes to inappropriate use by examining whether Community Health Centers reduced ED use in a county (Rust et al., 2009). An Australian study examined how referrals can reduce the number of inappropriate ED visits, jumping ahead with assumption of misuse as a serious problem, finding call-lines and patients are about equal on appropriateness (Ng et al., 2012).

Solutions tested from this perspective include requiring primary care physicians to be available 24-hours a day (Franco, Mitchell, & Buzon, 1997). Another program offered a free primary care clinic for patients, resulting in fewer non-urgent ED visits (Fertig, Corso, & Balasubramaniam, 2012).

This is not to imply these policy makers and researchers do not care about the health of the population but rather they are operating from the implicit assumption that the average health of the populace has not changed, only where patients receive care (Fertig et al., 2012). Further, the underlying presumption of shifting some of the patient load from the ED to alternative care settings will at the least not reduce the quality of care and at best may improve it, by reducing wait times for critical patients. It should be noted, however, this group of studies does not test the theory of reduced ED use leading to better outcomes.
The studies grouped under the cost heading share the perspective of the payer. They focus on whether ED visits are appropriate and if they can be redirected to other sources of care. They are split between establishing how many ED visits are appropriate and testing the impact of alternate care initiatives to move patients away from the ED.

2.4. Health of ED Patients

Another group of research takes the perspective of ED patients and is primarily concerned with the procedural quality of care received and their health outcomes. The question for this research group is whether ED crowding actually causes poorer health outcomes, and implicitly whether it is thereby actually a problem. This group goes so far as to describe the problem as “moral consequences” of ED crowding and emphasize the doctor’s oath to do no harm (Moskop et al., 2009a).

Procedural concerns are issues such as conformance to standards of care and hospital procedures for verifying patient ids before procedures, hand hygiene compliance (Muller, Carter, Siddiqui, & Larson, 2015) and double checking medication orders before they are administered. These are one step removed from actual outcomes but suggest a clear causal link. Those studied include the time for pneumonia patients to receive necessary antibiotics (Fee, Weber, Maak, & Bacchetti, 2007), administration of steroids to children for asthma exacerbation (Bekmezian, Fee, Bekmezian, Maselli, & Weber, 2013) and failure to receive guideline-appropriate care (Hollander & Pines, 2007). ED crowding has been associated with poor performance of damage control resuscitation in major trauma patients (Wu, Zhou, Ye, Gan, & Zhang, 2015).

Diercks et al. (2007) found longer ED stays resulted in worse adherence to American Heart Association Guidelines for myocardial infarction patients. Such delays may not be universal however, as one study found that ED crowding was not correlated with time for sepsis
patients to receive antibiotics or survival (J. M. Pines, Goyal, Band, & Gaieski, 2007). Another study found crowding an insignificant effect on time in the ED for Myocardial infarction patients (Chen et al., 2016; Ward, Baker, & Schuur, 2015) and the length of time in the ED may relate to admission time but was unrelated to health outcomes (Derose, Gabayan, Chiu, Yiu, & Sun, 2014; Gabayan et al., 2015; Verelst, Wouters, Gillet, & Van den Berghe, 2015).

Ambulance diversions can fall under procedural concerns as well as an indirect indication of delays in care and potentially adverse outcomes as viewed by (Patel, Derlet, Vinson, Williams, & Wills, 2006). They consequently see them as the problem and eliminating them as the direct solution. A solution which was implemented, in this case, through a program of coordination between regional hospital and commitment to avoiding going on ambulance diversion status (Patel et al., 2006).

Outcome measures vary in directness. One commonly used measure is the length of inpatient stay for patients admitted through the ED (Liew, Liew, & Kennedy, 2003; Lorch, Millman, Zhang, Even-Shoshan, & Silber, 2008; White et al., 2013). Though in case of acute appendicitis, a study found reduced time to operation reduced complication but not the mean length of hospital stay (Milzman et al., 2010). Arguably the most important outcome measure is patient mortality, and crowding has been found to increase mortality, however, mortality is often very low among patients in a study, only 1.3% total in one study, undermining the usefulness of the measure somewhat (D. B. Richardson, 2002). ED crowding has also been correlated to higher incidences of cardiovascular complication in ED patients (J. M. Pines & Hollander, 2007).

Other consequences include delayed care for acute conditions, prolonged suffering and violence amongst agitated patients in the waiting room (Derlet & Richards, 2000). Ula Hwang, Richardson, Sonuyi, and Morrison (2006) found increased crowding resulted in longer times to
assess and treat pain in elderly patients with hip fractures as well as treatment with inappropriate analgesics. Jesse M. Pines and Hollander (2008) found crowding increased delays for all patients with acute pain and reduced the likelihood of severe pain patients receiving any treatment.

It is worth noting this stream of research is not primarily concerned with how to resolve the problem of emergency department crowding, only with establishing whether it is harmful to patients. The primary stakeholders who seem to be addressed by this point of view are the patients themselves, who naturally care about their outcomes. The bulk of the research is directed at identifying whether patient outcomes are harmed with mixed results, depending on the particular condition and measure in question.

2.5. Population Health

The final area of inquiry is why the population needs more ED visits per capita. This question implies ED crowding is not a problem in and of itself, but a symptom of a greater issue for the population which is less healthy than it was in the past. This is a fundamentally different philosophy from the previous groups as it looks outside the ED system and patients and takes the viewpoint of society as a whole.

The largest subarea of research is in ambulatory care sensitive conditions (ACSC). These are conditions, such as asthma, for which the patient may have acute episodes requiring a visit to the ED. However, if the patient receives good routine care, he will have substantially fewer visits than otherwise. Studies have found avoidable ED visits from ACSCs do exist (Chukmaitov, Tang, Carretta, Menachemi, & Brooks, 2012; Hongsoo, Helmer, Zhonglin, & Boockvar, 2011; Kirby et al., 2010). One report showed there are simply more patients with these conditions, rather than each patient being sicker (McCall, 2004). This growing population of patients with complex conditions could be more cheaply treated in outpatient facilities (Berry et al., 2014).
Relevant studies to this perspective are indirect in some cases; establishing an increase in the prevalence of chronic diseases such as diabetes (Honeycutt et al., 2003; A. P. Jones et al., 2006).

This has naturally led the research into why ACSCs are not being properly managed. There are many potential reasons being researched including access (Longman et al., 2011; McCusker et al., 2012) and whether insurance status affects use of preventative care (Asplin et al., 2005; Fortuna, Robbins, & Halterman, 2009; Markovitz & Andresen, 2006; Small, 2011; Weber, Showstack, Hunt, Colby, & Callaham, 2005; Young, 2007). The correlation has been studied from both sides, with hospitalizations standing in as an indicator of poor access to primary care for ACSC patients (Hossain, 2009). Insurance status, on the other hand, has not been found to be correlated with emergency department use despite numerous studies (Anderson, Dobkin, & Gross, 2014; Hosseinichimeh, Martin, & Weinberg, 2016; Hosseinichimeh & Weinberg, 2014; S. Miller, 2012).

There has been some attention paid to the effects of changes to capacity for treatment of the mentally ill outside the ED and host hospital on crowding. A 2004 survey of emergency physicians by the American Psychiatric Association (APA), National Alliance for the Mentally Ill (NAMI) and National Mental Health Association (NMHA) found 60% reported than an increase in psychiatric patients was causing longer wait times and decreasing available beds in the ED (Carolla, 2004). This increase was attributed by the studies to budget cutbacks and closures of state psychiatric hospitals (Carolla, 2004; O'Malley, 2005). This is troublesome because psychiatric patients use more resources and are boarded in EDs for much longer than other patients.

Mental health status is the single greatest contributing factor to ED use among injection drug users (Lundgren, Chassler, Ben-Ami, Purington, & Schilling, 2005). The severely mentally
ill, as a whole, have fewer hospital admissions and ED visits when they receive management and recovery services outside the hospital (Salyers, Rollins, Clendenning, McGuire, & Kim, 2011). Continuity of care reduces ED visits for people with intellectual and developmental disabilities as well (Wood, Hall, Hou, Wludyka, & Zhang, 2007).

This is also accompanied by a concern that vulnerable populations receive poorer preventative care (Gresenz, Rogowski, & Escarce, 2006; Hongsoo et al., 2011; Johnson et al., 2012; Merrick et al., 2011; Oster & Bindman, 2003). Differences in ED visits for racial and ethnic minorities has also been explicitly examined, finding they have higher rates of urgent care visits (R. Jones, Shao, Munsie, Radigan, & Syni-An, 2008). Racial disparities have even been found to persist despite accounting for income and other socio-economic factors (Law, Oraka, & Mannino, 2011). This viewpoint emphasizes social justice issues as important societal concerns when studying healthcare and health outcomes.

The solutions stemming from this viewpoint involve improving access and quality of primary care services in the community. Indeed, at least one system dynamics model has recommended as much (Lattimer et al., 2004).

There is a subtle, but important, difference from the cost angle of asking whether patients should visit a primary care physician instead of the ED. The health perspective acknowledges the ED visit as urgent/necessary but also considers it avoidable: with appropriate preventative care the patient should not have had an emergency medical incident.

While proper preventative care is clearly of importance to the patient, and may save insurers and government programs money, the emphasis in the literature is on vulnerable populations and other social justice concerns. Based on this, the primary stakeholder of concern
for this category of research is taken to be society. The studies focus on whether people are receiving necessary preventative care and care for chronic conditions.

2.6. Summary

Each of the approaches discussed offers a very different perspective on the problem of “emergency department crowding.” Any complex system comparable to the health care system has a large number of stakeholders, who may disagree on what the most important goals are. Each stakeholder has their own view on what the problem is and what an acceptable solution would be. This is reflected in these four categories of research as shown in Table 1.

Rather than being competing theories about the causes and solutions to emergency department crowding, these areas of research should be seen as complementary. Each group has one piece of the puzzle, one view of the system as a whole. Different stakeholder groups have very different and sometimes competing goals. It is entirely possible if one group pursues policy it perceives as being in their own best interest, this will create the problems experienced by another group. For example, a hospital might close or downsize an ED that was not consistently running near capacity because it’s too expensive to leave slack, while patients would be upset to see wait times then increase.

By taking a broader, more general view, this sets the stage for a dynamic hypothesis and simulation model to explore how these disparate points of view may connect and inform each other. Such an exploration is the purpose and heart of this dissertation.
3.0 Phase One Research Plan

Having reviewed the literature, the next step in the research plan is identify a new dynamic mechanism increasing ED use to propose as the dynamic hypothesis. This was formalized as a system dynamics model. Key stocks were identified in the literature, as well several causal connections. Additional connections and variables were added as needed to fill out a running model. Where it was clear additional structure would be needed for the model to match the reference behavior from the literature, a mechanism was proposed. This mechanism represents one way the model could be completed which would allow it to be calibrated to historical data. This model will serve as a boundary object during interviews with experts. This provides a starting point and encourages interviewees to consider what they know about the healthcare system from an endogenous point of view.

An interview booklet will then be developed based on the model. This booklet will be used to conduct a series of disconfirmatory interviews with ED physicians. Andersen et al. (2012) describe the disconfirmatory interview as a tool to increase confidence in the model and improve model structure by eliciting concrete suggestions for improvements. Questions will invite participants to challenge the various causal relationships in the model and invite the suggestion of alternative or additional causal relationship important to the system. The final part of the interview booklet will elicit input on the translation of the dynamic hypothesis for statistical testing.

Empirical data would then be used in the form of the publicly available SPARCS data set. The New York SPARCS database provides a longitudinal set of healthcare data for all hospitals in New York State. The SPARCS dataset has the strength of being a large uniformly collected data set. Regression analysis is excellent for evaluating the strength of relationships, which is
difficult to determine with system dynamics alone. However, the data set is limited to New York State and may not be generalizable to the rest of the country. It also only covers hospital admissions; no data is available for physician visits.

Appendix F: SPARCS Data Definitions includes the data definitions for particularly relevant variables. The available data includes the source of hospital admissions and type of admission (emergency, urgent, non-urgent). The first test was to show the source of inpatient admissions has shifted from direct referrals to admissions through the emergency department. If the proposed dynamics mechanism were accurate, it is expected that the urgency of admission through the ED and direct admission will shift over time with more less-urgent cases being referred to the ED by physicians.

Additional potential regressions may examine relationships between admission sources over time for different diagnostic groups. Diagnoses which are typically more urgent should be expected to respond differently to changes in time to refer patient for inpatient services. The interviews were to be used to discuss this and other possibilities with emergency department doctors, nurses and other experts.
4.0 A High-Level Model of ED Patient Volume

4.1, Dynamic Hypothesis

Having reviewed the existing literature, the next step is formulate an endogenous dynamic hypothesis. The existing literature will inform the dynamic theory, likely by piecing together disparate pieces of the picture previously studied exogenously and separately. In the example of emergency department usage, the dynamic hypothesis arose from two facts in the existing literature. The first being total number of hospital admissions has remained constant ("Health, United States, 2012: With special feature on emergency care," 2013). The second being a patient’s insurance status does not affect his likelihood of using the emergency department despite this being considered a stand-in for access to primary care (Asplin et al., 2005; Fortuna et al., 2009; Gresenz et al., 2006; Hongsoo et al., 2011; Johnson et al., 2012; Merrick et al., 2011; Oster & Bindman, 2003; Small, 2011). An exogenous viewpoint assumes more patients are entering the system; in contrast, An endogenous viewpoint considers changes in how current patients are processed.

In the American system, healthcare is usually paid for by insurance providers or the government through programs such as Medicaid or Medicare; they are collectively referred to as “payers.” Figure 3 proposes a mechanism through which payers working to reduce hospital utilization and cost paradoxically and unintentionally cause a rise in ED visits. Facing rising costs for both inpatient and ED visits. Payers attempt to reduce hospital utilization, likely in an effort to eliminate inappropriate or unnecessary admissions. This manifests in the model as an increase in the time for a physician to have a patient admitted to the hospital. In response, the physician may choose to send his patient to the emergency department as a “backdoor” to the hospital rather than deal with wait.
Figure 3. High level causal diagram of the proposed dynamic mechanism driving increased per capita emergency department visits.

Physicians referring patients to the ED, instead of directly to the hospital, create an increase in both emergency department visits and consequently costs for the payer because each patient so referred result in a bill for both the ED visit and the hospital admission. The higher costs reinforce the payers desire to control their total costs by whatever means possible. A secondary balancing loop exists as payers slowly adjust to a higher expected cost.

In its current state this model focuses on several endogenous feedback loops, while at the same time some potential feedback loops open with exogenous, data driven, inputs. This approach capitalizes on the potential of system dynamics models for theory building and articulation, while also iteratively testing proposed mechanisms. The core hypothesis of the theory is physicians are redirecting patients to the ED instead of directly to the hospital. This snippet of the model seeks to establish this core before branching into necessary secondary hypotheses, the exploration of which is unnecessary if evidence does not support the core. These
two include payers create barriers to direct admission and physicians are sensitive to the time delay associated with these barriers.

