The Impact of Hospital Closures and Mergers on Patient Welfare*

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Abstract

We use data on a large wave of directed hospital mergers and closures in Ontario to investigate the impact of hospital reorganization on patient welfare. We estimate a model of patient hospital choice on data collected before the reorganization, finding that both distance and hospital quality are determinants of choice. The model is then used to determine the short-run and long-run welfare impact of reorganization. Results suggest that cost savings and efficiency are not the only factors to consider when restructuring in settings where patients do not pay for services. Hospital access and quality must be considered.

Keywords: Hospital, Closures, Directed Mergers, Quality, Healthcare reform, Administered-price markets, Amalgamations, Hospital systems, Restructuring, Healthcare, Choice

JEL Codes: I11, I18, L13, L32

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1 Introduction

In recent decades, public health systems operated by governments have experienced directed hospital mergers and closures, despite a lack of consensus regarding the impacts on patients. Cost savings and efficiency gains are frequently proposed arguments in favor of amalgamations of hospitals funded or administered by governments. These arguments have also been used to consolidate local electricity distribution companies, school boards and even entire municipalities. But such arguments ignore any potential impact on consumers. This is especially true in settings where prices paid by consumers for services are fixed or zero. Patient welfare can be negatively impacted if hospital mergers remove acute care services from some locations as some patients must travel farther to access care. Increased market concentration can also negatively affect patients if it limits competition between hospitals. In systems with administered prices (i.e. hospital markets where prices are set by regulators (Gaynor et al., 2015)), this may take the form of reduced quality competition (Gaynor and Town, 2011).[1] Patients can also be harmed if mergers close efficient hospitals as fewer patients are treated at a higher cost. If resources from eliminating duplicate services or inefficient hospitals are reinvested in ways that improve the quality of care and/or treat more patients, then there can be a positive impact on patients (Noether and May, 2017).

Our study contributes to the merger discussion by providing evidence on the effects of directed hospital mergers involving site closures on patient welfare in systems where prices are administered. We separate welfare into a short-run component that captures the immediate impact associated with the removal of acute care services, and a long-run component resulting from hospitals adjusting their characteristics due to reinvestments, and/or changes in hospital competition. This is important because governments and policymakers administering public health systems may continue to face incentives to force reorganizations as a result of shifting demographics, persistent rise of healthcare costs, and technological advancement.[2,3]

We focus on several questions. First, what factors influence hospital choice by patients in an environment with administered prices? Second, how are patients impacted in the short-run when hospital mergers involve site closures? Third, how are patients impacted in the long-run, when hospitals have had the opportunity to adjust quality following the mergers? Lastly, is the welfare impact different for urban, suburban, and rural patients

[1]Whether Canadian hospitals compete to attract patients is not clear. The analysis in this article does not rely on market concentration or any other mechanism in the estimation of patient welfare.

[2]OECD (2020), Elderly population (indicator). doi: 10.1787/8d805ea1-en. Accessed April 4, 2020 from https://data.oecd.org/pop/elderly-population.htm; OECD (2020), Health spending (indicator). doi: 10.1787/8643de7e-en. Accessed on April 4, 2020 from https://data.oecd.org/healthres/health-spending.htm

[3]Technology advancements could be complements or substitutes to existing technologies and therefore could have a positive or negative impact on health spending. In a literature review, Marino and Lorenzoni (2019) show that technological changes are associated with positive increases in health spending.

considering that hospital access is already unequal across regions?

To answer these questions, we examine a hospital reorganization that occurred in the province of Ontario, Canada between 1997 and 2003. In total, the province saw 24 mergers involving 66 hospitals and the closure of acute care services at 13 hospitals.[4] The merged hospitals are geographically diverse allowing us to separate the welfare effects between urban, suburban, and rural markets. The mergers and closures resulted from a government task force whose objective was to make hospital services more accessible and of higher quality such that patients of current and future generations could continue to obtain safe and quality care at the most affordable cost for the province (Sinclair et al., 2005). This was achieved primarily through amalgamations with the intent to eliminate duplicated services and unused space (HSRC, 1999). The task force was a byproduct of a provincial government bill aimed at achieving fiscal savings and economic prosperity by increasing efficiency in public sector operations.[5]

We use proprietary patient-level data to which we were granted access by the Institute for Clinical Evaluative Sciences (ICES). It includes demographic and health information for all adults treated in Ontario hospitals for one or more of the following emergency conditions: acute myocardial infarction (AMI/heart attack), pneumonia, sepsis (blood poisoning) and stroke.[6] Through ICES, we also have access to several other databases which can be linked to the patient-level data to construct a wide range of patient and hospital outcomes.

Our approach consists of estimating a model of hospital choice by patients using techniques derived from McFadden (1974) and using the estimated patient preferences to investigate several counterfactuals to obtain the welfare change associated with the mergers and closures. According to the model, among hospitals in their choice set, patients choose to receive treatment at the hospital that maximizes utility. The choice set consists of hospitals within a reasonable travelling distance–the ten closest hospitals within the 99th percentile of distance according to patient location (i.e. urban, suburban, rural). Patients derive utility from distance to the hospital and hospital characteristics such as hospital volume and hospital quality (e.g. mortality rates). Utility also depends on patient characteristics such as age, sex, and health status. To allow for preferences to vary by condition of admission we estimate preferences separately for each diagnosis in our data. We transform the estimated preference parameters into measures of willingness to travel to understand the tradeoffs between quality and distance. Willingness to

[4] In this article we refer to hospitals with closed acute care services as "closed", but some still provide some healthcare services (e.g. rehabilitative services). Acute care services concern the short-term intensive treatment of conditions such as strokes, severe infections, and bone fractures (Hirshon et al., 2013).

[5] *Bill 26, Savings and Restructuring Act,1995*, O-Reg. 26/95. Retrieved November 2, 2018 from `http://www.ontla.on.ca/web/bills/bills_detail.do?locale=en&BillID=1581&isCurrent=false&ParlSessionID=361&detailPage=bills_detail_status`

[6] These conditions are described in Appendix A.

travel informs us on the additional distance patients would be willing to travel to access a hospital where the quality measure is one standard deviation higher.

Generally, the estimated preferences are similar for the four diagnoses in our data. We find that patients dislike distance and prefer better quality hospitals as captured by lower occupancy and mortality rates for example. Although hospital quality matters, it is much less important in terms of magnitude. In other words, even though patients would be willing to travel farther to access better care, the additional distance they are willing to travel is small. We also find important differences between patient groups. For example, rural patients are less sensitive to distance and urban or older patients are more sensitive.