The feedback loops present in the model were created by placing all the historical data for related variables together and seeking an endogenous explanation. Some potential feedback loops were left open simply due to the lack of data at this point in time. If the core hypothesis can be supported then the model itself directs research to the secondary hypotheses, which should illuminate further feedback loops within the system.

4.2. A Preliminary Concept Model

The third step is to produce a small “concept model” as described by Richardson (G. P. Richardson, 2013). This small simulatable model offers a way to share a system dynamics approach to a problem and starting point for a greater conversation. Small models have the benefits of offering accessible, but still insightful, perspectives for policy makers (Ghaffarzadegan et al., 2011).

Small models have been used in the areas of urban planning, social welfare and tax assessment (Ghaffarzadegan et al., 2011; G. P. Richardson, 2013). This approach is also promising in the area of health policy. Many other health policy issues could also benefit from the small or concept model approach to build understanding among policy makers and develop theory.

As a small model, it focuses tightly on the system dynamics concept the researcher feels most important for health policy makers to consider; the unintended consequences of policy efforts. The model is deliberately vague in areas such as what the barriers to speedy admission are specifically. Such details offer natural and important avenues for discussion with health experts in the next steps of the research.
4.2.1. Structure of the ED Concept Model

The concept model for the example of emergency department visits behavior is driven by two sectors, which will be discussed here in detail. All of the equations are included in Appendix A along with a detailed description of how the value for each parameter was chosen. Figure 4 presents the payer sector, which encompasses the part of the dynamic hypothesis related to payers and increased costs. Payers have an expectation of the cost associated per patient treated and strive to control their expenses if the costs rise above their expectations. Expected costs has an initial value equal to the actual cost at the start of the simulation. The payer adjusts to changing costs over time. The time to adjust is an unknown parameter and set to fifteen years as a starting value. How often rates are adjusted is a significant unknown parameter in the model.
Figure 4 Stock and flow diagram of the major feedback loops of the example concept model of increasing emergency department visits

Figure 5 presents an important set of relationships in this first concept model as an exogenous function of time. The average cost for an inpatient hospital admission has increased over time. Many factors have contributed to this increase, medical technology development considered a primary driver by many (Cutler, 2004; Kaiser Family, 2007; Newhouse, 1992). This technology includes technologies in the form of machines, such as medical imaging equipment, and techniques for treating previously untreatable illnesses. For the purposes of this model the cost per admission uses time series data described in the U.S. Census Bureau’s statistical abstract as shown in Figure 5 ("Statistical abstract of the United States: 2012," 2011).
Figure 5 Time adjusted cost per hospital admission from U.S. Census Bureau data, as used in the concept model of increasing emergency department visits.

Figure 6 presents another important set of relationships as an exogenous function of time. Cost per ED visit likewise uses external time-series data compiled from multiple sources (Cutler, 2004; "Health, United States, 2012: With special feature on emergency care," 2013). Between 1990 and 2015 there has been an exponential increase in the cost per hospital admission despite the lowered length per admission (Moore, 2014; "Statistical abstract of the United States: 2012," 2011).

That is to say, payers’ efforts to reduce length of stay, while successful, were not sufficient to keep costs down after 1995. At this point, policies kick in on the part of payers to create barriers to patient admissions—an effort to reduce the number of admissions. There is no indication of these barriers in the existing literature, but they represent a plausible mechanism as a starting point. These barriers have the effect of both making it more difficult for a general practitioner to directly admit a patient and increases the time for such an admission. Such barriers may take the form of additional paperwork, prior approval requirements, etc., but the exact form is outside the scope of this hypothesis.
Figure 6 Time adjusted cost per ED visit compiled from data from Cutler, 2004 and Health, United States, 2012

The second major sector of the model is the general practice sector. Figure 7 presents a more detailed stock and flow diagram of the variables in this sector than Figure 6. The general practitioner has an expectation for how long it takes to have his patient admitted to the hospital should he deem it necessary, the “normal wait time” and an expectation of the reality “Expected wait time for GP referral”. The amount of time to have a patient admitted is used because it is considered likely a physician seeks to limit the wait time for a hospital admission for patients whose condition is serious, in order to prevent their condition from deteriorating further.

The actual values for the “normal wait time” and “expected wait time” for GP referrals are set at arbitrary values and start equal. The ratio is what matters and the exact values aren’t important to the behavior of the model, particularly given that GP sensitivity to changes in that weight time is another large unknown. Because of all these unknowns, extensive sensitivity testing will be done to observe the full range of behavior the model can produce.
When the payer faces pressure to reduce costs, the result is an increase in artificial barriers to direct referrals by physicians to the hospital. The effect of costs on artificial barriers is formulated as an s-shaped effect, with little response for small overages in cost, exponentially.
increasing responses in the middle and leveling off eventually. It is formulated as a Gompertz function in the concept model, which is the generic form for an s-shaped graphical function.

\[ y(x) = ae^{-bx^c} \]

\(a\) is the asymptote (upper bound of the graphical function), \(b\) is the displacement along the x-axis, \(c\) is the growth rate (how steep the curve is) and \(e\) is Euler’s number.

Figure 8 presents a graphical representation of this function for a full span of values for the expected/actual costs. The effect function is formulated as a mathematical function rather than a graphical function because the payer sensitivity to pressure, the slope, is unknown. By using a function, the sensitivity can easily be varied during Step 3b. It may turn out in the real world that GPs are entirely unaffected by anticipated wait times to admit patients.

\[ \text{effect of costs on artificial barriers to direct referrals} = 6 \times e^{-5 \text{payer sensitivity to pressure} \times (\text{actual over expected costs} - 1)} \]

![Effect of pressure on wait times](image)

*Figure 8. The Gompertz function of the effect of pressure to reduce costs on wait times for physician to admit patients to the hospital*

A similar Gompertz function is used for the effect of the wait time to admit on GP referrals to ED. Again this is because GP sensitivity is an unknown.
The Gompertz function used to formulate the effect of wait time to admit on GPs referring patients to the ED

4.2.2. Base Behavior of the Concept Model

The base run of the model is presented here in Figure 10 against historical data and a baseline of no change in per capita emergency department visits. It is intended to explain approximately twenty percent of the increase in per capita use of emergency departments. The green line indicates historical per capita ED visits, the blue line represents no change from the 1990 level and the red is the model results. Additional mechanisms driving increased use are beyond the scope of this model.

Historical data shows ED visits increased by 15 million between 2003 and 2009, while inpatient admission from the ED increased by 3.1 million (McCaig, 2003; Morganti, 2013).

\[
\frac{3.1 \text{ million}}{15 \text{ million}} = 20.7\% \text{ of the total increase in ED visits}
\]
While this is by no means even the majority of the increase, it does represent a large proportion of patients who were ill enough to require a hospital admission and raises the question of whether these patients could have been admitted through other means.

**Figure 10.** Base run of the ED model of per capita ED visits plotted against the historical data and a baseline of no change in ED visits.

The number of redirected patients rises exponentially until the pool of eligible patients for redirection by general practitioners is exhausted creating the S-shaped growth seen in the line with squares. A key concept in the behavior of this model is the pool of patients and the severity of their illness is always constant. Policies implemented in this framework can only shuffle how patients are processed through the system.
4.3. *Sensitivity Tests*

This very preliminary concept model hinges on two primary and entirely unknown variables, payer sensitivity to pressure and GP sensitivity to wait time. These two variables are actually the slopes of the effect of costs on artificial barriers to admission and the effect of weight times on GP referrals respectively. Furthermore, it is the ratio between these two slopes which has the greatest impact on model behavior.

During the sensitivity runs all variables, except payer sensitivity to pressure and GP sensitivity to wait time, are held constant. Those two variables are varied randomly between 25 and 150 percent of their original value. The model was run for 25 years 1000 times using Vensim’s built-in sensitivity testing tools. The number of ED visits per 1000 people at the end time of the model was exported. The end value of each run was graphed against the associated values of the GP and payer sensitivity. The resulting surface graphs show the interaction of these two parameters and all possible end values for per capita ED visits from remaining at the baseline of 350 to an increase to 378 Ed visits per 1000 people. While this change seems small it represents a huge number of total additional ED visits for the United States population.

As can be seen in Figure 11, not all combinations of GP and payer sensitivity result in patients being redirected to the ED. If either GPs or payers are completely insensitive there is no increase in ED visits per capita, regardless of the other’s sensitivity.

Provided both sensitivities are above zero, the number of patients redirected at time 25 rises exponentially with the sum of the two sensitivities. In other words, an increase in either GP or payer sensitivity increases the number of ED visits per capita, and if both increase the effect is greater. The effect hits a peak when physicians have redirected all available patients. This is seen as the smooth top of the surface, where higher combined sensitivities have a capped effect.
Figure 11 A surface graph of the per capita ED visits at time 25 when the payer and GP sensitivities are varied between 0.25 and 2 times the base value.

Figure 12 shows the data from the same set of runs in a more familiar two-dimensional sensitivity graph. This visualization shows the effect of the combined GP and payer sensitivities on ED visits per capita over the 25-year run. The graph illustrates with higher sensitivities the number of ED visits per capita reaches its maximum faster, while slower sensitivities take longer to reach the maximum.
Figure 12 Sensitivity run graph of per capita ED visits when payer and GP sensitivities are varied between 0.25 and 2 times the base values.

The other two unknown parameters are the time for payers to change their expectations of costs and the time for physicians to adjust expectation for how long it will take to have a patient admitted to the hospital. The values for these times to adjust expectations were lowered to 25% of the initial value. Then the above procedure for varying sensitivities was repeated. Next, the values for time to adjust expectations were set to twice the base values and the process was repeated.

The resulting surface graphs are shown in Figure 13. The behavior mode remains consistent with the base values. With longer times to adjust expectations, lower GP and payer sensitivities are required to reach the maximum ED visits per capita. In contrast, with a shorter time to adjust much higher sensitivities are required to reach the maximum ED visits per capita within the 25-year run.
Figure 13 Sensitivity surface graphs when the times for payers and physicians to adjust expectations are doubled and reduced to a quarter of the base values respectively.
5.0 Qualitative Interviews to (Not) Confirm the Dynamic Hypothesis

The overall purpose of these interviews is to challenge the dynamic hypothesis. The logic of disconfirmatory interviews is to present the model’s structure and behavior to respondents and both encourage and challenge them to present disconfirmatory comments—“What is wrong about this model?” If the model survives multiple rounds of disconfirmatory interviews by experts, this should build confidence in the model. Of course, the larger the sample size the greater the relative confidence which can be built from such a procedure. By contrast, disconfirmation requires a much smaller sample of interviews.

5.1. Sample

Three interviews were conducted with long-term ED doctors, one with experience as a chief medical officer. Subjects were chosen using a convenience sample of colleagues and advisors contacts. Subjects were first contacted by the colleague to ask if they would be willing to participate and then put in touch with the researcher via email to schedule an interview.

5.2. Instrument Development

There is a strong tradition in the field of system dynamics of using interviews for model validation. (Andersen et al., 2012) describe the disconfirmatory interview as a tool to increase confidence in the model and improve model structure. This type of interview is ideal to achieve the first two goals of the interview process.

Therefore the format selected was semi-structured interviews centered on boundary artifacts as recommended by (Andersen et al., 2012), with additional questions aimed at fulfilling the third purpose of informing the empirical phase. Interviews were conducted one-on-one and audio recorded. Interviews with subjects who live out of state were conducted over an internet video call; materials were provided via email for the subject to print.
A workbook, included in Appendix B: Interview Instrument, was developed. The introductory segment consists of a script for the start of each interview for consistency and building rapport. This script covers the basic introduction to the researcher, purpose of the research and ensures confidentiality for the participant (Bryman, 2008).

The first section of the script is boundary objects, as suggested in the guidelines provided by (Andersen et al., 2012). These include the reference mode graphs for hospital admissions by source and ED visits per capita. These graphs serve to ground the interview in the specific problem being addressed. Participants are invited to produce additional graphs over time to elicit other variables they feel were left out.

The second section covers assumptions of actor behavior. This elicits the motivations, and perceived motivations, of the important actors in the dynamic hypothesis, including primary care doctors, payers, emergency department doctors and hospital administrations.

The third section of the workbook provides causal loop diagrams of the dynamic hypothesis with explanations. Participants will be encouraged to ask clarifying question to ensure they understand the diagram provided. They will then be asked if they feel any connections are wrong and if they would add to the diagrams presented.

The fourth section of the workbook provides a sample of data definitions available in the public SPARCS data set. It questions whether the interviewee agrees with proposed connections between the data and dynamic hypothesis. It then elicits expert advice on whether diagnostic groups would differ in their response to the proposed mechanism and for other suggestions of what health experts would find persuasive evidence.

Interviews were conducted in person at a location of interviewees choosing and took an hour each. The participants were given a booklet and asked to write down their notes and
thoughts as well as discuss aloud with the researcher. The researcher also took written notes; the booklet responses and researcher notes were combined in the interview appendix. The data was sent to the participant to confirm it was an accurate record of the interview.

The booklet formed the outline of the discussion and was used to keep the discussion directed and flowing productively. However, the participants were encouraged to maintain a dialogue and the interviewer asked clarifying questions and follow-up questions where appropriate. In some cases, questions or sections were skipped because the interviewee did not feel comfortably knowledgeable enough to respond to them or felt they were irrelevant and wanted to expand on other concepts.

5.3. Results

All three doctors interviewed agreed the graph showing an increase in admissions from the emergency department and a decrease in direct admissions reflected their experience in their own hospitals and this would naturally mean some additional ED visits. Though participant 2 (P2) was quick to point out the reference graph only went to 2009 and he was seeing a plateau of ED visits with the “last 3 years stable or 3-5,000 per annum decrease.”

The participants challenged the dynamic hypothesis’s proposed mechanism leading to this shift from direct admissions to admissions through the ED. The dynamic hypothesis proposed this shift might be due to policies of health insurance companies making it more difficult for primary care physicians to directly admit their patients. Participants roundly rejected this idea, with P3 emphasizing the many attempts by payers to influence doctors, such as incentivizing them to keep their office open after hours or providing data, has been entirely ineffective.
What all three participants brought up instead was the shift to using hospitalists instead of PCPs overseeing their own patients in the hospital. P1 stated that there was “no mechanism to send patients from their doctor to the hospital” resulting in most using the ED, while P3 stated he didn’t know what percent of hospitalists will see directly admitted patients. From these responses it seems likely there is some variation between hospitals, and possibly even between hospitalists, as to whether a patient can be referred from his PCP directly to a hospitalist.

An important point the participants emphasized was the hospitalist system has many benefits and is preferred by both PCPs and hospitals as summarized in Table 2 along with challenges. Primary care doctors prefer not to have to travel to the hospital, enabling them to maintain a higher volume of outpatient visits. Hospitals prefer to use hospitalists as they reduce the length of stay and testing in the ED reduces unnecessary hospitalizations. This comes with benefits for patients as well as “patients have a higher probability of becoming infected or sicker in the hospital,” according to P3.