Our estimation and counterfactuals are designed to take into account two data features. First, the mergers occur over several years, and it may take time after merging for quality changes to appear. Second, the late 1990s marks a conversion to outpatient care, which occurs when patients are treated without being assigned to a bed (Sinclair et al., 2005). Since patients treated through outpatient care do not appear in our data, the share of patients we do not observe is increasing over time. As a result, the demographics of patients admitted to the hospitals change over the merger years, making it difficult to compare welfare calculated in the pre-period to welfare calculated in the post-period. To control for changes in the admitted patient pool, we estimate the model on data from the period before the mergers, but incorporate post-merger hospital characteristics from several years after the mergers to compute some of our counterfactuals.

We examine two counterfactuals in which we use the estimated parameters to calculate McFadden (1996)'s *log-sum* change in consumer surplus to answer our research questions. In the first counterfactual, hospitals closed by the merger wave are no longer in the choice sets, and characteristics of the remaining hospitals are unchanged. In the second, closed hospitals are still removed, but characteristics of the hospitals are those of the post-merger period. In the first case, only mergers involving closures will have an impact, capturing the short-run effect of the mergers. In the second case, mergers not involving closures also have an impact. This captures potential resource reallocation or changes in quality competition that may occur in the long-run. For both counterfactuals, we estimate heterogeneous effects for urban, suburban and rural patients.

We find that in the short run, hospital closures are associated with a welfare reduction that is equivalent to increasing distance to the hospital by about 3%. Depending on the condition of admission 60% to 69% of patients are worse off in the short-run. Conditional on having a site closure in their choice set, rural patients see the largest welfare decrease. In the long-run, when hospitals have adjusted their characteristics following the mergers and closures, the welfare effect is heterogenous across conditions. We find a negative average impact for AMI and sepsis and a positive average impact for pneumonia and stroke. It is important to note that even for the two conditions that have a positive average welfare change, the majority of patients are worse off in the long-run. Respectively, 74.7%, 61.1%, 70.5% and 56.4% of AMI, pneumonia, sepsis and stroke patients are worse off in the long-run. The median patient across all conditions is harmed by the restructuring (welfare decrease equivalent to increasing distance by 5.8%, 2.4%, 9.6% and 1.7% for AMI, pneumonia, sepsis and stroke patients). Especially for pneumonia and stroke, the distribution of welfare is positively skewed with a small number of patients experiencing extremely large welfare gains. We observe very small changes in hospital quality between the pre- and post-merger period suggesting that hospitals did not react to the merger by improving quality. This is consistent with results from Barker and Watt (2021) who study the impact of the same hospital reorganization on hospital outcomes. Overall, this suggests that both hospital access and quality are important to patients and should be considered by governments and policymakers intending to force consolidation within an industry.

Lastly, as we observe very small quality changes and find that hospital quality impacts hospital choice, we follow Chandra et al. (2016) to break down the changes between the pre-merger period and the post-merger period. This exercise allows us to understand how changes in patient flows between the pre-merger period and the long-run post-merger period impact hospital quality. It separates the quality change adjusted for hospital market shares into several components including one that captures quality improvements/worsenings as well as a component for reallocation of patients from low- to high-quality hospitals. We find evidence of reallocation of patients from low to high quality hospitals as well as to hospitals that were already high quality prior to the mergers, but we also find that hospital quality changes would not have been much larger if market shares remained fixed over time. In other words, the long-run welfare effects are not mitigated or amplified by changes in patient flows. Although results from this study are most applicable to systems with administered prices, it is relevant to other healthcare markets where hospitals compete on quality (Gaynor and Town, 2011). Private hospitals may compete on quality if the majority of their patients are insensitive to price, as is the case when patients are insured. It can also be informative for other settings with regulated prices where governments and policymakers may want to direct mergers.

The remainder of the article proceeds as follows. Section 2 reviews the literature, Section 3 discusses institutional details of healthcare and hospitals in Ontario, Canada, as well as a brief but important overview of the Health Services Restructuring Commission that directed the mergers. Section 4 describes the data, followed by the details of the methodology used to estimate patient preferences in Section 5, and estimation results in Section 6. Section 7 discusses the counterfactuals results that quantify the impact of the mergers. Finally, Section 8 concludes.

2 Literature Review

We contribute to the hospital-choice literature that originates from the demand estimation methodology proposed by McFadden (1974). Hospital-choice studies that use this methodology can be divided according to the type of healthcare market on which they focus; the United States hospital market (Ho, 2006; Gowrisankaran et al., 2015; Barrette et al., 2021; Luft et al., 1990; McNamara, 1999; Howard and Kaplan, 2006; Tay, 2003; Kessler and McClellan, 2000), countries with social health insurance models (Varkevisser et al., 2012; Beukers et al., 2014; Choné and Wilner, 2020), the U.K. with a single-payer national health model (Beckert et al., 2012; Gaynor et al., 2016; Gutacker et al., 2016; Moscelli et al., 2016; Santos et al., 2015), and countries with a national health insurance model (a combination of social and single-payer models) (Moscone et al., 2012). Across different market types, findings are similar. Hospital quality and distance matter to patients when choosing hospitals, indicating that regardless of hospital prices some patients will bypass the nearest hospital to access better quality care. Our study, one of the few in the context of a national health insurance setting, follows more closely the latter two groups where distance is the main hospital cost incurred by patients to access care.

Patient preferences recovered from a hospital-choice model have also been used to study the effects of hospital mergers (Adams et al., 1996; McNamara, 1999; Capps et al., 2003, 2010; Gaynor and Vogt, 2003). To our knowledge, only Beckert et al. (2012) focus on the effects of mergers in a regulated-price setting with a hospital demand model as the starting point. They simulate mergers of U.K. hospitals using demand elasticities with respect to quality calculated from patient preferences, and find that increased market concentration from mergers decreases elasticity with respect to quality, indicating that responsiveness to quality decreases after mergers. Instead, our approach takes advantage of post-merger hospital characteristics and uses McFadden's (1996) change in consumer surplus to calculate measures of patient welfare in the short and long run, using our diverse set of hospitals to draw conclusions about heterogeneous impacts on urban, suburban and rural patients. Though our implementation and model differs, the intuition is similar to the endogenous product choice literature (Mazzeo, 2002; Draganska et al., 2009; Crawford et al., 2019) and to Fan (2013) who accounts for adjustment in product characteristics when looking at the effect of mergers in the context of the US daily newspapers market.

Our study also contributes to the literature that examines the impact of hospital mergers on welfare by assessing the effects on various patient and hospital outcomes. Much of this literature focuses on the U.S. market and discusses price changes as a determinant of patient welfare (Gaynor and Town, 2012). For example, Dafny et al. (2019) find that hospital mergers that have common customers lead to higher prices, acquirers raise their prices suggesting that improvements in quality are not driving the price increases, merging parties with overlapping insurers have larger price increases, and mergers involving closer hospitals have the largest price increases. However, there are some studies concerning the impact of mergers on quality in markets where prices are administered. One example is a matched DiD study that examines hospital mergers in the U.K. and finds little evidence that hospital mergers have a positive impact on financial performance, productivity, wait times, or quality (Gaynor et al., 2012). In the Canadian context, Pérez (2002) uses analysis of variance (ANOVA) and finds that early Ontario hospital mergers (in the beginning of our merger wave) did not affect the readmission risk of heart attack and pneumonia patients. In a similar study, Curtis et al. (2005) evaluate the effect of acute care restructuring in Newfoundland and Labrador, a Canadian province. They find that mergers were associated with an increase in some quality measures, but that access to health services remained as problematic as prior to the restructuring. Using the same data as in this paper, Barker and Watt (2021) use matched differences-in-differences (DiD) and find that Ontario mergers were associated with a reduction in hospital-standardized mortality, and that hospital networks that close a hospital location at merger improved their financial performance as measured by total margin—the hospital surplus/deficit as a percentage of revenue. An advantage of the patient choice model over these methods is that it allows us to quantify the effect of mergers on patient welfare. The model also allows us to take an extra step in understanding patient behaviour by computing willingness to travel from the estimated patient preference parameters.

Another hospital-related literature focuses on hospital competition in markets with administered prices. Many authors have exploited a U.K. policy that removed choice constraints on patients to better understand how hospitals respond to changes in competition in such markets (Moscelli et al., 2021; Cooper et al., 2011; Gaynor et al., 2013). Lastly, this article also ties in with the vast literature on divestitures, mergers and acquisitions by studying a set of government-directed hospital mergers that are not often the focus of research (Gaynor and Town, 2012; Clark and Samano, 2021; Harman and Harman, 2003; Brasington, 1999; Saarimaa and Tukiainen, 2014).

3 Background

3.1 The Ontario Healthcare System

Ontario hospitals are privately owned and operated. They are often perceived as public entities because a greater part of their funding comes from the government (Sinclair et al., 2005). During our study period, hospital budgets were set according to a *Global Funding* scheme. They were fixed amounts paid from the government to each hospital for delivering services for a fixed period with yearly increases across all hospitals (Sutherland et al., 2012).[7,8] They were determined from past spending and independently of the number of patients treated and the intensity of resources required to treat them.[9] Hospitals are registered charitable corporations that operate on a not-for-profit basis and according to the bylaws of the corporation. Boards of directors oversee activities and administration of hospitals. Directors are often volunteers from the community, and representatives of physicians and of other hospital employees. They are elected at general meetings just as in other corporations (Sinclair et al., 2005). Therefore, by law, the government does not have power to direct hospitals without the use of parliamentary bills. Nevertheless, hospitals are still required to follow governmental guidelines and standards as described by Ontario's *Public Hospitals Act*.[10] The inability of the government to direct hospitals without enacting legislation combined with political consequences suffered when this was attempted by previous government before 1995 led to the bill that temporarily gave power to an organization outside of the corporations to direct reorganization as discussed in Section 3.2.

The majority of physicians were compensated according to a fee-for-service system with a capping policy that regulated the maximum compensation one could receive.[11] The caps were removed in 1998 to try to prevent physicians from finding work in the United States, where compensation was higher (Henry et al., 2012). Physicians working in hospitals are also compensated by fee-for-service. For specialists, a professional fee is paid directly to them while a technical fee is paid to the hospital to cover certain costs

[7] "Hospitals, Questions and Answers". Ontario Ministry of Health and Long-Term Care. Last modified July 11, 2017. Accessed November 2, 2018 `http://www.health.gov.on.ca/en/common/system/services/hosp/faq.aspx`

[8] In 1995, before the Health Services Restructuring Commission was established, the provincial government had announced that the total healthcare operating budget would remain stable, but that hospital budgets should steadily be reduce over the following three years. These decisions were made by the government and not the Commission. (HSRC, 2000)

[9] Since budgets were sets based on past spending it made inflows of funds to the hospital predictable and transparent (Sutherland et al., 2012). *Global Funding* shifted the financial risk for hospital care from the government to hospitals by acting as a cap on funding. As long as hospitals could balance their budgets, this funding approach allowed them flexibility in types and volumes in the provisions of services (Sutherland et al., 2013). Some of the weaknesses of *Global Funding* are potential restrictions of resources at the beginning of the time period to ensure availability later in the same period, the flexibility of hospitals to choose types and volume of services creating waiting lists, and hospitals having no incentive to improve quality as it is more costly for them to do because their funds do not depend on any quality measures.

[10] "Hospital, Questions And Answers." Ontario Ministry of Health and Long-Term Care. Last modified July 11, 2014. Accessed November 2, 2018 `http://www.health.gov.on.ca/en/common/system/services/hosp/faq.aspx`

[11] Details regarding billing requirements are described in *Health Insurance Act* under the *Schedule of Benefits* (R.S.O. 1990, c. H.6 s.15).

such as the cost of equipment (Henry et al., 2012).[12]

Most health care services are publicly funded for Ontario residents through the *Ontario Health Insurance Plan* (OHIP). It is one of 13 insurance plans, each covering residents of a province or territory, that make up Canada's publicly funded and administered health care system. OHIP must operate on a not-for-profit basis, provide residents with "reasonable access to medically necessary hospital and physician services without paying out-of-pocket", and is designed around federal standards that ensure that all residents of Canada have access to health services across the country, regardless of their province or territory of origin and residence.[13] The provincial government funds OHIP through taxes collected from residents and businesses. Services and procedures covered by OHIP are regulated by *The Health Insurance Act* under the *Schedule of Benefits*.[14] Hospital and physician services are fully covered. For services not covered or for which only a portion of the charges are covered (e.g. private room), expenses must be paid out of pocket or a private health insurance can be purchased. Health care providers (e.g. hospitals and physicians) bill OHIP directly, therefore unless there are out-of-pocket costs or non-standard services (e.g. ambulance transport), patients never actually see the costs.[15,16,17] Upon discharge, patients would be aware of "hotel" (e.g. bed and food) and transportation (e.g.ambulance) fees, even if these are fully covered by OHIP.[18] Typical treatments and services received by patients in our sample are covered by the insurance plan.[19]

Due to the single insurance plan, and because all providers are paid directly by OHIP, patients are not restricted in their hospital choice. They can receive care at any hospital in the province irrespective of where they live or of where their primary care provider (i.e. family physician or general practitioner) works. In some cases, diagnosis may be done

[12]Starting in 1999, alternate payment models were steadily introduced. First to physicians in remote and northern communities, followed by physicians in emergency departments, then general and family practitioners. For a long time after the introduction of alternate payment models, the majority of physicians were still paid on a fee-for-service basis. Even after the end of the Commission and the merger wave, alternate payment methods remained negligible. Alternate payment methods only became prevalent starting in 2005, and as of the fiscal year 2009 still only represented 30% of all payments to physicians (Henry et al., 2012). This was also true for specialists such as cardiologists and respirologists, who may be more involved in the treatment of patients in our sample.