The role of patient preference, as well as what preference is, was disputed between the interviewees. P3 believed patients would prefer to “avoid the ordeal of the ED” as it has no “added value for patients.” In contrast, P2 felt chronically ill patients would prefer the ED because it is quicker, while the acutely ill have no choice. From P1’s perspective patients “understand why they go directly to the ED.” This diversity of viewpoints on patients’ preferences suggests it may vary quite a bit; patients are not a homogenous group sharing the same preferences.

The hospitalist system is not without challenges. An increase in ED visits clearly results from patients who would have been directly admitted being sent to the ED instead. However, they may represent a disproportional burden on the ED compared to the average patient. Patients
who will be admitted spend longer in the ED than those who are not. P1 describes patient
boarding as the largest problem contributing to crowding and more patients who will be admitted
means more patients being boarded.
### The Emergency Department as the Front Door for Admissions

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<th>Advantages</th>
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<tr>
<td>• Improved patient care</td>
<td>• “Chronically ill [patients] prefer the ED because it will be quicker, such as blood work x-ray and EKG would all be done right there instead of going to three different departments and registering” – P2</td>
</tr>
<tr>
<td>o Better diagnostic equipment available</td>
<td></td>
</tr>
<tr>
<td>o Faster testing</td>
<td>• “Tests done in the ED are much faster – ½ hour vs hours at their office” – P1</td>
</tr>
<tr>
<td>• More efficient</td>
<td>• “Less work, worry, uncertainty, liability to send to ED” – P3</td>
</tr>
<tr>
<td>o General practitioners don’t have to travel to see patients</td>
<td>• “Hospitalists want to be certain the patient requires hospitalization and not all referrals do” – P1</td>
</tr>
<tr>
<td>o No wait for GP to order tests and then return to interpret results</td>
<td>• “takes more time to see patients/travel than to stay in office” – P1</td>
</tr>
<tr>
<td>o Higher certainty of need to admit</td>
<td>• “Copay is waived if you are admitted. ED costs are rolled into admission (exception is ED physician charge), no extra income for hospital” – P1</td>
</tr>
<tr>
<td>• No separate ED charge if patient is</td>
<td></td>
</tr>
<tr>
<td>Challenges</td>
<td>Supporting Interview Quotes</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>- Patients who need admission spend longer in the ED than other patients</td>
<td>- “takes a lot of time to get community services set up, often can’t get elderly patients discharged into a safe situation” – P1</td>
</tr>
<tr>
<td>- Can be difficult to find a place to discharge patients to</td>
<td>- “Biggest problem is patient boarding, due to shortage of nursing staff and patient surging” – P1</td>
</tr>
<tr>
<td>- Additional ED visits over direct admissions</td>
<td>- “No mechanism to send patient from their doctor to the hospital, most use ED” – P1</td>
</tr>
<tr>
<td></td>
<td>- “No idea what percent [of hospitalists will see directly admitted patients]. If not, strong incentive for ED” – P3</td>
</tr>
</tbody>
</table>

*Table 2: Advantages and Challenges of the Emergency Department as the Front Door for Admissions*
6.0 Conclusions to First Phase of the Research

The results of the interviews just described took this dissertation research in an unexpected “good news, bad news” direction. The bad news was the initial cost- and payer-driven dynamic hypothesis of the dissertation appeared to be rather clearly disconfirmed by the respondents in the interview process. There seems to be little point in doing further research to build confidence in this dynamic hypothesis. On the other hand, participants did seem to agree endogenous actions of hospitals in utilizing hospitalists rather than family physicians with admitting privileges to oversee inpatients has changed the way patients are admitted. Increasingly over the past several decades, the emergency department is being transformed into the primary way a hospital admits the majority of patients, resulting in an increase in patient volume, with the additional patients placing a disproportionately high burden on the ED.

6.1. Broad Disconfirmation of Modeled Dynamic Hypothesis

The dynamic hypothesis proposed the ED as a "backdoor for admissions" in response to pressure by payers on PCPs to reduce hospitalizations. The hypothesis proposed payers’ policies intended to reduce hospitalizations would increase paperwork and time for PCPs to get hospitalizations approved by insurance and they would respond by sending patients to the ED to circumvent this. The doctors interviewed soundly disconfirmed this precise mechanism.

The first disconfirmation was whether physicians’ behavior was influenced by payer incentives when making healthcare decisions. P3 stated he doesn’t believe any payer attempts to influence doctors have been successfully, specifically saying, “incentives to keep [their] office open after hours doesn’t work. Providing data to doctors doesn’t work.” Nor did he believe providing data to providers about their ED utilization was effective. From the provider’s prospective it’s “less work, worry, uncertainty, liability to send to ED.”
The consensus of the participants was PCPs are relatively inured to the efforts of payers to control their behavior. P3 described the factors used by physicians in determining whether to directly admit a patient as the “clarity of diagnoses – easier to directly admit someone when you know what is wrong, severity – would much rather have sicker patients evaluated in the ED and patient preference – some patients insist on being admitted directly.” None of the doctors considered the payer a factor in these decisions.

6.2. *Meta-Hypothesis of Endogenous Causes to Overcrowding in the Emergency Room not Disconfirmed*

The disconfirmation of the specific mechanism does not disconfirm the meta-hypothesis of an endogenous mechanism redirected patients to the ED. Quite to the contrary, all participants brought up hospitalists, hospitalists, hospitalists. The rise of the profession of hospitalists created a fundamental shift in the way patients with urgent medical problems are admitted to the hospital.

Hospitals prefer patients to be managed by hospitalists because they have a shorter average length of stay; P1 estimated a GP’s patients would stay in hospital for at least an extra day. He also said hospitalists have better outcomes for patients because the nurses have immediate access to hospitalists. The ED was described as superior to a GP’s office for testing and determining the necessity of admission with tests taking “half an hour vs [multiple] hours at their office” (P1).

PCPs experience their own pressures to give up admitting privileges in favor of using hospitalists. Travel to the hospital to visit patients is seen as inefficient compared to remaining in their office and seeing additional outpatients (P1). Higher outpatient volume in the clinic means
higher income for PCPs. Giving up admitting privileges also allows a PCP to have a more regular schedule and avoid late nights or weekend work attending to admitted patients.

6.3. An Emergent Proposition: The Emergency Department is becoming the Hospital’s Primary Admissions Department

P1 flat out stated, “there is no mechanism to send a patient from their doctor to the hospital, most use the ED.” He estimated only 5-10% of physicians still visit their patients in the hospital. P2 said in 2003-2005 there was a shift from patients being directly admitted to using hospitalists. Under this system, his hospital system uses a quasi-transfer center, which a PCP can call. The center routes acute and stable-but-acute patients to the ED. He said it is possible for a PCP to talk to a hospitalist to get a patient directly admitted but estimated the number of patients actually admitted this way was in the “single digits.” Consequently, this leaves the ED as the primary admission department for non-elective admissions. This translates in the model to a closing of the flow of patients from the PCPs office directly to the hospital inpatient floors. Instead, this flow is redirected to the emergency department. There would be a growing stock of hospitalists to replace the PCPs treating the patients in the hospital.

As discussed in Chapter 3.0, if the dynamic hypothesis is disconfirmed, as it was here, the next step is return to creating/refining a dynamic hypothesis. The interviews, in addition to disconfirming, offered a great deal of direction, as described above, about what a new dynamic hypothesis might look like. Part II used this as a springboard to repeat the process of using the existing literature and reference data (along with the work in Part I) to develop a new formal dynamic hypothesis.
Part II: Reimagining the Emergency Department as the Hospital Admission Department

7.0 Return to the Literature: Is Emergency Department-as-Admissions Department a New Idea in Health Policy Research?

The interviews reported in Chapter 6 both closed off the first phase of research by providing important disconfirmation of the original dynamic hypothesis, but also opened up a new line of inquiry. The proposition of the emergency department now serving as the admissions department for most of the rest of the hospital seemed very apparent to the emergency room doctors who were interviewed in our sample. But this result raises the question of why the literature review, reported in Chapter 3, did not clearly point to this endogenous mechanism, clearly stated by the participants who live and work in the system, as an important driver of admissions to and hence patient census in the emergency department.

These observations motivated a return to the literature. Had the dissertation’s initial literature review just overlooked these important drivers of emergency room overcrowding or is it possible these causes of overcrowding have not yet been explored and reported upon in health policy research? To explore these questions, we go back to search the literature for any existing studies linking hospitalists with increased emergency visits.

The hypothesis before beginning the search was no previous study had linked the rise of hospitalists with an increase in the number of emergency department visits. The search was conducted using EBSCOhost: Academic Search Complete, Health Source - Consumer Edition, Health Source: Nursing/Academic Edition, MEDLINE with Full Text, Social Sciences Full Text (H.W. Wilson), MEDLINE and Google Scholar. The following search terms were used in database:
Hospitalists AND hospital admission process
Hospitalist AND admitting privileges
"physician admitting privileges"
allintitle: hospitalist "emergency department"
allintitle: hospitalist "emergency room"

The search was further limited to articles which were peer-reviewed and published after 1995, as hospitalists did not exist in any significant number prior to this. Articles were hand screened for relevancy, particularly from Google Scholar, which produced 308 results, but the vast majority were irrelevant. Articles were disqualified immediately if they were not peer-reviewed, published after 1995 and about the US healthcare system.

Articles which passed this screening were then evaluated for relevancy. To be included, an article had to either discuss both hospitalists and the emergency department, or hospitalists and the hospital admission process or changes over time in the hospital admission process. The screening process narrowed the results down to 30 articles.

These articles can be grouped broadly into five major themes: the transition to hospitalists, health outcomes and quality of care, choice of service providers for admissions, hospitalists and ed throughput, and hospitalists as educators. The first major theme, transition to hospitalists, table 3, covers articles which discuss how the use of hospitalists came about and the characteristics of physicians who switched to using hospitalists. Many studies tracked the percent of physicians using hospitalists as the profession was established and expanded (Boonyasai Romsai, Lin, Brotman Daniel, Kuo, & Goodwin James, 2015; Ivins, Blackburn, Peterson, Newton, & Puffer, 2014)
Some studies examined the benefits of hospitalists which motivated the transition. These included pressure for PCPs to increase outpatient volumes (Pham Hoangmai, Devers Kelly, Kuo, & Berenson, 2005), revoking of admitting privileges as retribution for PCPs offering services which compete with hospitals (Berenson, Ginsburg, & May, 2007) and the view PCPs have of hospital visits as an inefficient use of time (Srivastava et al., 2005). One study on the origin of hospitalists found local orchestrators were key in getting hospitalists accepted and supporting the expansion of their profession (Wallace & Schneller, 2008).

Many studies focused on the characteristics of PCPs or patients, such as PCP specialty or age. The studies looked for a correlation between these characteristics and whether they utilized hospitalists (Boonyasai Romsai et al., 2015; Ivins et al., 2014). All of the studies in this category, while tracking which and how many doctors and patients were using hospitalists, did not dig down into the nitty-gritty of the process of how patients are admitted. The only study to mention the emergency department at all did so as a discussion of how sharing a hospital between an inpatient program with low patient volume and the ED could improve the financial sustainability of the inpatient program (Dudas, Monroe, & McColligan Borger, 2011).
<table>
<thead>
<tr>
<th>Study</th>
<th>Method</th>
<th>Research Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boonyasai Romsai et al. (2015). Characteristics of primary care providers who adopted the hospitalist model from 2001 to 2009</td>
<td>Retrospective study using 100% of Texas Medicare claims in 2001-2009</td>
<td>PCPs who adopted the hospitalist model transitioned rapidly. Hospitalist use associated with U.S. training, family medicine specialty and high outpatient volumes. Relative hospitalist use decreased among female PCPs, those in urban locations and high inpatient volumes.</td>
</tr>
<tr>
<td>Pham Hoangmai et al. (2005). Health care market trends and the evolution of hospitalist use and roles</td>
<td>Semistructured interviews in 12 randomly selected, nationally representative communities</td>
<td>Wide variation in hospitalist use. Financial pressure on PCPs to increase volume of outpatient volume. Plans to support hospitalists based due to belief they reduce costs. Hospitalist use predominately related to the hospital payment method.</td>
</tr>
<tr>
<td>Srivastava et al. (2005). Community and hospital-based physicians' attitudes regarding pediatric hospitalist systems</td>
<td>Cross-sectional survey of all physicians with admitting privileges at a tertiary-care, pediatric, teaching hospital</td>
<td>61% were community physicians and 72% spent the majority of their time in outpatient care. Community physicians more often characterized inpatient care as an inefficient use of time. Being &lt;40 years old and practicing &gt;13 miles from the hospital were associated with more positive attitudes towards hospitalists.</td>
</tr>
</tbody>
</table>

**Literature Review**

Local orchestrators achieved enough confluence of interests with key stakeholders to create a new professional role. Problems of communication and coordination of care are endemic to all specialist medical divisions of labor, not just hospitalists and PCPs.

Dudas et al. (2011). Community pediatric hospitalists providing care in the emergency department: an analysis of physician productivity and financial performance

**Revenue and cost data for July 1, 2008-July 1, 2009 for two community-based pediatric hospitalist programs**

Some pediatric inpatient programs are losing money. To improve sustainability the pediatric hospitalist was also assigned to the ED. The two hospitals have low inpatient pediatric volumes. Change improved the financial sustainability.

Ivins et al. (2014). A majority of family physicians use a hospitalist service when their patients require inpatient care

**Secondary analysis of cross-sectional survey of physicians in 2001**

Survey of family physicians’ strategies when patients require inpatient care. 54% use hospitalist service. 18% manage hospitalized patients themselves. Physicians who provide care that generally requires admission (such as obstetrics or major surgery) more likely to manage their own patients.

Table 3: Summary of articles about the transition to hospitalists

The second major theme was how hospitalists affect health outcomes and quality of care for patients, table 4. The most common concern expressed about hospitalists in regard to health outcomes was the loss of continuity of care, doctor-patient relationship and accompanying challenges with ongoing care coordination (Antommaria & Srivastava, 2006; Pham, Grossman, Cohen, & Bodenheimer, 2008; Solan, Sherman, DeBlasio, & Simmons, 2016). Chart reviews of admitted patients found patients with a PCP without admission privileges had an 84.1% rate of unacceptable medication discrepancies compared to 44.9% of those whose PCPs did have admitting privileges (Trompeter Jessica, McMillan Ashlee, Rager Michelle, & Fox Jeremy, 2014). A survey found PCPs were notified via admission summaries 93% of the time when their
patients were admitted to the hospital under the care of a hospital and received a phone call only 5.8% (McMillan, Trompeter, Havrda, & Fox, 2013).