[13]"Canada's healthcare system." Government of Canada. Last modified August 22, 2016. Accessed November 2, 2018. `https://www.canada.ca/en/health-canada/services/canada-health-care-system.html`

[14]Government of Ontario, Ministry of Health, *Schedule of Benefits, Physician Services Under the Health Insurance Act*. December 22, 2015 `www.health.gov.on.ca/en/pro/programs/ohip/sob/physserv/sob_master20160401.pdf` (accessed March 28th, 2020).

[15]"What OHIP Covers". Government of Ontario. Last modified January 8, 2020. Accessed June 26, 2020. `https://www.ontario.ca/page/what-ohip-covers#hospital`

[16]*Health Insurance Act*, R.S.O. 1990, c. H.6. `https://www.ontario.ca/laws/statute/90h06#BK20`

[17]Except in special cases, a fixed co-payment of $45 is paid by patient for medically necessary transport to a hospital (Health Insurance Act, R.S.O. 1990, c. H.6, R.R.O. 1990, Reg. 552: GENERAL).

[18]"Room options and billing". Grand River Hospital. Accessed September 21, 2021. `http://www.grhosp.on.ca/care/visitors/billing/room-options`

[19]"What OHIP Covers". Government of Ontario. Last modified January 8, 2020. Accessed June 26, 2020. `https://www.ontario.ca/page/what-ohip-covers#hospital`

by the primary care provider with a referral to a hospital for treatment, with hospital treatment carried out exclusively by the primary care provider, or in conjuncture with specialists. In others, they may not provide treatment, but still visit their patients to ensure appropriate treatment and provide support (CFPC, 2003). Patients admitted to hospitals located far from their physicians, or when their primary provider is unavailable will be treated by a physician working at the hospital (CFPC, 2003).[20] This is also the case for patients who do not have a primary care provider. Physician referral to a particular hospital does not impact the interpretation of our results as long as patient and physician preferences are aligned. Additionally, three of the four conditions in our sample were selected because treatment is time sensitive alleviating concerns that primary care provider act as gatekeepers to influence patient preferences. Patients needing urgent medical attention, such as patients with conditions in our sample, are to seek treatment at an emergency room. Appointments or referrals are not needed for treatment at an Ontario emergency room.[21] In estimation we also examine whether patients arriving by ambulance have significantly different preferences than patients not arriving by ambulance, therefore we are confident that if a gatekeeper effect exist it is negligible.

3.2 Ontario Health Services Restructuring Commission (HSRC)

The Health Services Restructuring Commission was a result of Bill 26, the *Savings and Restructuring Act*, which was approved on January 30th, 1996.[22] This bill proposed amendments to a large number of provincial legislations and aimed to achieve fiscal savings and economic prosperity by increasing efficiency in public sector operations. It was a response by the newly elected provincial Conservative government to years of increased net public debt by previous governments.[23]

Before the Health Services Restructuring Commission, various interlinked factors increased the pressure on Ontario's healthcare system. First, the years prior to 1995 had seen escalating healthcare spending causing concerns about the sustainability of providing quality healthcare for current and future generations. Second, technological advancements had shifted how health services were delivered and an increase in home care had led to declining length of stays and excess beds within hospitals. Third, several cities had multiple hospitals performing duplicate services—a potentially inefficient allocation

[20]Following the merger period, the province implemented multiple initiative to better integrate the delivery of primary care by the various players as a response to the various shifts experienced by the healthcare system(Marchildon and Hutchison, 2016).

[21]"Emergency rooms". Government of Ontario. Last modified June 8, 2021. Accessed July 5, 2021. https://www.ontario.ca/page/emergency-rooms

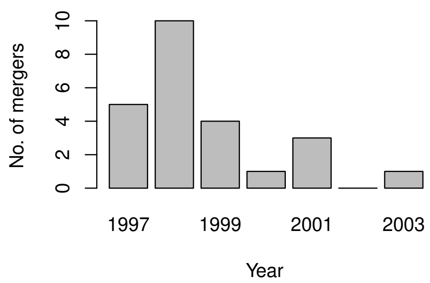
[22]*Bill 26, Savings and Restructuring Act,1995*, O-Reg. 26/95. Retrieved November 2, 2018 from http://www.ontla.on.ca/web/bills/bills_detail.do?locale=en&BillID=1581&isCurrent=false&ParlSessionID=361&detailPage=bills_detail_status

[23]Between 1990 and 1995, the provincial net public debt increased from $38.4 billions to $101.9 billions. (https://www.fraserinstitute.org/article/brief-history-of-ontario-public-debt)

of government resources. Fourth, in the five years prior to the beginning of the Commission, 11,000 hospital beds were closed—the equivalent of 30 medium-sized hospitals. Despite these bed closures, no hospitals were closed or consolidated, meaning that resources, money and staff still had to be put towards maintaining the spaces these beds took. Finally, other factors such as shifting demographics were also putting pressure on hospital spending (Sinclair et al., 2005). Between 1990 and 1995, hospital spending increased by over 20% (HSRC, 1999). Hospitals were the primary target for reducing spending as part of *Savings and Restructuring Act* because hospital spending was such a big portion of the total healthcare expenses—32% of the provincial budget was for healthcare and 41% of this amount was for hospitals alone (Sinclair et al., 2005).

To be able to direct hospital corporations, Bill 26 gave power to the Health Minister to reorganize health care, change hospital funding or take away a hospital's right to operate, and to replace current hospital boards with a supervisor to carry out reorganization when hospital boards showed opposition. The legislation also authorized the Minister of Health to delegate this authority, and this is how the Health Services Restructuring Commission came to life. Bill 26 specified that all powers of the Health Minister and the commissioners expired on March 1st, 2000.

Figure 1: Number of hospital mergers per year

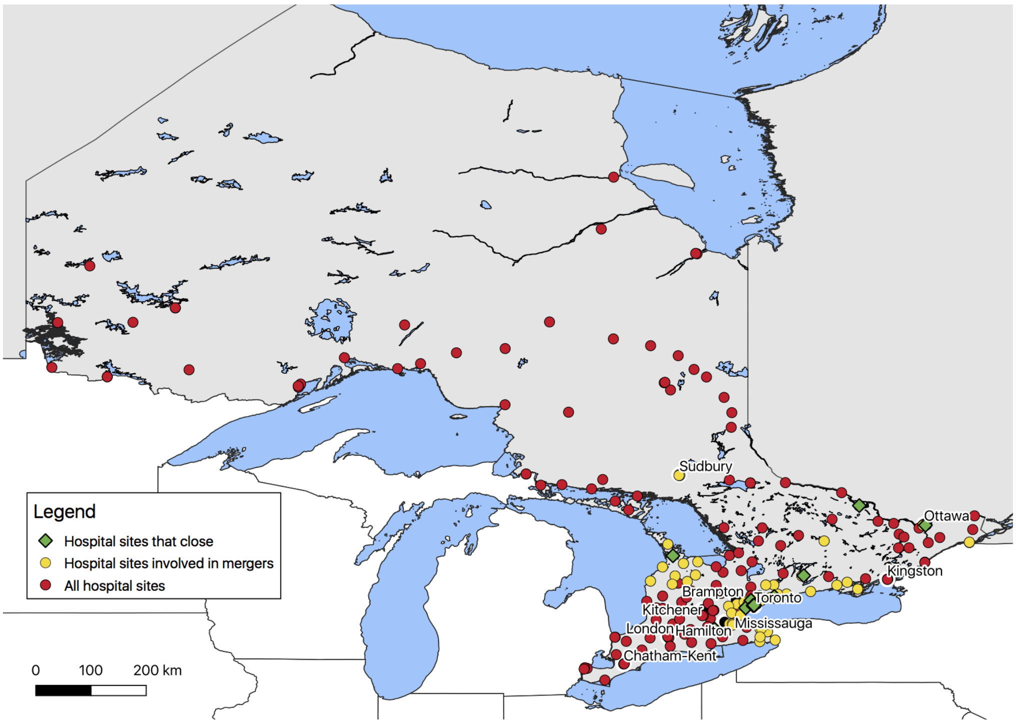


Over the four years, the HSRC had a mandate with unprecedented and unconstrained authority to make the healthcare system more efficient (Sinclair et al., 2005). Specifically, the mandate of the twelve commissioners included decision making related to hospital restructuring, and recommendations to the Health Minister regarding reinvestment and potential restructuring of other parts of the Ontario healthcare system to achieve better integration of services (HSRC, 2000).[24] The HSRC also needed to make hospital services more accessible, of higher quality, and affordable such that patients of current and future generations could continue to obtain safe and quality care at the most affordable cost for the province.

[24]The Health Minister had power to change hospital funding, but the HSRC had no such authority. This is one of the only constraints faced by the commissioners.

The HSRC mandated a large number of hospital mergers and closures to occur between 1997 and 2003.[25] Table 19 in Appendix C lists the hospitals involved in mergers as well as the sites that were closed as a result of the mergers. The mergers mostly took place near Toronto, the capital of the province, but a significant number were still widespread across the territory, in rural, suburban and urban regions (Figure 2). The Commission also made a significant number of recommendations that aimed at increasing the quality of patient care and the system's efficiency through reinvestments of savings from the restructuring, hospital renovations, establishments of alternative health services, and better integration between the parts of the health care system (HSRC, 2000, 1999).[26]

Figure 2: Location of hospitals



[25]Marc Rochon, "Restructuring Health and Hospital Services: The Ontario Experience" (Canadian Masterclass on Managing a Health System through an Economic Downturn, London, England, U.K., May 17th, 2011) Retrieved April 1st, 2018 from `http://www.cfhi-fcass.ca/NewsAndEvents/Events/Event/11-04-13/48813e78-4653-45d4-983a-b04bbbf02324.aspx`

[26]For a more thorough and detailed historical overview of the Health Restructuring Commission, refer to *Riding the Third Rail: The Story of Ontario's Health Services Restructuring Commission, 1996-2000*, a book written by the Chair of the Commission, Duncan Sinclair and chief executive officers Mark Rochon and Peggy Leatt.

4 Data

We were granted access to the proprietary datasets by the Institute for Clinical Evaluative Sciences (ICES) that include patient-level information.[27,28] These datasets were linked using unique encoded identifiers and analyzed at ICES. Our linked dataset contains all adults (18 years of age or older) admitted to an acute care hospital in Ontario with one of four conditions (AMI, pneumonia, sepsis, and stroke) from 1994 through 2013. These conditions are selected for several reasons. First, they are commonly treated across Ontario hospitals giving us enough power to break down the welfare effect by region, and second, immediate treatment is required for survival reducing the likelihood of gatekeeper effects influencing patient preferences. Additionally, these conditions have non-negligible mortality and readmission risk allowing us to construct condition-specific measures through which hospital quality is reflected. Gaynor and Town (2011) highlight that these measures are not quality *per se*, but reflect a hospital's choice of quality of care which determines patient outcomes. The quality decision of hospitals impacts patient outcomes, even for individuals for which time is sensitive (Barker and Watt, 2021). The dataset includes demographic information such as age, gender, longitude and latitude of residence, and whether the residence is located in an urban, suburban or rural area. It also includes health information such as admission and discharge dates, the condition for which the patient is treated, comorbidity status (measured by the ADG score—see Appendix B), whether arrival to the hospital was by ambulance, and to which hospital the patient was admitted. Using patient and hospital latitudes and longitudes, we calculate the approximate distance travelled to the chosen hospital by taking the geodesic distance (i.e. the shortest distance between two points) between the patient's residence and the location of the hospital.

The data also contain hospital attributes and measures of quality. Attributes used are overall hospital volume, indicators for whether the hospital has a teaching status, and for the RIO category (urban/suburban/rural) of the hospital.[29] Quality measures that are not specific to a condition are hospital-standardized mortality ratio (HSMR) and average alternate-level-of-care length of stay (ALC). In the absence of wait-time data, we proxy for hospital congestion using hospital occupancy rate. We can also calculate condition-specific quality measures: 30-day excess mortality, 30-day excess readmission, and average length of stay (LOS). To standardize the mortality rate, we estimate a logistic regression model that predicts mortality using patient characteristics. The excess rate is

[27] ICES is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze health care and demographic data, without consent, for health system evaluation and improvement.

[28] Grigolon and Lasio (2019) also access their data through ICES. Their main dataset is the Ontario Cancer Registry while our main dataset is the Discharge Abstract Database.

[29] "Measuring Rurality - RIO2008_Basic: Methodology and Results", Boris Kralj. Accessed March 7, 2019 from `https://www.oma.org/wp-content/uploads/2008rio-fulltechnicalpaper.pdf`

then calculated as the actual number of deaths over the predicted number of deaths for the given year. We do the same exercise for the 30-day readmission rate and also control for patient characteristics in the average length of stay. For hospital measures that may be influenced by patient characteristics, we also adjust for patient selection as proposed by Gowrisankaran and Town (1999). Measures for which we can correct for patient selection are mortality and readmission rates, and average lengths of stay. Summary statistics of selection-corrected measures, tests and robustness checks of estimation results can be found in Appendix D.

Though we have access to data from 1994 through 2013, we only use data collected prior to 2006. This avoids policy contamination from the reorganization of the District Health Councils into Local Health Integrated Networks (Gardner, 2006). Since we use lagged quality measures in our model and the merger wave begins in 1997, we estimate the model using patients admitted in 1995 and 1996. In our second counterfactual, we use hospital characteristics from 2005 to capture long-run effects of hospital mergers.