Challenges in continuity of care exist in any situation in which there is a patient hand-off and rather than avoiding hand-offs, which may not be ideal or even possible in some cases, another is to improve them as one study did. This study conducted a pilot test of a hand-off tool for transfers of patients from the ED to hospitalists and it reduced the number of intensive care transfers by 58% (Gonzalez et al., 2018).

The effects of hospitalists are far from all negative. Hospitalists reduce both cost and length of stay compared to internists without compromising either mortality or patient satisfaction (Davis et al., 2000). Another study found hospitalists to be effective at identifying and preventing unnecessary admissions, which shields patients from the risks of infection inherent in any inpatient stay (Caulfield et al., 2018).
<table>
<thead>
<tr>
<th>Study</th>
<th>Method</th>
<th>Key Research Points</th>
</tr>
</thead>
</table>
| Antommaria and Srivastava (2006). If cardiologists take care of patients with heart disease, what do hospitalists treat?: Hospitalists and the doctor-patient relationship | Literature Review                           | • Doctor-Patient Relationship (DPR)  
• Patient choice of doctor undermined if hospitalist is mandatory  
• PCPs use hospitalists for rarer conditions |
| McMillan et al. (2013). Continuity of care between family practice physicians and hospitalist services | Chart review of patients from one PCP office admitted to hospitalist services | • Continuity of care, PCPs contacted via admission summary 93% of the time and phone call in only 5.8% of cases  
• Frequent medication discrepancies |
| Trompeter Jessica et al. (2014). Medication discrepancies during transitions of care: a comparison study | Retrospective chart review of patients admitted to the hospital | • PCP-AD had a 63.4 % and 44.9% rate of unacceptable medication discrepancies on admission and discharge respectable  
• PCP-NOAD had 90.3% and 84.1% |
| Pham et al. (2008). Hospitalists and care transitions: the divorce of inpatient and outpatient care | Interviews with hospitalists and non-hospitalists | • Increase in hospitalists creates divide in inpatient and outpatient care  
• Challenge to ensure accountability and care coordination  
• Few respondents believe providers are tackling these challenges |
| Solan et al. (2016). Communication challenges: a qualitative look at the relationship between pediatric hospitalists and primary care providers | Two sets of focus groups, one a mix of local PCPs and the other hospitalists from a pediatric institution | • Interviews with PCPs and hospitalists about communication  
• Different perceptions of provider roles  
• Conflicting expectations of each other  
• Unclear post-discharge responsibilities |
<table>
<thead>
<tr>
<th>Study</th>
<th>Methodology</th>
<th>Results</th>
</tr>
</thead>
</table>
| Caulfield et al. (2018). Patients discharged from the emergency department after referral for hospitalist admission | Retrospective study of consults performed in the ED by the Division of Hospital Medicine at the University of North Carolina School of Medicine | - Unnecessary hospitalizations expose patients to risk and cost
- Hospitalists able to safely identify unnecessary hospitalizations in patients referred to the ED for admission |
| Davis et al. (2000). Effects of hospitalists on cost, outcomes, and patient satisfaction in a rural health system | Comparison of outcomes for patients at the North Mississippi Medical Center | - Compared outcomes between patients treated by internists or hospitalists
- Hospitalists had reduced cost and length of stay
- No difference in mortality or patient satisfaction |
| Gonzalez et al. (2018). Handoff tool enabling standardized transitions between the emergency department and the hospitalist inpatient service at a major cancer center | Pilot test of a handoff tool for admitting patient from ED to hospitalist | - 1-month pilot test
- Reduced number of intensive care transfers by 58%
- Reduced number of rapid-response team calls by 39%
- Decreased time to inpatient order by 31% |
- 95% reported their hospital accepted direct admissions and 50% believed more children should be admitted directly
- Only 1% did not have pediatric hospitalists
- Improves efficiency of admitting and getting patient to pediatric specific care
- Direct admits increase workload for nurses
- Difficulty determining appropriateness of admissions |

Semistructured interviews with parents of hospitalized children at four structurally diverse hospitals

- 45% had chronically ill children
- 52% were admitted directly
- Children had a median of two healthcare encounters in the week prior to admission
- Among ED admissions 43% had first contacted PCP and been directed there
- Hospital admission priorities were clinical care, efficient admission process, safety, timeliness and patient and family-centered processes of care

<table>
<thead>
<tr>
<th>Table 4: Summary of articles about hospitalists’ effect on the quality of care and patient outcomes.</th>
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</table>

The third major theme was the impact of hospitalists on the ability for patients to choose their own care provider as summarized in table 5. The most obvious problem in this area is for patients who prefer being seen by their own doctor in the hospital, but are now forced to use a hospitalist (Sox, 1999). The second issue is whether patients have any choice in which hospitalist they are assigned and finally, there is some concern about whether patients whose PCP would see them in the hospital are mistakenly assigned to a hospitalist and how this determination is made (Zsenits, Polashenski Walter, Sterns Richard, Brown David, & Moheet, 2009).
### Choice of Service Providers for Admissions

<table>
<thead>
<tr>
<th>Study</th>
<th>Method</th>
<th>Research Issues</th>
</tr>
</thead>
</table>
| Morsi, Lindenauner Peter, and Rothberg Michael (2012). Primary care physicians' use of publicly reported quality data in hospital referral decisions | Web-based physician survey                                              | • PCP use of public data for hospital quality  
• No doctors reported using hospital quality data in admission decisions |
| M. E. Miller, Welch, and Englert (1995). Physicians practicing in hospitals: implications for a medical staff policy | Analysis using file all Medicare admission nationally in 1992          | • 62% of attending physicians have only one hospital affiliation  
• Attending physicians average 1.35 affiliations |
| Carlin Caroline, Feldman, and Dowd (2015). The impact of hospital acquisition of physician practices on referral patterns | Longitudinal dataset of referrals for inpatient admissions and outpatient diagnostic imaging from three clinic systems purchased in 2007 by two hospital-owned integrated delivery systems (IDSs) | • Patient choice of facility is guided by the recommendations of their doctor  
• After acquisition, a decrease in the use of facilities historically selected  
• Increase in use of acquiring IDS’s facilities |
| Sox (1999). The hospitalist model: Perspectives of the patient, the internist, and internal medicine | Literature review, problem statement                                   | • MCOs may have mandatory hand-offs, threatening patient choice of their physician  
• Threat to the professional identity of internists as distinct from family physicians |
| Zsenits et al. (2009), Systematically improving physician assignment during in-hospital transitions of care by enhancing a preexisting hospital electronic health record | Evaluation of integrated system of algorithms and interface solutions integrated into the hospitals electronic health records (EHR) program | • System is a support tool for determining which patients should be admitted by the hospitalist team and which to their PCP  
• Have ED call PCP was unreliable  
• System received unanimously positive assessment by users |

*Table 5: Summary of articles discussing patient choice of physician*
The fourth major theme was studies of how hospitalists could be used to improve ED throughput as summarized in Table 6. These studies are of pilot tests or pre- and post-intervention examinations of various interventions using hospitals to improve efficiency and decrease wait times for patients to receive care. One study used volunteer and attending physicians to help EMS direct ambulances based on hospital resources (Shah Manish et al., 2008).

The rest of the studied interventions are variations of using hospitals in active bed management or evaluating, and in some cases treating, patients directly in the ED. All of these interventions dramatically reduced the amount of time patients were in the emergency department and in the case of patients treated in the ED some were even able to be discharged or downgraded directly from the ED. These programs helped alleviate the disproportionate burden of patients using the ED as the admissions department, but they do not explain why additional patients got to the ED in the first place.

<table>
<thead>
<tr>
<th>Hospitalists and ED Throughput</th>
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<tbody>
<tr>
<td><strong>Study</strong></td>
</tr>
</tbody>
</table>
| Shah Manish et al. (2008). Description and evaluation of a pilot physician-directed emergency medical services diversion control program | Controlled trial in Rochester, New York | - Pilot test of a physician directed ambulance destination control program  
- EMS consults with volunteer attending physicians  
- Ambulance destination based on hospital resources and need for continuity of care |
<table>
<thead>
<tr>
<th>Studies</th>
<th>Methods</th>
<th>Findings</th>
</tr>
</thead>
</table>
| Chadaga et al. (2012). Hospitalist-led medicine emergency department team: associations with throughput, timeliness of patient care, and satisfaction | Pilot test of Hospital Medicine ED (HMED) team at the Denver Health Medical Center | • Developed HMED team for active bed management  
• Patients were seen earlier  
• Number of patients transferred to medicine floor and discharged within 8 hours reduced 67%  
• Discharge from ED of admitted patients increased 61% |
| Howell et al. (2008). Active bed management by hospitalists and emergency department throughput | Pre-post study of hospitalist-led active bed management program at John Hopkins Bayview Medical Center in Baltimore, Maryland | • Program in which a hospital would regularly visit the ED, evaluate and help triage admitted patients to particular departments  
• Throughput time for admitted patients decreased by 98 minutes  
• Throughput time for patients not admitted stayed constant  
• Time on ambulance diversion decreased |
| Howell, Bessman, and Rubin (2004). Hospitalists and an innovative emergency department admission process | Observational study of pre and post-intervention cohorts at John Hopkins Bayview Medical Center | • Test of new admission procedure involving patients being admitted form the ED after a phone consultation with a hospitalist  
• Reduced admission time from 2.5 hours to 18 minutes for transfer to a ward  
• Length of stay and mortality rates remained constant |
| Howell, Bessman, Marshall, and Wright (2010). Hospitalist bed management effecting throughput from the emergency department to the intensive care unit | Pre-post study of active bed management program at John Hopkins Bayview Medical Center | • Hospitalist dedicated 24/7 to evaluation and assignment of admissions and proactive management of department of medicine resources  
• Throughput time from ED to medical ICU was reduced by 99 minutes  
• ICU transfer and death rates were stable |
Briones et al. (2010). A model of a hospitalist role in the care of admitted patients in the emergency department

| Three-month test of a new ED Hospitalist role at Mount Sinai Medical Center in NYC | • Designated a full-time hospitalist to manage patients boarded in the ED  
• Quality and timeliness of care improved  
• Considerable number of patients discharged or downgraded from high demand telemetry beds |

*Table 6: Summary of articles covering the impact of hospitalists on ED throughput*
The final major theme is the role hospitalists play as educators, table 7. It was hypothesized hospitalists may improve in hospital teaching because they are experts in hospital care rather than generalists (Goldman, 1999). A survey of residents in a teaching hospital found 97% reported hospitalist clinician educators improved the quality of teaching (Kulaga et al., 2004).

<table>
<thead>
<tr>
<th>Study</th>
<th>Method</th>
<th>Research Issues</th>
</tr>
</thead>
</table>
| Kulaga et al. (2004). The positive impact of initiation of hospitalist clinician educators | Two hospitalist clinician educators were hired (HCE), length of stay and cost per case calculated for their first year. Residents were surveyed to assess their impact on education. | • Norfolk Hospital, a 250-bed university-affiliated hospital in Connecticut  
• 42 total residents in 4 teams, 2 teams worked with each HCE  
• HCEs reduced LOS and cost per case  
• 78% return rate of resident surveys, 97% reported the HCEs improved or greatly improved teaching |
| Goldman (1999). The impact of hospitalists on medical education and the academic health system | Literature Review                                                      | • Discusses the risk and benefits of using hospitalists  
• Benefits: may improve quality of care, efficiency, trainees supervised by experts in hospital care and standardized standard of care  
• Risks: may be less likely to request consults, continuity of care |

Table 7: Summary of articles on hospitalists as educators

The existing literature, as described above, cover many facets of the transition to hospitalists and the benefits and risk of their increasing use in health care system. However, there has been no focus on the impact of the shift to hospitalists on the admissions process and the potential consequences of the change on ED patient volume, which could result from PCPs.
directing patients to the ED when they might previously have directly admitted the patient themselves.
Empirical Evidence for the Emergency Department-as-Admission Department

Hypothesis

8.1. Time Series Evidence for the Emergency Department-as-Admissions Department

Hypothesis

Fortunately, a reliable source of time series data documenting sources of admission exists for all inpatient visits to hospitals in New York State. Empirical data was pulled from the publicly available SPARCS data set. The New York SPARCS database provides a longitudinal set of healthcare data for all hospitals in New York State. It is a compilation of patient level data for inpatient and outpatient services at all hospitals and ambulatory surgery centers in New York. Reporting of this data is mandatory for all such health facilities in the state.

The SPARCS dataset has the strength of being a large uniformly collected data set. This analysis used the publicly available audit reports of the dataset. These summarize how many outpatient admissions, inpatient admissions, emergency department visits, and admissions from the ED records each hospital reported each year.

The SPARCS data set can provide time series on overall hospital admissions by individual hospital, by region and for New York State as a whole. Below we provide a SPARCS-driven analysis of admissions from the emergency department for New York State as a whole as well as for each of the three hospitals in the interview sample. Pulling out the audit reports for individual hospitals allows the data to be compared directly against the participants statements in the interviews about the impact of hospitalists on ED visits and the source of hospital admissions. The audit reports summarize how many inpatient, outpatient and ED patient encounters each facility reported each month. Whether a patient was seen in the ED is determined by whether the patient record includes an ED billing code.
The interviews were compared against data of hospital admissions and ED visits for New York State and the individual hospitals at which the interviewed doctors worked. A further interview was conducted with a senior member of the admissions department of hospital A to discuss admissions policies and available avenues for admission.

8.1.1. Data for New York State as a Whole.

New York shows the same pattern of admissions sources seen in the national reference mode data of decreasing direct hospital admissions and increasing admissions from the ED as seen in Figure 14. Notably, this change appears to have started prior to 2005 in New York, while the national data shows the trend starting in 2007. This suggests different regions, and potentially different hospitals, began using hospitalists at different times. The time of this switch shows a mismatch with the behavior of the dynamic hypothesis v1.

![Figure 14. New York State Hospital Admissions by Source](image-url)
Figure 15 shows the total number of ED visits in New York steadily increasing from 2005 to 2016, though at a linear rather than exponential rate seen in the national reference data. Figure 16 shows an interesting picture of the percentage of ED visits admitted to the hospital remaining constant despite the accompanying decrease in patients being admitted from other sources and steady overall admissions. On the surface this does not fit with the idea of patients being redirected from direct admission to ED, as intuitively those new patients would have a higher percentage being admitted.

It is possible, however, the ED tests rule out unnecessary hospitalizations among redirected patients. All three interviewees discussed the benefits of testing available in the ED to confirm diagnoses prior to admission which could not be done in a PCP’s office prior to a direct admission. P3 specifically called out the value of the ED in “eliminating any uncertainty about what is wrong with the patient and how sick they are.”