Table 1: Descriptive statistics - AMI patient characteristics

	Pre-Merger	
Variable	Mean	S.d.
Pneumonia	0.059	0.236
Sepsis	0.013	0.112
Stroke	0.019	0.135
Comorbidity	1.090	0.306
Death within 30 days	0.201	0.400
Readmission within 30 days	0.007	0.080
Total LOS (days)	9.905	14.370
Age	68.707	13.202
Sex (male = 1)	0.619	0.486
ADG score	20.392	9.215
Visit no. for patient	1.050	0.227
Multiple stays	0.048	0.214
Patient income quintile	2.879	1.406
Distance to choice (10km)	1.498	4.690
Patient location: Urban	0.659	0.474
Patient location: Suburban	0.237	0.425
Patient location: Rural	0.104	0.305
Admission via ambulance	0.419	0.493
Urban	0.443	0.497
Suburban	0.382	0.486
Rural	0.352	0.478
Observations	38,373	

Notes: The first four rows report the proportion of patients who are diagnosed with more than one condition (e.g. 5.9% of AMI patients also have pneumonia, 1.2% also have sepsis and 1.8% also have a stroke). LOS-length of stay or the number of days the patient in hospital as an inpatient. Sex takes a value of 1 when a patient is recorded as male. ADG score - a measure of health status at the time of hospital admission. It is constructed using weights on each ADG according to their prediction of mortality. Distance is calculated as a straight line between the patient's residence and the hospital.

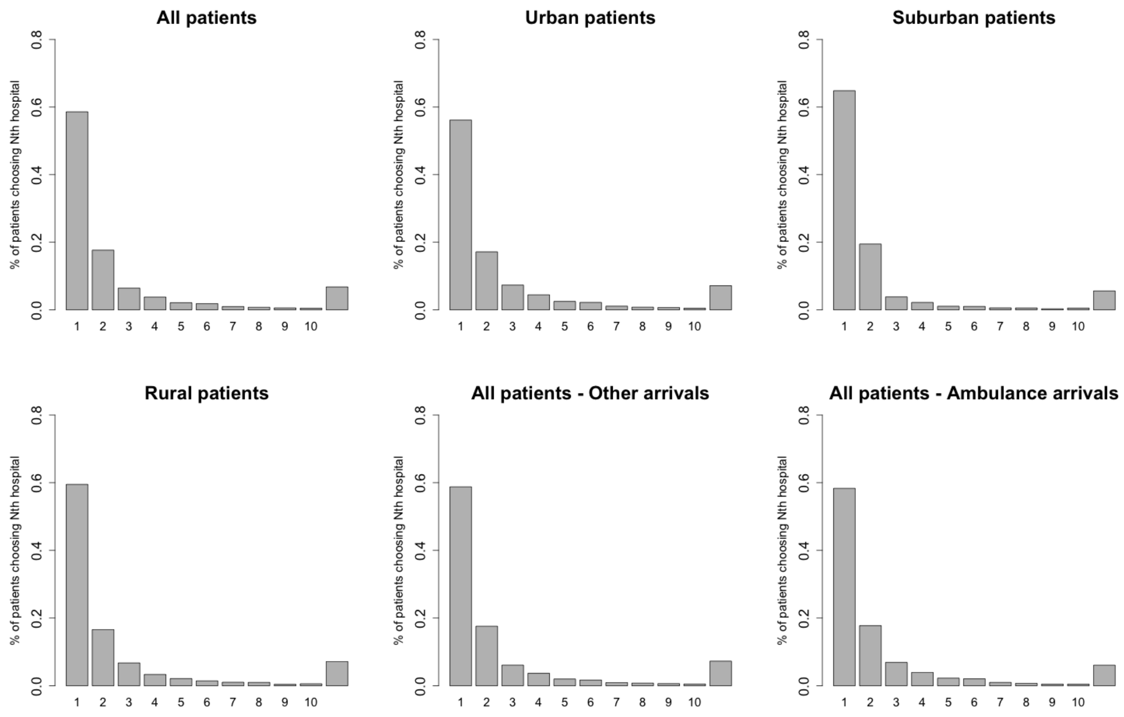
For ease of exposition, we focus on patients admitted with an AMI diagnosis in the remainder of the paper. Overall, results for the four diagnosis are similar. When results differ across conditions we highlight it in the text. Tables and Figures for patients diagnosed with pneumonia, sepsis, and stroke are found in the Online Appendix E. Table 1 reports characteristics of AMI patients during the pre-merger period (i.e. estimation sample). Observations of patients that have missing information are removed. We also omit patients that transferred to or from a hospital because we cannot observe the reason of transfer (e.g. referral, condition improving/worsening, etc.). The estimation sample then consists of 38,373 patients admitted with AMI. The average patient admitted to the hospital with this diagnosis is 68.7 years old, has an ADG Score of 20.4, and a length of stay of 9.9 days. More males are diagnosed with AMI. The average patient is admitted to the hospital once during our sample period, and has a mortality (readmission) rate within 30 days of discharge of 20.1% (0.7%). A very small portion of patients are diagnosed with more than one of the conditions observable in our data during a single hospital stay (e.g. a patient was both recorded as having received treatment for AMI and stroke).[30] Respectively, 5.9%, 1.3%, and 1.9% of AMI patients also have a diagnosis of pneumonia, sepsis, or stroke. 41.9% of AMI patients arrive to the hospital by ambulance. Arrival by ambulance is highest for urban patients (44.3%), but suburban and rural patients are also often admitted to the hospital via ambulance (38.2% and 35.2%). The majority of AMI patients live in urban locations compared to suburban and rural locations (65.9%, 23.7% and 10.4%), and the average distance travelled to the choice hospital is 14.98km.

Figure 4 in Appendix C demonstrates that close to 72.1% of patients receive treatment at a hospital located within 10km from their residence, and this is mostly driven by patients that live in urban areas. Almost 85.8% of urban patients travelled 10km or less. That number is only 53.4% and 29.7% for patients living in suburban and rural areas respectively. 16.5% of rural patients travelled 50km or more to their chosen hospital. For urban patients, only 2.7% of patients travelled such a distance, while 6.7% of suburban patients travelled more than 50km. The top left histogram of Figure 3 shows that 41.4% of patients admitted for AMI in our sample chose to bypass the closest hospital site. We separate patients according to their location of residence and see that the shape of the distribution remains the same with slight variation across location (see Urban, Suburban and Rural histograms of Figure 3). The pattern remains if we instead break down patients according to arrival type (ambulance v. other arrival).[31] This is graphical evidence that there exists heterogeneity in patients' willingness to travel and hospital choice. We could expect that, due to this heterogeneity, patients living in different regions of Ontario could

[30]This is more common for sepsis patients, which is to be expected as sepsis can originate from pneumonia (Rautanen et al., 2015). Sepsis also causes organ damage and can cause a dramatic drop in blood pressure, both of which can lead to AMI (Schilling, 1997) or stroke (Rhee et al., 2019).

[31]See two histograms at bottom right of Figure 3 for AMI arrival type. The pattern also holds across conditions – see Figures in Online Appendix E for pneumonia, sepsis and stroke.

Figure 3: Histograms of the proportion of AMI patients choosing the Nth closest hospital, overall, by location, and by arrival type



be impacted differently by hospital mergers.

Table 2: Average distance to Nth closest hospital - AMI patients

	1	2	3	4	5	6	7	8	9	10	11+
All AMI	5.6	9.6	13.1	14.3	16.9	17.6	24.9	26.5	27.4	36.2	103.0
By arrival type											
Ambulance	5.6	9.2	12.6	13.9	15.3	14.4	24.4	26.0	32.2	35.0	103.3
Other	5.7	10.0	13.4	14.6	18.3	20.5	25.2	26.0	24.8	37.0	102.7
By location											
Urban	3.4	5.6	7.1	7.7	8.4	8.3	14.1	11.6	11.8	15.26	7.15
Suburban	7.4	13.7	26.4	29.1	36.6	42.0	49.6	54.1	52.4	68.1	151.9
Rural	14.5	24.80	36.0	46.5	56.5	67.8	64.2	65.1	140.7	76.1	211.3

Notes: Distance measured in kilometers (km). Table 28 for pneumonia, sepsis and stroke are in the Online Appendix (E).

In theory, patients could seek treatment at any hospital in Ontario. Since patients in our estimation sample have conditions that require immediate treatment, we reduce the size of the choice set so that each included hospital can be reached within a reasonable travelling distance. If the assumptions of the model are correct, then eliminating irrelevant choices will not affect the results. We can therefore test our model by varying the size of the choice set. In our baseline case, the choice set consists of the closest 10 hospitals located within the 99th percentile of distance according to patient location. Hospitals located at a distance that exceeds the 99th percentile in kilometres from the patient are not part of the choice set. They are excluded even if they are one of the 10 closest hospitals because it would not be possible for patients to reach these hospitals within a reasonable time frame. Such alternatives will be grouped under the outside option. Patients choosing a hospital outside of the 10 closest hospital within the 99th percentile of distance are choosing the outside option.[32] Table 2 reports the average distance to the Nth hospital for the 10 closest hospital.

Table 3: Descriptive statistics - Hospitals before mergers - AMI

	1995	*1996*	*Pre-Merger*	
Variable	Mean	Mean	Mean	S.d.
Teaching status	0.156	0.163	0.160	0.367
ALC (days)	6.961	8.860	7.927	6.263
HSMR (%)	100.215	100.289	100.253	3.156
Occupancy (%)	78.740	76.095	77.399	24.963
Volume (1,000s)	5.220	5.465	5.344	5.649
Specialization - AMI (%)	2.310	2.317	2.313	0.920
Mortality rate - AMI (%)	21.758	22.088	21.949	18.338
Readmission rate - AMI (%)	28.758	28.579	28.667	75.454
LOS - AMI (days)	8.382	8.910	8.650	5.806
Urban	0.382	0.388	0.385	0.487
Suburban	0.283	0.287	0.285	0.452
Rural	0.335	0.326	0.330	0.471
Observations	172	177	349	

Notes: All variables are lagged, except teaching status and hospital location which are indicators and time-invariant. ALC is the number of days in alternate-level-of-care as an inpatient. HSMR is the hospital standardized mortality ratio calculated from all patients diagnosed with conditions accounting for 80% of in-hospital deaths. LOS is the average inpatient length of stay adjusted for patient characteristics. The occupancy rate is a congestion proxy as measured by the estimated annual percentage of beds occupied by all patients receiving inpatient care. Mortality rates are within 30 days of discharges meaning they include in-patient deaths and deaths within 30 days after discharges. Readmission rates are calculated based on hospital readmissions within 30 days following discharge. The mortality rate and the readmission rate measure the excess mortality and readmission rate to adjust for the patient pool.

Table 3 describes hospital characteristics over the same period as our patient information. We exclude a set of hospitals that merged during our merger wave on the grounds that they had formed a network several years prior to merging. In addition, we exclude a small number of hospitals that merged voluntarily just before the merger wave. Depending on the condition some hospitals will also be excluded due to missing information. This leaves us with 349 hospital-year observations to construct our hospital characteristics for the AMI sample. The average hospital treats around five thousand patients per year, with an occupancy rate of 77.4%. In our sample, 16.0% of hospitals have a teaching status and the hospital-standardized mortality ratio (i.e. observed death divided by expected death multiplied by 100) is 100.253. In terms of the prevalence of the conditions for which we have patient-level information, or in other words condition-specific specialization, 2.31% of all patients discharged were treated for AMI. The 30-day excess mortality and read-

[32]Patients in the estimation sample have an average of 10.67 hospitals in their choice set.

Table 4: Descriptive Statistics - Hospitals selected for closure - AMI

	Not selected to close		*Selected to close*		
Variable	Mean	S.d.	Mean	S.d.	Difference
Teaching status	0.133	0.34	0.538	0.519	-0.405**
ALC (days)	8.740	6.942	10.378	6.134	-1.638
HSMR (%)	100.538	2.832	97.130	6.135	3.408*
Occupancy (%)	76.648	24.778	70.382	23.379	6.266
Volume (1,000s)	5.414	5.784	6.109	4.346	-0.695
Specialization - AMI (%)	2.368	0.859	1.673	1.192	0.695*
Mortality - AMI (%)	21.859	19.920	24.994	27.090	-3.135
Readmission - AMI (%)	26.715	77.473	52.239	140.453	-25.524
LOS - AMI (days)	8.795	6.883	10.375	7.011	-1.58
Urban site	0.358	0.481	0.769	0.439	-0.411***
Suburban site	0.297	0.458	0.154	0.376	0.143
Rural site	0.345	0.477	0.077	0.277	0.268***
Observations	165		13		

Notes: * p <0.10 ** p <0.05 *** p <0.01. Variable definitions in Appendix A. All variables are lagged, except teaching status and hospital location which are indicators and time-invariant. Only hospitals that treat AMI patients observed in out data included. See Table 31 for pneumonia sepsis and stroke.

mission rates of all patients treated with AMI are 21.949% and 28.667% respectively. The average hospital stay of patients treated for AMI was 8.65 days. Taking a closer look at where hospitals are located, 38.5% of hospitals are located in urban areas, 28.5% are located in suburban regions while the remaining 33.0% are located in rural areas.