![Total ED Visits in New York State](image)

*Figure 15. Total ED visits in New York state from 2005-2016*
8.1.2. Data for Hospital A in Interview Sample

P1 had little to say on the particulars of trends in admissions at the hospital at which he worked, with his input focused primarily on the perspective. It is possible Hospital A saw the transition from majority of admissions being direct to the majority being through the ED earlier than the state as 2004-2005 show this increasing disparity in admission sources in Figure 17, but as-is the data does not match the model behavior either due to a time shift or behavioral difference. Overall the hospital had a consistent majority of admissions coming from the ED with a slight decline in total admissions. Shown in Figure 18, the percent of admission coming from the ED went from 71% in 2004 to 79% in 2017. Meanwhile the percentage of ED visits that were admitted remained fairly steady with a slight of 6% between the highest and lowest points, consistent with the state as a whole.
At the 2004 start of the available audit data, Hospital B already has more of its admissions coming from the ED rather than direct admissions, Figure 19. It may be the hospital
always had this pattern of admissions or it may have transitioned sooner than the majority of hospitals in the state. Hospital B also shows the decrease in total inpatient admissions and ED visits as emphasized by P2.

It also has what initially appears to be a bizarre anomaly. Between 2010-2011, the number of patients admitted from the ED falls to near zero, while the number of patients admitted in other ways rises to keep total admissions consistent. This turns out to be a result of the policy P2 described of not billing for an ED visit if a patient is admitted from the ED and represents a serious limitation of the data. The SPARCS dataset using revenue codes to determine whether a patient was seen in the ED, so because the admitted patients were not billed for the ED portion of their stay they do not appear as ED patients at all. This also means the total ED visits for Hospital B after 2010 will be understated by the number of ED patients admitted and cannot be reliably used.

![Hospital B: Admissions by Source](image)

*Figure 19. Hospital B admissions by source*
This change to not charging for the ED if a patient is admitted does imply the hospital embraces the ED being used as the primary admissions department for the hospital, which is consistent with the participants responses. Certainly, it is an incentive for patients to be sent straight to their ED, rather than looking for another avenue of admission. In Figure 20, you can see ED visits were rising from 2004-2010 when the coding change occurred.

![Hospital B ED Visits vs Inpatient](image)

*Figure 20. Hospital B ED visits vs total inpatient admissions*

### 8.1.4. Data for Hospital C in Interview Sample

The tail-end of an increase in admissions from ED and decrease in admissions from other sources can be seen between 2004 and 2005, for hospital C, in Figure 21. This further supports the idea this region transitioned sooner than the rest of the state as a whole. Starting in 2009, it can be seen the hospital was making a transition away from being an inpatient facility. It is currently an ambulatory center having entirely phased out its inpatient service offerings. This makes hospital C entirely inconsistent with model. All three hospitals show very idiosyncratic behavior, the limited number of represented hospitals is a limitation of this study. Furthermore,
none of the three represented hospitals match the aggregated hospital data for the state as a whole. The findings are not generalizable outside the study area and require further research.

P1 and P2 discussed how hospitalists reduce length of stay. This would mean fewer beds would be needed to see the same number of patients in a year. With total inpatient admissions in the state remaining constant to slightly declining, this would suggest there would be a need to reduce excess inpatient capacity in the state. This could be part of the driver behind hospital C moving away from having an inpatient facility in favor of being solely an urgent care center. This possibly casual connection could be included in the second version of the dynamic hypothesis.

![Hospital C: Admissions by Source](image)

*Figure 21. Hospital C admissions by source*
8.2. Related Evidence from Exploration of Other Hospital Admissions Procedures and Records

A very straight-forward approach to seeing whether or not the emergent propositions sketched in Chapter 7 do indeed represent current hospital admissions practices would be to visit the admissions offices of the three hospitals in the interview sample and collect admissions forms and other documentary evidence which details how admissions are currently completed and how such procedures have changed in the recent past.

Interview subject P2, from hospital B in our sample, recommended an experienced member of the admissions staff to provide this research with samples of admissions documents currently in use in hospital B. We visited hospital B with the intent of collecting a set of relevant documents which detail how admissions procedures are currently structured, including descriptions of standard operating procedures. Apparently, such documentary evidence does not exist because inpatient admissions are now fully online and are not supported by documentary evidence. Furthermore, exact online records are protected by HIPPA regulations.

Figure 22, below, is a legacy paper version of the information required for patient registration in hospital B. The key field in the record is “Admitting Physician”. The normal procedure for an admission from the emergency department is to have a member of the emergency department staff call up to a hospitalist or other key staff in the department to which the patient is being admitted. Records from the emergency department are transferred to the admitting department and the admitting physician is the hospitalist or other staff from the designated admitting department.

In lieu of being able to provide written policies or other forms, P4 was interviewed as summarized in 14.0 Appendix D. The most important information she had to impart was while it
was always possible for a patient to be admitted urgently, by having a PCP doctor call and have them admitted by a hospitalist or surgeon, the number of these admissions was “minimal compared to ER.” She also said what counted as an inpatient procedure or emergency had changed dramatically in her time there. For example, “gallbladder is no longer an emergency” and many procedures which were once inpatient surgeries can now be done outpatient. Finally, she said ED visits “are way up” and admissions have always been highest from the ED.
Figure 22: Hospital A paper patient registration form front and back
9.0 Dynamic Hypothesis Version 2

A new dynamic hypothesis was developed based on the disconfirmatory interviews, statistical evidence and secondary literature review. This new hypothesis centered on the adoption of hospitalists, the way patients are admitted and the resulting impact on ED crowding and hospital revenues. The stock and flow diagram is shown in Figure 23.

9.1 Model Structure

The creation and growth of the hospitalists was modeled using a Bass diffusion model. The initial trigger was the switch from Fee for Service, which payed hospitals per day, to Fee for Value, which payed a fixed amount for a diagnosis, from the insurance companies as described by Participant 2 and cited by Pham Hoangmai et al. (2005). This change promotes the use of hospitalists, because their patients have shorter lengths of stay than patients admitted by their PCP, and allows PCPs to increase their outpatient volume because they spend less time traveling back-and-forth between the hospital and their clinic.

A Bass diffusion was chosen because the participants all emphasized PCPs like the hospitalist model because of its many benefits to them. These include less travel, ability to have more outpatients in a day, and a more predictable and regular schedule. Without inpatients, a PCP never has to go to the hospital late or visit his inpatients during the weekend. The use of hospitalists was an innovation which had to be proven by a few earlier adopters before it began to catch on; once it did, it took off rapidly (Wallace & Schneller, 2008). This growth pattern is consistent with a bass diffusion model of technological innovation and adoption. There are few early adopters early on then as the innovation spreads the word-of-mouth feedback loop takes over and there is exponential growth of adopters until it starts leveling off at market saturation.
Figure 23. Dynamic hypothesis version 2 stock and flow diagram.
All primary care doctors start out directly admitting patients. The number of doctors is calibrated to New York State, based on data from the Association of American Medical Colleges website (Colleges). The contact rate, adoption fraction and adoption from pressure were chosen such they transition over the 24-year timeframe of the model. This matches P1’s statement “as recently as 5 years ago many doctors were still admitting.”

The percent of admissions using hospitalists depends solely on the number on PCPs who have transitioned to using hospitalists. This is because the hospital cannot turn away patients at the emergency department even if they are understaffed. An increase in these urgent admissions drives an increase in the desired number of hospitalists. This drives recruitment of additional hospitalists, though this takes time and assumes an infinite supply. As a result, the actual number of hospitalists lags behind the desired number, which would mean each hospitalist has a higher than ideal patient load. This has no effect in this version of the dynamic hypothesis but is a point which could be built upon in expert interviews and should be discussed. For example, it is possible higher patient loads could increase length of stay or even result in more readmissions, further increasing the number of urgent admissions the hospital must deal with.

The average days per direct admission and average days per hospitalists admission are based on the current range of length of stay for hospital admissions in the US ("Hospital admissions, average length of stay, outpatient visits, and outpatient surgery, by type of ownership and size of hospital: United States, selected years 1975–2014," 2016) and P1 and P2’s statements about using hospitalists can reduce the length of stay by between one to five days. The number of desired inpatient beds for urgent admissions is based on the number of admissions and the length of stay. As a result, as length of stay goes down, the desired number of
inpatient beds goes down and thus capacity is reduced. This saves the hospital money and raises profits.

9.2. Model Output

The model begins in equilibrium; this is disrupted by the Switch to FFV from FFS, which occurs in 1996, corresponding with the earliest appearances of hospitalists in the literature. The pay structure change activates the adoption from pressure mechanism. It also changes the income for hospitals over to being paid per patient rather than per day each patient is admitted.

Figure 24 shows the transition of doctors from the stock of PCPs who directly admit patients to the stock of PCPs who use hospitalists. The calibration aligns with the appearance of hospitalists as a profession in 1996 and the statement of multiple interviewees contending very few PCPs still directly admit in 2018. These admissions are shown in Figure 25 as generating new ED visits. This assumption comes from P1’s claim there is no mechanism for a PCP to have a patient directly admitted to his hospital along with P4’s statement “urgent admissions are minimal compared to ER.” It may be possible for PCPs to directly hand off a patient to hospital staff, but the interviews all indicate this is rare and probably not ideal because the ED has faster testing.
Figure 24. The shift of PCPs from directly admitting patients to using hospitalists.

Figure 25. Admissions from PCPs using hospitalists create new ED visits.
Figure 26 shows a graph of the number of hospitalists and the desired number of hospitalists to meet the demand of patients no longer being directly admitted. Due to the delay inherent in recruiting or training new hospitalists there is a shortfall of hospitalists for the entire run; the size of shortfall changes in proportion to the time to recruit. This shortfall has no causal impacts in the current version of the model but recommends a point future interviews may expand upon. It is possible, for example, the higher patient load on hospitalists increases patient length of stay or even results in more patients bouncing back after discharge, possibly to the ED.

**Gap in Desired vs Actual Hospitalists**

![Gap in Desired vs Actual Hospitalists](image)

*Figure 26. The desired number of hospitalists vs the actual number.*

Figure 27 shows the number of hospital beds in the state declining, albeit on a delay. This happens because the total number of patients being admitted is steady, but the length of stay has decreased. This efficiency improvement in throughput means fewer beds are needed which results in the reduction in beds seen in Figure 27. This causal link should be tested using expert interviews.
Figure 27. The number of hospital beds declines due to increased efficiency of hospitalists.

9.3. Additional Mechanisms

This model is the barebones necessary to produce the observed dynamic behavior and is currently without feedback. There are likely many different feedback connections driving this behavior in the real world. The next round of interviews should explore and elicit these type of additional feedback connections from interview participants. Some of these additional mechanisms are discussed below.

2a. PCP Contagion

The second hypothesis in the barebones model is the “PCP contagion” mechanisms where PCPs convince each other to use hospitalists. This happens through word of mouth contact between physicians.

2b. Change in Hospital Reimbursement
There was a shift in how hospitals were paid for their services. The original model, fee-for-service, gave hospitals a set amount of money per patient, per day. The new model, fee-for-value or “capitated” reimbursements give the hospital a lump sum per patient based on diagnoses regardless of how long the patient is admitted for. This change incentivizes hospitals to find ways to reduce length of stay for patients to maximize profits. Hospitalists have a shorter length of stay than PCPs because they don’t have to travel and are on-site all day to order and review tests on their patients.

2c. Hospitals can maximize income/hospitalists recruits

PCPs are often independent from hospitals, running their own community clinics alone or in physician groups. By using hospitalists, a hospital keeps the patients care “in-house” which can increase their income. This could incentivize a hospital to recruit hospitalists, so they don’t need to outsource as many patients.

2d. Why become a hospitalist?

The current model does not discuss what leads physicians to become hospitalists. This could, and based on future interviews, should be filled out. Possible drivers of appeal for PCPs could include having more regular hours at the hospital or a physician finds the more acute situations which come with admissions more interesting than PCP care.
10.0 Conclusions, Reflections, and Next Steps

10.1. Reflections on Hospitalists and Emergency Departments

This research set out originally with two hypotheses. The first was a high-level assertion there is an endogenous mechanism contributing to ED crowding. The second was the exploration of what this specific mechanism is. The original model proposed PCPs were using the ED as a back-door to admit patients to hospitals to avoid obstacles or delays required by payers to reduce unnecessary or excessive use. The policy was backfiring on payers as not only would patients still be admitted, they would generate an extra ED visit each on top of those hospital admissions.

The interviewees universally and emphatically rejected the back-door mechanism. However, they supported the overarching hypothesis of an endogenous mechanism and proposed hospitalists as a driver of increased ED use. A return to the literature revealed prior to the mid-90’s, virtually all PCPs would admit patients to local hospitals when needed under their own care. In the mid-nineties, the new profession of hospitalist emerged. Hospitalists took over the duties of caring for admitted patients from PCPs. This arrangement benefitted both the hospital and the PCP. Hospitalists had shorter lengths of stay than PCPs, increasing the number of patients who could be served over the year. PCPs benefitted from not having to travel the hospital to see patients. Hospitalists began growing in number until very few PCPs still admit patients themselves.

This transition had a potentially unanticipated side-effect. When PCPs had admitted patients, those patients had entered the hospital through the admission or patient registration department. In contrast, to be admitted under a hospitalist the vast majority of patients go through the ED. This creates a significant burden on EDs. Patients admitted through the ED
spend significantly longer there than patients who are discharged from the ED. These patients may also end up boarded in the ED, waiting for inpatient rooms to become available.

Admissions through the ED offer advantages over those through patient registration. The ED can order tests and have them completed quickly. This allows ED physicians and hospitalists to verify a patient truly requires admission and can confirm diagnosis prior to admitting them. The increased load on the ED does not suggest a policy should move away from using hospitalists. It does, however, indicate a hospital increasing its use of hospitalists should be aware of, and prepare for, the increase burden on the ED as it becomes the front door for admissions.

The exact size of the impact of this switch in how patients are admitted is difficult to determine. There has been little research published about how the LOS of admitted and discharged patients varies. Historical data shows ED visits increased by 15 million between 2003 and 2009, while inpatient admission from the ED increased by 3.1 million (McCaig, 2003; Morganti, 2013). A 2011 multisite cohort study of pediatric patients found, during the observed 24-hour period, patients who were discharged from the ED had an average LOS of 157 minutes while admitted patients had an average LOS of 239 minutes (Barata et al., 2013). Using these numbers, patients admitted represent twice the load in hours spent in the emergency compared to those who are discharged despite being only 20% of the total increase in the number of patients.

$$3.1 \text{ million patients} \times 239 \text{ min/patient} = 740.9 \text{ mill mins}$$

$$11.9 \text{ million patients} \times 157 \text{ min/patient} = 1868.3 \text{ mill mins}$$

It is unclear if pediatric data can be generalized to all emergency department patients. It is also unlikely the true impact of an increasing percentage of admitted patients can be captured in a simple comparison of each cohort individual LOS. The pediatric study used above noted
discharged patients spent longer waiting to be seen initially than admitted patients and these waits were included in LOS. Studies have found admitted patients waiting for a bed increase time to be seen by discharged patients above what it would otherwise be (White et al., 2013). Studies have also found LOS can spike by up to 70 minutes at different times of day (Karaca, Wong, & Mutter, 2012). It is unknown if the additional admitted patients are distributed equivalently throughout the day as discharged patients making this another confounding factor.

This “ED as the front-door” hypothesis was expanded into a second model. This model should serve as a boundary object for additional interviews. These interviews will serve to challenge and elaborate the new hypothesis. From there the hypotheses can tested using econometric methods. This research fills a gap in the literature by examining how policies about how patients are admitted to hospitals may impact the use of EDs.

10.2. Limitations of the Study

This study has several limitations. A small, convenience sample of three ED physicians was used for the interviews. These physicians represented three major hospitals in the New York Capital Region, but cannot be generalized. Each hospital represented also had a unique story in the data both from each other and New York State as an aggregate. This further calls into question how generalizable, or applicable, the interview and data are to other hospitals even within the state, let alone the nation at large.

Data pulled from the SPARCS dataset was based on billing codes. This resulted in a clear miscoding error for the hospital which stopped billing patients admitted through the ED for their ED visits separately. This effectively hid how many patients were admitted through the ED. It cannot be guaranteed there are no other oddities in how hospitals billed and therefore how patients appear in the dataset.
The second dynamic hypothesis leaves many poorly elaborated mechanisms. It should not be considered a complete model of the relationship between the hospital, ED, hospitalists and PCPs. It is filled out enough to serve as a boundary object for interviews with hospital administrators and hospitalists. Those interviews will be necessary to move forward.


The original dynamic hypothesis did not pass the disconfirmatory interview stage. This is much like a statistical study failing to reject the null. However, the researcher proposes this method has a significant advantage over a statistical study which fails to reject the null in its failure to pass the interview stage. When a statistical analysis fails to reject the null, the study is done, and it offers nowhere to go from there. With this method, the way the original hypothesis was rejected generated proposals and ideas for what a new hypothesis might look like. Interviewees did not merely say, “this is wrong” they said, “no, this is what is happening.”

The interviewees were presented with both the available data of the changes in the source of hospital admission and the proposed causal connection of payers making direct admissions more difficult for PCPs. They were asked not just to reject proposed causal connection but propose alternative explanations. The original proposed mechanism created both a problem boundary of sorts and pushed interviewees to consider the entire health system and how PCPs, hospitals, payers, patients and EDs interact.

This worked wonderfully to elicit both disconfirmation and alternative proposals. The work of Part II comes entirely from this feedback from the interviewees. It inspired the new literature review into the relationship between hospitalists and the ED and a look at the public data from a new perspective. From these three steps a second dynamic hypothesis was developed and modeled. The building of the running model produced a number of questions and potential
causal links. The next step of the research would be to compile this into a new interview booklet and conduct a new round of disconfirmatory interviews with hospitalists, PCPs and hospital administrators to test the new dynamic hypothesis.

The cyclical process all but drove itself forward, with each new step coming naturally from the one before. It is the researcher’s assertion this result is not just a one off for this instance of using this process to generate new theory, but intrinsic to the process. This makes the proposed method a powerful tool for generating new theories when there are no obvious theories left to test. This research fills a gap in the area of methods to reliably generate new endogenous theory in health policy issues without waiting for inspiration to strike. This is useful to researchers and policy makers who have either exhausted obvious hypotheses for a complex problem or do not know where to start.


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11.0 Appendix A: Model Equation Documentation

(1) \[ ED \text{ Crowding} = \frac{\text{Total patient hour demand}}{\text{Patient hours ED Capacity}} \]

(2) \[ \text{total patient hour demand} = \text{Total ED Visits} \times \text{normal time in ed} \]

\[ \text{Normal time in ED} = 6 \text{ hour} \]

This, patient hours and capacity are arbitrary value balanced with against the population to start in equilibrium.

(3) \[ \text{Patient hours ED Capacity} = \text{Patient hours per bed per year} \times \text{ED Capacity} \]

\[ \text{Patient hours per bed per year} = 7800 \text{ hours/bed/year} \]

(4) \[ \text{ED Capacity} = \int (\text{ED construction}) dt \]

\[ \text{initial value} = 27 \text{ bed} \]

(5) \[ \text{ED construction} = \text{Planned ED Capacity}/\text{Time to construct ED} \]

\[ \text{Time to construct ED} = 10 \text{ years} \]

(6) \[ \text{Planned ED Capacity} = \int (\text{Planning ED capacity changes} - \text{ED construction}) dt \]

(7) \[ \text{planning ED capacity changes} = (\text{Desired ED capacity} - \text{ED Capacity})/\text{Time to plan ED changes} \]

\[ \text{Time to plan ED changes} = 5 \text{ years} \]

(8) \[ \text{Desired ED capacity} = \text{Total patient hour demand}/\text{Patient hours per bed per year} \]

(9) \[ \text{Total ED Visits} = \text{natural ED visits} + \text{ED referrals by GPs} \]

(10) \[ \text{natural ED visits} = \text{Population} \times \text{natural ED visits per capita} \]

\[ \text{Population} = 100,000 \]

\[ \text{natural ED visits per capita} = 0.35 \]
Population was set an arbitrary round number. Natural ed visits refers to emergency department visits not originating from doctor referrals, such as patient self-referrals or medical emergencies. The natural per capita number of ed visits was set at the approximate United States historic 1990’s level of 350 per 1000. The value from 1990 was chosen because 1990 is the baseline year for this model. From this, the yearly number of visits is a simple multiplication.

\[(11) \quad ED \text{ referrals by GP} = \text{percent of GP admits redirected to ED} \times \text{desired admits from gp}\]

\[(12) \quad \text{desired admits from gp} = \text{total gp visits per year} \times \text{percent of gp visits requiring hospital admission}\]

percent of GP visits requiring hospital admission = 0.07

This is another unknown parameter.

\[(13) \quad \text{total GP visits per year} = \text{gp visits per capita} \times \text{Population}\]

GP visits per capita = 0.4

This is another unknown parameter.

\[(14) \quad \text{percent of gp admits redirected to ED} = \text{effect of wait time to admit on gp referrals to ed} - 1\]

This shifts the output of the logistics function for the effect of wait time admit on GP referrals to ED to a y-range of zero to one rather than one to two.

14.b)

\[
\text{effect of costs on artificial barriers to direct referrals} = 6 \times e^{-5e^{-\text{payer sensitivity to pressure}}(\text{actual over expected costs} - 1)}
\]

gp sensitivity to wait = 2
The use of the Gompertz function in place of a graphical lookup allows the slope of the curve, GP sensitivity to wait, to be automatically varied for sensitivity testing. The initial GP sensitivity was calibrated so that ED Visits per 1000 matches the reference mode.

14.c) expected over normal wait time = \( \frac{\text{Expected wait time for gp referral}}{\text{normal wait time to admit gp referral}} \)

\begin{align*}
(15) \quad & \text{Expected wait time for GP referral} = \\
& \int (\text{chg expected wait for GP referral}) dt \\
& \text{initial value} = 6 \text{ hours} \\
(16) \quad & \text{chg expected wait for gp referral} = (\text{actual wait time to admit gp referral} - \text{Expected wait time for gp referral})/\text{time to adjust expectation} \\
& \text{time to adjust expectation} = 1 \text{ year} \\
(17) \quad & \text{actual wait time to admit GP referral} = \\
& \text{normal wait time to admit gp referral} \times (11 \times \\
& (\text{effect of costs on artificial barriers to direct referrals} - 1) + 1)
normal wait time to admit gp referral = 6

The effect of costs on artificial barriers is rescaled here from a maximum increase of 200% to a maximum increase of 1,200% and then multiplied with the normal wait time to get the actual wait time.

17.b)

effect of costs on artificial barriers to direct referrals

\[ = 6 \times e^{-5e^{-\text{payer sensitivity to pressure} \times (\text{actual over expected costs} - 1)}} \]

payer sensitivity to pressure = 4

Again, the use of a Gompertz function in place of a graphical lookup allows the slope of the curve, payer sensitivity to pressure, to be automatically varied for sensitivity testing. The function output is a percent increase ready be rescaled to any relative maximum increase on the normal wait time. The initial payer sensitivity was calibrated so that ED Visits per 1000 matches the reference mode.

(18) Pressure from payer to reduce hospital use = Total costs / Expected costs

(19) Expected Cost = \int (\text{chng expected costs}) dt
(20) \[ \text{chng expected costs} = \frac{\text{total costs} - \text{expected costs}}{\text{time to change expectations}} \]

\text{Time to change expectations} = 15 \text{ years}

(21) \[ \text{total costs} = \text{ED costs} + \text{total inpatient cost} \]

(22) \[ \text{ED costs} = \text{time adjusted cost per ED visit} \times \text{total ED Visits} \]


(23) \[ \text{total inpatient cost} = \text{Time adjusted cost per admission} \times \text{total admission} \]

The average cost for an inpatient hospital admission has increased over time. Many factors have contributed to this increase, with medical technology development considered a primary driver by many (Cutler, 2004; Kaiser Family, 2007; Newhouse, 1992). This technology includes technologies in the form of machines, such as medical imaging equipment, and
techniques for treating previously untreatable illnesses. For the purposes of this model the cost per admission uses time series data described in the U.S. Census Bureau’s statistical abstract as show in ("Statistical abstract of the United States: 2012," 2011).

(24) total admissions = admits from ED + direct admission from GPs

In this model general practitioners stand in for all potential non-emergency sources of hospital admissions including GPs and other outpatient specialists. Disaggregation is not essential to setting up the dynamic hypothesis. Therefore, the total hospital admissions are merely the sum of direct admissions from “GPs” and admission from the ED.

(25) admits from ED = admits from GP referrals + admits from natural ED visits

(26) admits from natural ED visits = percent of normal ED visits admitted * natural ED Visits

percent of normal ED visits admitted = 0.13

The percent of normal emergency department visits admitted was set at 13 percent based on a survey of California emergency departments in 1990.

(27) admits from GP referrals = ED referrals by gp * percent of gp referral patients admitted

percent of gp referral patients admitted = 1

Percent of referred patients is simply set as one, making it an inactive part of the model, but allowing for the policy lever of emergency departments declining to admit some referred patients.

(28) direct admits from gp = desired admits from gp – ED referrals by gp
Endogenous Policy Design in Healthcare: A Case Study of Emergency Department Crowding

Interview Booklet
I appreciate the opportunity to talk with you today. Thank you in advance for sharing your thoughts and insights. Per capita use of the emergency department (ED) has been rising exponentially for the past two decades. This has led to much concern about ED crowding and expense. Research suggests that there are likely many causes contributing to the problem. My dissertation research focuses on just one. It is examining the potential relationship between emergency department visits and inpatient hospital admissions. The literature suggests that payer and provider policies related to hospital admissions have caused use of the emergency department as a backdoor to hospital admissions. I am interested in your insightful opinions on the motivations and tools of healthcare professionals.

I have planned for this conversation to last no longer than an hour. During this time, we will go over a list of questions in the booklet together. These questions include both verbal open-ended questions and written questions. Please feel free to ask questions at any point and talk with me as you record your responses. It will be most helpful for you to challenge the causal relationships shown throughout this booklet and to add comments, corrections or additions to the diagrams included.
For this section we’re looking for insights into changes in hospital admission sources. You’re experience with hospital admission patterns can help up better understand the trend. This graph shows the historic trend in the source of hospital admissions nationwide.

**Figure 4.4. Trends in Non-Elective Hospital Admissions, by Source, 2003–2009**

1.1 Some literature indicates a relationship between the trend in source of non-elective hospital admissions and the volume of emergency department visits. Based on your experience, does it seem plausible that more patients are going to through the ED because they are not being referred directly to the hospital?

1.2 What do you think was driving this change in the source of non-elective hospital admissions?
Payer Assumptions

There is research which indicated a relationship between payers, ED visits and non-elective hospital admissions.

2.1 *Payers are motivated to reduce healthcare costs.*

☐ 1-Strongly disagree ☐ 2-Disagree ☐ 3-Neither agree or disagree ☐ 4-Agree ☐ 5-Strongly agree ☐Not sure/not applicable

2.2 *Payers discourage unnecessary hospital admissions to reduce costs.*

☐ 1-Strongly disagree ☐ 2-Disagree ☐ 3-Neither agree or disagree ☐ 4-Agree ☐ 5-Strongly agree ☐Not sure/not applicable

2.3 *What other motivations drive payer behavior in relation to hospital admission and emergency department visits? How important are these motivations relative to the above assumptions? Please rank them from most to least important.*

2.4 *Do you believe payers take actions that influence ED visits and hospital visits? If so, how? How effective are these actions? Please rank their effect on hospital admissions from most to least effective.*
General Practitioner Assumptions

Research indicates that doctors may be influenced by various factors when deciding whether to refer a patient directly for inpatient admission or to refer them the ED. Please indicate how strongly you agree or disagree that general practitioners are influenced by these suggested motivations.

2.5 General practitioners are concerned with how long it takes for a referred patient to be admitted to the hospital.

☐ 1-Strongly disagree ☐ 2-Disagree ☐ 3-Neither agree or disagree ☐ 4-Agree ☐ 5-Strongly agree ☐ Not sure/not applicable

2.6 General practitioners are risk averse in regard to choosing whether to refer patients to the hospital or ED.

☐ 1-Strongly disagree ☐ 2-Disagree ☐ 3-Neither agree or disagree ☐ 4-Agree ☐ 5-Strongly agree ☐ Not sure/not applicable

2.7 General practitioners send patients to the ED as an alternative to attempting to refer them to the hospital for admission.

☐ 1-Never ☐ 2-Rarely ☐ 3-Sometimes ☐ 4-Frequently ☐ Not sure/not applicable

2.8 From your perspective what are the most important factors that determine whether a doctor refers a patient to the emergency department or seeks a direct inpatient admission? Please rank these relative to the above factors.
Patient Motivations

The literature is divided on how much influence patients have versus their doctors in healthcare decisions including how they are admitted to the hospital. In this section, we are looking at the factors that cause a patient to go to the ED.

2.9 Patients often consult their personal doctor before going to the emergency department.

☐ 1-Strongly disagree ☐ 2-Disagree ☐ 3-Neither agree or disagree ☐ 4-Agree ☐ 5-Strongly agree ☐Not sure/not applicable

2.10 From your perspective do patients care whether they are admitted to the hospital directly or sent to the ED? What do you think influences their decision?

2.11 How important do you think their doctor’s recommendation is compared to other factors such as cost or convenience? Please rank the importance of these factors from most to least important.
This diagram is the start of a causal loop diagram. The purpose of this section is for you to use your experience to examine the proposed causal links between doctors, patients, payers and emergency department visits. Please draw arrows between things you believe are directly and causally connected. Pluses mean the relationship is direct while minuses mean it is inverse. Feel free to add things to the diagram you feel are missing and dispute the existing causal links.

**Evidence Based Support**
We’re looking to link publicly available data to the motivations and causal links discussed above that determine a physician’s decision to direct a patient to the ED rather than being directly admitted to the hospital.

4.1 Rank these factors in order of how important you believe they are to a doctor’s decision to direct a patient to the ED.

- Type of Admission (Emergency, Urgent, Elective)
- Admitting Diagnosis
- Primary Diagnosis Code
- Source of Payment (Medicare, private insurance, out-of-pocket, etc)

4.2 For each of these factors, are the policies of payers discussed on page 7 more or less likely to affect the decision to direct patients to the ED based on the patient’s category? For example, would the payer’s policies be more likely to affect the decision for a patient whose admission is elective versus one whose admission was urgent?
Thank you very much for your participation!
13.0 Appendix C: Interview Data and Summaries

13.1. P1 Interview Summary

Participant one (P1) is an emergency department doctor. He is associated with hospital A and hospital D in the Capital Region. He has been a licensed physician for almost forty years.

The participant agreed with the shift in source of hospital admission and cited a shift to hospitalists. Hospitalists are internal or family medical doctors who work solely at a hospital. Hospitals no longer take walk-in or referred admissions from general practitioners, requiring patients to be admitted through the ED. This transition took time and as recently as five years ago many doctors still had admitting privileges.

The participant explained that there are actually many benefits to this system. Tests done in the ED are faster than those from a doctor’s office or even a hospital bed. This means patients can be diagnosed more quickly and reduces risk and uncertainty in some cases, such as patients with chest pains. Nurses also have faster access to hospitalists compared to having to contact a general practitioner who may be at her home office, which improves outcomes. Hospitalists also have shorter lengths of stay, because they get tests done faster, saving money. This system is also more efficient for the general practitioner, who can see more patients in a day if she does not have to travel to the hospital.

The participant also discussed difficulty in discharging patients from the ED as contributing to crowding problems, particularly elderly patients. The ED cannot discharge patients unless they are going into a safe situation. Setting up community services can take a long time, sometimes resulting in patients being kept overnight because a safe situation couldn’t be established.
13.2. P1 Interview Data

1.1 Some literature indicates a relationship between the trend in source of non-elective hospital admissions and the volume of emergency department visits. Based on your experience, does it seem plausible that more patients are going to through the ED because they are not being referred directly to the hospital?

- Yes.
  - Tests done in the ED are much faster
  - ½ hour vs hours at their office
  - also takes longer from a hospital bed

1.3 What do you think was driving this change in the source of non-elective hospital admissions?

- Hospitalists – internal or family medicine practitioner who work solely at hospital
  - Very few office-based physicians who visit patients at hospital, 5-10%
  - No mechanism to send patient from their doctor to the hospital, most use ED

- Specialties that directly admit
  - Surgery (hernia, gallbladder)
  - OBGYN

- Clinical care coordinator (C3’s)
  - Liaison between hospital and insurance company
  - Medicare most critical of admission

2.1 Payers are motivated to reduce healthcare costs.

5-strongly agree

2.2 Payers discourage unnecessary hospital admissions to reduce costs.

5-strongly agree
2.3 What other motivations drive payer behavior in relation to hospital admission and emergency department visits? How important are these motivations relative to the above assumptions? Please rank them from most to least important.

- Costs #1
- Safety—but not in acute care!
  - Nursing homes
  - Observation care
- Quality care
- ED in morning, takes a lot of time to get community services set up, often can’t get elderly patients discharged into a safe situation

2.4 Do you believe payers take actions that influence ED visits and hospital visits? If so, how? How effective are these actions? Please rank their effect on hospital admissions from most to least effective.

- Nurse call lines to triage
- To reduce frequent flyer proactive in-home nursing care for them and number to call

2.5 General practitioners are concerned with how long it takes for a referred patient to be admitted to the hospital.

Not sure/not applicable, Changed so much – always to ED

2.6 General practitioners are risk averse in regard to choosing whether to refer patients to the hospital or ED.

4-Agree Example: Chest pains, could do an EKG in office, but hard to determine so will send in, but wouldn’t if patient were 15, risk averse but not inappropriately
2.7 General practitioners send patients to the ED as an alternative to attempting to refer them to the hospital for admission.

No response

2.8 From your perspective what are the most important factors that determine whether a doctor refers a patient to the emergency department or seeks a direct inpatient admission? Please rank these relative to the above factors.

- No longer applicable due to hospitalists
- Why shift to Hospitalists?
  - Inefficient for GP – takes more time to see patients/travel than to stay in office
  - Outcomes are better, nurses have access to hospitalists immediately
  - Downside doctor relationship lost
  - Hospitalists have shorter length of stay, get tests and such done faster, a GP would be at least a day slower
  - Hospital paid by diagnosis code, not days in hospital

2.9 Patients often consult their personal doctor before going to the emergency department.

4 - Agree but it depends on condition/symptoms, ex. Weakness, fever and cough see doctor; chest pain, stroke straight to ED

2.10 From your perspective do patients care whether they are admitted to the hospital directly or sent to the ED? What do you think influences their decision?

- Nowadays patients understand why they go directly to the ED
- As recently as 5-years ago many doctors were still admitting
2.11 *How important do you think their doctor’s recommendation is compared to other factors such as cost or convenience? Please rank the importance of these factors from most to least important.*

- Copay is waived if you are admitted
- ED costs are rolled into admission (exception is ED physician charge) no extra income for hospital

*Figure 28. Interviewee did not write in booklet, above is the interviewer filling out the diagram based on their verbal responses.*

4.1 *Rank these factors in order of how important you believe they are to a doctor’s decision to direct a patient to the ED.*

1. admitting diagnosis,
2. primary diagnosis,
3. source of payment (doesn’t matter), only emergency admission encountered in ED

**4.2 For each of these factors, are the policies of payers discussed on page 7 more or less likely to affect the decision to direct patients to the ED based on the patient’s category? For example, would the payer’s policies be more likely to affect the decision for a patient whose admission is elective versus one whose admission was urgent?**

- Surgeons always send patients directly to the OR
- Hospitalists want to be certain the patient requires hospitalization and not all referrals do
- Biggest problem is patient boarding, due to shortage of nursing staff and patient surging

**13.3 P2 Interview Summary**

Participant 2 (P2) worked as an emergency department physician for over ten years before becoming a Vice President at large capital district hospital in New York, hospital F in the data. P2 was interviewed in person at his office.

The participant expressed concern that reference mode graphs only went up to 2009. He asserted that the number of ED visits has been stable for the past three years or possibly seen a 3-5,000 per annum decrease. He attributes this in part to see fewer chronically ill people in the ED and successful redirection of less acutely ill patients to other sources of care. He also emphasized the impact of programs such as DISRIP, a Medicaid program to reduce hospital admissions, in recent years.

Around 2003-2005, the hospital transitioned from taking walk-in or direct admits to using hospitalists. The ED is considered better as the patients’ first stop because it can mobilize resources better. It is faster because many tests can be done right there compared to going to different departments and the patients having to register with each.
Some hospitals have been experimenting with a quasi-transfer center system if a primary care physician wants to admit a patient. In this system, the doctor calls the center and the center sends all acute patients to the ED, stable but acute to ED and for stable but needing the hospital will put the doctor in touch with a hospital. The number of admits through the third option is very low though, in the single digits.

13.4. **P2 Interview Data**

1.1 *Some literature indicates a relationship between the trend in source of non-elective hospital admissions and the volume of emergency department visits. Based on your experience, does it seem plausible that more patients are going through the ED because they are not being referred directly to the hospital?*

- Graph is only up to 2009, The ARRA was in 2009 – H17 ECH
- Deductibles are used up in q1-q3 then all expenses are covered by insurance in q4
- ACA reducing uninsured without PCP and insurance, get referred to immediately
- DISRIP – Medicaid program to reduce hospital admissions
- Seeing a plateau now of ED visits, last 3 years stable or 3-5,000 per annum decrease
- Penalties for hospitals not complying

1.4 *What do you think was driving this change in the source of non-elective hospital admissions?*

- 2003-2005 change from patients being directly admitted/walking up to admitting desk to hospitalists
- Seeing fewer chronically ill people in the ED
- Less acutely ill are being successfully redirected
- Underinsured – not high deductibles but have high co-pays

2.1 *Payers are motivated to reduce healthcare costs.*
4-agree PMPM (per member per month) cost, can threaten to not reimburse PCP or ED if the PMPM cost gets too high, assign community resources

2.2 Payers discourage unnecessary hospital admissions to reduce costs.

Can threaten to not reimburse PCP or ED if the PM cost gets too high, assign community resources

Admission length decrease seven-day admission down to two days, hospital beds cost $2000 per day care being moved from hospital to home

2.3 What other motivations drive payer behavior in relation to hospital admission and emergency department visits? How important are these motivations relative to the above assumptions? Please rank them from most to least important.

- Reimbursement changed from FFS to FFV
- Bundle model coming get paid ones not again for reimbursement
- Health Care not free market can't look up prices, captive audience
- FFV promotes better care as well because it limits payment
- quasi transfer center if PCP wanted to admit they can call the center and center will channelize
  - Acute to ED
  - Stable but acute to ED
  - Stable but need hospital Dr. Speaks to Dr. and they get admitted single digits
- ED is better because it can mobilize resources better

2.4 Do you believe payers take actions that influence ED visits and hospital visits? If so, how? How effective are these actions? Please rank their effect on hospital admissions from most to least effective.
• No response

2.5 General practitioners are concerned with how long it takes for a referred patient to be admitted to the hospital.

No response

2.6 General practitioners are risk averse in regard to choosing whether to refer patients to the hospital or ED.

No response

2.7 General practitioners send patients to the ED as alternative to attempting to refer them to the hospital for admission.

No response

2.8 From your perspective what are the most important factors that determine whether a doctor refers a patient to the emergency department or seeks a direct inpatient admission? Please rank these relative to the above factors.

• No response

2.9 Patients often consult their personal doctor before going to the emergency department.

5-strongly agree - insurers have phone numbers either solve problem over the phone or authorize ED visit

2.10 From your perspective do patients care whether they are admitted to the hospital directly or sent to the ED? What do you think influences their decision?

• Acutely ill have no choice

• Chronically ill prefer ED because it will be quicker, such as blood work x-ray and EKG would all be done right there instead of going to three different departments and registering
2.11 How important do you think their doctor’s recommendation is compared to other factors such as cost or convenience? Please rank the importance of these factors from most to least important.

- See above

[Interviewee did not fill in diagram on page 7]

4.1 Rank these factors in order of how important you believe they are to a doctor’s decision to direct a patient to the ED.

No response

4.2 For each of these factors, are the policies of payers discussed on page 7 more or less likely to affect the decision to direct patients to the ED based on the patient’s category? For example, would the payer’s policies be more likely to affect the decision for a patient whose admission is elective versus one whose admission was urgent?

No response

13.5. P3 Interview Summary

Participant 3 (P3) has nearly 40 years of health care experience. He was a chief medical officer for eight years and currently works as a physician at a capital district hospital in New York, Hospital C. P3 was interviewed in person at a local coffee shop of his choosing.

He described the ED as having many benefits for referring doctors compared to trying to get a patient directly to the hospital. These include less work, uncertainty and liability for the referring GP. EDs provides immediate access to tests to screen patients for whether they should be admitted. Avoiding unnecessary admissions is important because patients have a higher risk of infections or becoming sicker if admitted.
From his perspective, patients have no added value from going to the ED and would rather avoid it if possible. Patients see the ED as an “ordeal” and want to get to the comfort of an inpatient bed as quickly as possible.

13.6. **P3 Interview Data**

1.1 Some literature indicates a relationship between the trend in source of non-elective hospital admissions and the volume of emergency department visits. Based on your experience, does it seem plausible that more patients are going to through the ED because they are not being referred directly to the hospital?

- Less work, worry, uncertainty, liability to send to ED

1.5 What do you think was driving this change in the source of non-elective hospital admissions?

- Provider can work with hospitalist

2.1 Payers are motivated to reduce healthcare costs.

5 – Strongly agree

2.2 Payers discourage unnecessary hospital admissions to reduce costs.

4 – Agree

2.3 What other motivations drive payer behavior in relation to hospital admission and emergency department visits? How important are these motivations relative to the above assumptions? Please rank them from most to least important.

- Eliminating any uncertainty about what is wrong with the patient and how sick they are
- Knowing that patients have a higher probability of becoming infected or sicker in the hospital. Unnecessary tests more likely
2.4 Do you believe payers take actions that influence ED visits and hospital visits? If so, how? How effective are these actions? Please rank their effect on hospital admissions from most to least effective.

- I don’t believe that any of these are effective
  - Patient education
  - Incentivizing after hours outpatient options
  - Providing information to providers about their ED utilization
- Incentives to keep office open after hours doesn’t work, providing data to doctors doesn’t work, they are not adequately educated on epidemiology
- Pediatric services use shared call centers with trained RNs – suggested for adult patients

2.5 General practitioners are concerned with how long it takes for a referred patient to be admitted to the hospital.

  4 – Agree

2.6 General practitioners are risk averse in regard to choosing whether to refer patients to the hospital or ED.

  5 – Strongly agree

2.7 General practitioners send patients to the ED as an alternative to attempting to refer them to the hospital for admission.

  4 – Frequently

2.8 From your perspective what are the most important factors that determine whether a doctor refers a patient to the emergency department or seeks a direct inpatient admission? Please rank these relative to the above factors.
• Clarity of diagnoses – easier to directly admit someone when you know what is wrong with them.

• Severity – would much rather have sicker patients evaluated in ED

• Patient preference – some patients insist on being admitted directly

• Will hospitalist see directly admitted patients? No idea what percent. If not, strong incentive for ED

2.9 Patients often consult their personal doctor before going to the emergency department.  
4-agree

2.10 From your perspective do patients care whether they are admitted to the hospital directly or sent to the ED? What do you think influences their decision?

• Every patient would like, I think to avoid the “ordeal” of the ED. They really want to get two a caring place, “creature comforts” ASAP. The doctor’s advice, family and friends tend to be influences as do cost and convenience. ED has no added value for patients.

2.11 How important do you think their doctor’s recommendation is compared to other factors such as cost or convenience? Please rank the importance of these factors from most to least important.

• Cost

• M.D. recommendation*

• Convenience

• Prior experience

• Large differences in functional status, trust in Healthcare System, socio economic status

• Can place patient on observation status. They get inpatient bed at outpatient rate, seeds Medicare money because it’s under Physician parts and patients have 20% responsibility.
ED have criteria for whether they can admit for observe. Physician recommendations are not that important unless it’s emphatic “you’re gonna die” or “I don’t know what’s wrong”

Figure 29 Interviewees written addition to the diagram were scanned in.

4.1 Rank these factors in order of how important you believe they are to a doctor's decision to direct a patient to the ED.

1. Type of admission
2. Admitting diagnosis
3. Source of payment
4. Primary diagnosis
4.2 For each of these factors, are the policies of payers discussed on page 7 more or less likely to affect the decision to direct patients to the ED based on the patient’s category? For, example, would the payer’s policies be more likely to affect the decision for a patient whose admission is elective versus one whose admission was urgent?

- Exceptions from payer rules/policies for the truly urgent/emergent
- No disincentives from payer to doctor Increases ED use
- Urgent admissions relatively spared from ED directs decision
- Prescreening of patients in the ER to determine suitability for admission
- Urgent care centers are a disincentive to ED, tendency to send sicker and sicker patients there
14.0 Appendix D: Interview with Senior Admissions Department Employee

14.1. Interview Summary

The researcher contacted the interviewed doctors for a referral to speak with a knowledgeable employee in the hospital admissions department with the goal of obtaining a copy of hospital admissions policy and procedures as well as blank copies of forms used for patient admissions. P1 put us in contact with P4 at Hospital A; she is a senior employee in patient registration who had worked there for “about 20 years” according to P1. The other doctors declined to provide a referral.

Upon meeting with P4, it became clear that the original goal of obtaining documents and policies fundamentally misunderstood the way hospitals admit patients. P4 explained that they don’t have forms requesting admission; rather a doctor will issue a physician order for a patient to be admitted or for a procedure which requires admission. Additionally, the hospital had moved entirely to electronic health records, so there are no blank forms around. Examples of doctor orders cannot be shared due to HIPAA privacy requirements. She was able to provide a legacy paper form for patient registration.

P4 was gracious enough to answer questions related to patient admissions and trends she had seen over her long career in the department in lieu of the requested forms. She described three basic routes of admission into the hospital. The first is elective admissions, which are scheduled in advance. The second is urgent admissions, in which a family doctor refers a patient for admissions. This can be done by calling a surgeon or by calling a hospitalist and having the patient admitted under his name, which happens often for this type of admission. In total however, urgent admissions are minimal compared to emergency admissions, which happen through the ED.
When asked what trends she had seen throughout her career, she discussed huge changes in what type of admissions many procedures are. Many procedures once done inpatient are now outpatient procedures. Many conditions that would once have been emergencies in the ED are also now outpatient. On the whole, she describes ED visits as way up and states that admissions are higher from the ED than other from other sources, but “this has always been the case.”

14.2. Raw Interview Notes

- All records are electronic—first see Dr. outpatient, supposed to come in w/ hard copy of an order
- B/c all the paperwork is electronic it is hard/impossible to get blanks. There isn’t a form per say, rather patients have orders from a doctor; got a copy of one legacy hard copy form for patient registration
- Unlikely for a patient to be admitted through this office—only if, for example, an x-ray came back broken and patient was admitted for surgery
- Types of admissions:
  - Electively, which are scheduled
  - Urgently, family doctor could call and have admitted by sending to surgeon. Primary care can call hospitalist and admit under his name, that happens a lot—happens often
  - Emergency—through ED
  - Call-in and refer to hospitalist
- Primary care doctor could refer to a surgeon directly, in which case a patient can go straight up to their floor
- Urgent admissions are minimal compared to ER
• Many procedures have changed type for example gallbladder is no longer an emergency
• Huge change in what counts as an outpatient, ED to outpatient
• ED visits are way up
• Admissions are higher from the ED, but this has always been the case
15.0 Appendix E: Dynamic Hypothesis V2 Equations

Adjusting capacity= (Desired urgent inpatient beds - Hospital beds for urgent admissions)/Time to adjust capacity
~ beds / years

Adoption fraction= 0.4
~ dmnl

Adoption from pressure= PCPs directly admitting patients * Max pressure adoption fraction * Switch to FFV
~ doctors / years

Adoption from word of mouth= Contact rate * Adoption fraction * PCPs directly admitting patients * PCPs using hospitalists / total PCPs
~ doctors / years

Avg days per admission= Percent of admissions using hospitalists * Avg days per hospitalist admission + (1 - Percent of admissions using hospitalists) * Avg days per direct admission
~ days / patient
~

Avg days per direct admission= 8
~ days / patient

Avg days per hospitalist admission= 5.5
~ days / patient
~

Avg FFV pay per admission= 5000
~ dollars / patient

Contact rate= 0.8
~ 1/Year

Days per year= 365
~ days / Year

Desired hospitalists= Urgent admissions going through the ED / Desired patients per hospitalist
~ doctors

Desired patients per hospitalist= 15
~ patients / doctors

Desired urgent inpatient beds= (Urgent admissions * Avg days per admission) / Days per year
~ beds
FFS pay per day = 1000
~ dollars / day

Hospital beds for urgent admissions = INTEG (Adjusting capacity, Desired urgent inpatient beds)
~ beds

Hospitalists = INTEG (Recruiting, 0)
~ doctors

Income = FFS pay per day * Avg days per admission * Urgent admissions * (1 - Switch to FFV) + (Switch to FFV) * Avg FFV pay per admission * Urgent admissions
~ dollars / years

Inpatient operating costs = Hospital beds for urgent admissions * Operating costs per bed
~ dollars

Max pressure adoption fraction = 0.01
~ 1 / years

Operating costs per bed = 800 * 365
~ dollars / bed / day

PCPs adopting hospitalist model = Adoption from pressure + Adoption from word of mouth
~ doctors / Year

total PCPs = PCPs directly admitting patients + PCPs using hospitalists
~ doctors

Urgent admissions = 500000
~ patients / years

Percent of admissions using hospitalists = PCPs using hospitalists / total PCPs
~ dmnl

Profits = Income - Inpatient operating costs
~ dollars / years

Recruiting = (Desired hospitalists - Hospitalists) / Time to recruit hospitalists
~ doctors / years

Switch to FFV = STEP(1, 2)

Time to adjust capacity = 10
~ years
Time to recruit hospitalists = 3
~ years

Urgent admissions going through the ED = Urgent admissions*Percent of admissions using hospitalists
~ patients / years

PCPs using hospitalists = INTEG (PCPs adopting hospitalist model, 0)
~ doctors

PCPs directly admitting patients = INTEG (-PCPs adopting hospitalist model, 21612)
~ doctors

********************************************************

.Control

Simulation Control Parameters

FINAL TIME = 24 ~ Year ~ The final time for the simulation.

INITIAL TIME = 0 ~ Year ~ The initial time for the simulation.

SAVEPER = TIME STEP ~ Year [0,?] ~ The frequency with which output is stored.

TIME STEP = 0.0625 ~ Year [0,?] ~ The time step for the simulation.
16.0 Appendix F: SPARCS Data Definitions

16.1. Admission Date/Start of Care

Definition:

This is the date of the patient's admission to the hospital.

Codes and Values:

1. YYYY MM DD = Year Month Day

16.2. Type of Admission

Definition:

The code which indicates the manner in which the patient was admitted to the health care facility.

Codes and Values:

1. "1" = Emergency - The patient requires immediate medical intervention as a result of severe, life threatening, or potentially disabling conditions.

2. "2" = Urgent - The patient requires immediate attention for the care and treatment of a physical or mental disorder. Generally the patient is admitted to the first available and suitable accommodation.

3. "3" = Elective - The patient's condition permits adequate time to schedule the admission based on the availability of a suitable accommodation.

4. "4" = Newborn - Use of this code necessitates the use of special codes in the Source of Admission (Data Element 13).

5. "5" = Trauma - Visit to a trauma center/hospital as licensed or designated by the state or local government authority authorized to do so, or as verified by the American College of Surgeons and involving a trauma activation.

9. "9" = Information not available. The provider cannot classify the type of admission.
16.3. Source of Admission / Point of Origin

Definition:
The code that best described the origin of the patient's admission to the hospital.

Codes and Values:

Non-Health Facility Point of Origin
Inpatient: The patient was admitted to this facility upon an order of a physician.

Outpatient: The patient presents to this facility with an order from a physician for services or seeks scheduled services for which an order is not required (e.g. mammography). Includes non-emergent self-referrals.

Clinic
Inpatient: The patient was referred to this facility as a transfer from a freestanding or non-freestanding clinic.

Outpatient: The patient was referred to this facility for outpatient or referenced diagnostic services.

Reserved for assignment by the NUBC.

Transfer From a Hospital (Different Facility)
Inpatient: The patient was admitted to this facility as a hospital transfer from an acute care facility where he or she was an inpatient or outpatient.

Outpatient: The patient was transferred to this facility as an outpatient from an acute care facility.

Transfer From a Skilled Nursing Facility (SNF) or Intermediate Care Facility (ICF)
Inpatient: The patient was admitted to this facility as a transfer from a SNF or ICF where he or she was a resident.

Outpatient: The patient was referred to this facility for outpatient or referenced diagnostic services for a SNF or ICF where he or she was a resident. Note: NYS no longer uses ICF determination.

Transfer From Another Health Care Facility
Inpatient: The patient was admitted to this facility as a transfer from another type of health care facility not defined elsewhere in this code list.

Outpatient: The patient was referred to this facility for services by (a physician of) another health care facility not defined elsewhere in this code list where he or she was an inpatient or outpatient.

Emergency Room
Inpatient: The patient was admitted to this facility after receiving services in this facility's emergency department.

Outpatient: The patient received unscheduled services in this facility's emergency department and discharged without an inpatient admission. Includes self-referrals in emergency situations that require immediate medical attention.

Excludes: Patients who came to the emergency room from another health care facility.

Court/Law Enforcement

Inpatient: The patient was admitted to this facility upon the direction of a court of law, or upon the request of a law enforcement agency representative.

Outpatient: The patient was referred to this facility upon the direction of a court of law, or upon the request of a law enforcement agency representative for outpatient or referenced diagnostic services.

8 = Information Not Available

The means by which the patient was admitted to this hospital was not known.

Transfer from a Rural Primary Care Hospital (Only valid for discharges prior to 10/1/2007)

A = The patient was admitted to this facility as a transfer from a Rural Primary Care Hospital (RPCH) where he or she was an inpatient.

Transfer from One Distinct Unit of the Hospital to another Distinct Unit of the Same Hospital Resulting in a Separate Claim to the Payer

Inpatient: The patient was admitted to this facility as a transfer from hospital inpatient within this facility resulting in a separate claim to the payer.

Outpatient: The patient received outpatient services in this facility as a transfer from within this hospital resulting in a separate claim to the payer.

Transfer from Ambulatory Surgery Center (Effective 10/1/2007)

Inpatient: The patient was admitted to this facility as a transfer from an ambulatory surgery center.

Outpatient: The patient was referred to this facility for outpatient or referenced diagnostic services from an ambulatory surgery center.

Transfer from Hospice and is Under a Hospice Plan of Care or Enrolled in a Hospice Program (Effective 10/1/2007)

Inpatient: The patient was admitted to this facility as a transfer from a hospice.

Outpatient: The patient was referred to this facility for outpatient or referenced diagnostic services from a hospice.
16.4. *Unscheduled/Scheduled Admission*

**Definition:**

The code which best describes the urgency of the patient's admission to the hospital.

**NOTE:** Effective January 1, 2001 (for all discharges) this data element is no longer collected by SPARCS from provider information systems. For the period January 1, 2001 through September 30, 2007 it was derived and populated from the Type of Admission and Source of Admission. Effective October 1, 2007 (when Source of Admission was replaced with the Point of Origin) this data element was no longer populated by SPARCS.

- **January 1, 2001** - Unscheduled/Scheduled data element no longer collected by SPARCS
- **January 1, 2001 through September 30, 2007** - Unscheduled/Scheduled data element derived and populated by SPARCS
- **October 1, 2007 through Present** - Unscheduled/Scheduled data element is no longer collected or derived and populated by SPARCS

**Codes and Values:**

1. "1" = Unscheduled - An admission which was not arranged with the hospital at least 24 hours before the admission.

2. "2" = Scheduled - An admission arranged through the hospital at least 24 hours before the admission.

9 = Information not available.

16.5. *Source of Payment Code*

**Definition:**

The code which indicates the type of payment for this occurrence.

**Codes and Values:**

1. "A"=Self-Pay
   "B"=Workers' Compensation
   "C"=Medicare
   "D"=Medicaid
   "E"=Other Federal Program
"F"=Insurance Company
"G"=Blue Cross
"H"=CHAMPUS
"I"=Other Non-Federal Program

16.6. **Emergency Department Indicator**

**Definition:**

The Emergency Department Indicator is set based on the ancillary revenue codes. If the record contained an Emergency Department ancillary revenue code of 045X, the indicator is set to "E", otherwise it will be blank.

**Codes and Values:**

1. "E" = Emergency Department Services indicated on record.

16.7. **Admitting Diagnosis Code/Patient's Reason for Visit**

**Definition:**

The diagnosis provided by the physician at the time of admission which describes the patient's condition upon admission to the hospital. Since the Admitting Diagnosis is formulated before all tests and examinations are complete, it may have been stated in the form of a problem or symptom and it may differ from any of the final diagnoses recorded in the medical record.

**Codes and Values:**

1. Must have been a valid ICD-9-CM code excluding the decimal point. To be valid, ICD-9-CM codes must have been entered at the most specific level to which they are classified in the ICD-9-CM Tabular List. Three-digit codes further divided at the four-digit level must have been entered using all four digits. Four-digit codes further subclassified at the five-digit level must have been entered using all five digits. Failure to enter all required digits in the diagnosis codes would have caused the record to be rejected.

2. Must have been left justified and entered exactly as shown in the ICD-9-CM coding reference, excluding the decimal point, and space filled.

3. E-codes were not valid as Admitting Diagnosis Codes. E-codes were reported in External Cause-of-Injury Code and Place-of-Injury Code.
16.8. **Principal/Primary Diagnosis Code**

**Definition:**

The Principal/Primary Diagnosis is the condition established after study to have been chiefly responsible for occasioning the admission of the patient to the hospital for care. Since the Principal/Primary Diagnosis represents the reason for the patient's stay, it may not necessarily have been the diagnosis which represented the greatest length of stay, the greatest consumption of hospital resources, or the most life-threatening condition. Since the Principal/Primary Diagnosis reflects clinical findings discovered during the patient's stay, it may differ from Admitting Diagnosis.

**Codes and Values:**

1. Must have been a valid ICD-9-CM code excluding decimal points. To have been valid, ICD-9-CM codes must have been entered at the most specific level to which they are classified in the ICD-9-CM Tabular List. Three-digit codes further divided at the four-digit level must have been entered using all four digits. Four-digit codes further subclassified at the five-digit level must have been entered using all five digits. Failure to enter all required digits in the diagnosis codes would have caused the record to be rejected.

2. Must have been left justified and entered exactly as shown in the ICD-9-CM coding reference, excluding the decimal point, and space filled.

3. Manifestation and Unacceptable Principal/Primary Diagnosis conditions as indicated by the edit flag on the ICD-9-CM reference file were invalid.

E-codes were not valid as Principal/Primary Diagnosis Codes. E-codes are reported in External Cause-of-Injury Code and Place-of-Injury Code.