Table 5: Descriptive Statistics - Hospitals selected for merger - AMI

	Not selected to merge		*Selected to merge*		
Variable	Mean	S.d.	Mean	S.d.	Difference
Teaching status	0.088	0.284	0.297	0.460	-0.209
ALC (days)	8.890	7.210	8.806	6.316	0.084
HSMR (%)	100.838	2.953	99.311	3.621	1.527***
Occupancy (%)	74.482	24.834	79.012	24.285	-4.530
Volume (1,000s)	4.293	4.754	7.551	6.684	-3.258***
Specialization - AMI (%)	2.381	0.881	2.204	0.934	0.177
Mortality - AMI (%)	22.303	23.112	21.705	14.704	0.598
Readmission - AMI (%)	22.868	42.796	38.751	126.718	-15.883
LOS - AMI (days)	8.459	7.747	9.714	4.950	-1.255
Urban site	0.237	0.427	0.656	0.479	-0.419
Suburban site	0.342	0.477	0.188	0.393	0.154
Rural site	0.421	0.496	0.156	0.366	0.265
Observations	114		64		

Notes: * p <0.10 ** p <0.05 *** p <0.01. Variable definitions in Appendix A. All variables are lagged, except teaching status and hospital location which are indicators and time-invariant. Only hospitals that treat AMI patients observed in out data included. See Table 32 for pneumonia sepsis and stroke.

On average, hospitals selected to close have similar characteristics to other hospitals as shown in Table 4 and Table 31 in the Online Appendix E. Though, there is some evidence of worse quality at hospitals that remain open. Specialization and HSMR for AMI, HSMR and excess readmission for pneumonia and, excess readmission for sepsis are significantly higher. Slightly more hospitals with a teaching status are closed. A disproportionate number of urban hospitals are closed over rural hospitals. Hospitals selected to merge (including the mergers that involve site closures) also have similar characteristics as non-merger hospitals (Table 5 and 32). Measures that show worse quality at hospitals not involved in mergers include HSMR for AMI, LOS for pneumonia, HSMR and LOS for sepsis, and LOS for stroke. Larger hospitals are selected to merge. Urban sites are not more involved in a merger.

5 Methodology

To analyze the impact of mergers, we must first understand how patients decide where to seek care. We use a patient hospital choice model based on McFadden (1974)'s conditional logit analysis of choice behavior to recover patient preferences for hospitals. We then use the estimated preferences to investigate the welfare effects of restructuring. In estimation, we perform the exercise separately for each of the four conditions: AMI (heart attack), pneumonia, sepsis, and stroke.

5.1 Model

Among several Ontario acute care hospitals, a patient requiring hospital care chooses to be treated at the site associated with the highest ex-ante utility. The equation characterizing the utility of patient i receiving treatment at hospital j is the following:

$$u_{ij} = \underbrace{Q_j\beta_i^q + X_j\beta_i^x - D_{ij}\beta_i^d}_{V_{ij}} + \varepsilon_{ij}, \quad i = 1, ..., I \quad \& \quad j = 1, ..., J \tag{1}$$

where Q_j, X_j and D_{ij} are vectors of hospital quality measures, time-invariant hospital characteristics, and distances between patient i and hospital j, respectively. These may all be considered by the patient when choosing where to receive treatment. Some quality measures included in Q_j are specific to the condition experienced by the patient (e.g. excess readmission rate for patients with the condition) and some are not (e.g. the hospital standardized mortality ratio, HSMR).[33] In other words, a patient seeking treatment for AMI will have lagged quality measures specific to AMI and lagged overall quality measures in their utility function, but not lagged quality measures specific to other conditions. We use lagged quality measures because it may take time for patients to learn about changes in quality. Additionally, patients admitted during a given year impact the quality measures for that year, potentially causing endogeneity problems if current quality measures were used. Time-invariant hospital characteristics, X_j, include

[33] Though we might expect that patients facing a medical emergency cannot be sensitive to quality, Gaynor and Town (2012) discuss theory and empirical evidence suggesting that mortality rates for emergency conditions such as AMI do in fact adjust in response to changes in competition between hospitals. This suggests that hospitals compete by investing in quality in a way that influences mortality rates, making them an appropriate quality measure for this study.

hospital location (urban, rural, suburban) and whether the hospital is a teaching institution. Characteristics included in X_j are current as opposed to lagged since they are not impacted by the composition of patients admitted during the period. In our setting, since patients do not pay for hospital services received, distance travelled to the hospital is the observable cost of treatment. This is captured by D_{ij}, the distance between patient i and hospital j.[34] Lastly, ε_{ij} represents the idiosyncratic preferences of patient i for hospital j, which are unobservable to the researchers. For example, preferences caused by relationships with hospital staff or physicians would be captured in ε_{ij}. The idiosyncratic preference term will also reflect cases where patients are not home (e.g. on vacation or at work) at the start of the illness. For simplicity of exposition, we refer to the observable part of the patient utility function as V_{ij}.

Although wait times could be another cost of treatment, we do not observe this information in the data. Additionally, wait times and capacity constraints are less important for the conditions of admission in our sample. Most symptoms for the conditions in our sample fall under an acuity level of *Resuscitation* or *Emergent* according to the *Canadian Triage & Acuity Scale* (CTAS, v2).[35] The median patient assigned a *Resuscitation* level of acuity, the most severe acuity level, sees a physician in approximately five minutes following arrival at the emergency department. Most of the time spent in the emergency department will be spent undergoing diagnostics and treatment (Canadian Institute of Health Information, 2005) With this in mind, we do not explicitly model capacity constraints.[36]

In Section 4, we mentioned that the choice set consist of the ten closest hospitals within the 99th percentile of distance. Patients treated at a hospital not included in the choice set are choosing the outside option (choice 0).[37] We normalize the observable utility, V_{i0}, for the outside option to 0. The utility from the outside option is then

$$u_{i0} = \varepsilon_{i0} \tag{2}$$

If we assume that the idiosyncratic component, ε_{ij}, is independently and identically distributed according to the Type I extreme value distribution, we can compute the

[34]Although many studies (Gutacker et al., 2016; Moscelli et al., 2016; Santos et al., 2015) include polynomial terms of distance we choose to omit them to simplify the implementation of our counterfactuals, and because estimation results are robust to their exclusion. The specification is further discussed in Section 6.

[35]Common *Resuscitation* complaints include unresponsiveness, cardiac arrest, septic shock, unconsciousness, severe respiratory distress, hypothermia and more. Typical *Emergent* complaints include tachycardia, bradycardia, sudden onset of confusion, weakness, severe headache, moderate respiratory distress, abdominal pain with vomiting/diarrhea/abnormal vital signs (CTAS, v2).

[36]To control for hospital congestion we use the occupancy rate instead.

[37]We follow Gowrisankaran et al. (2015) and set the outside option to be choosing a hospital outside a given radius. In our case, the outside option is a choice hospital not part of the 10 closest hospitals within the 99th percentile of distance calculated by patient location.

probability that patient i chooses hospital j:

$$P_{ij} = \frac{exp(V_{ij})}{\sum_{k \in 0, M_i} exp(V_{ik})} \tag{3}$$

The numerator is the observable portion of utility from the choice hospital. The denominator is a sum of observable utility associated with each k alternative hospital in patient i's choice set, M_i, and the outside option, 0.

The log-likelihood function for estimation is then given by

$$lnL = \sum_i \sum_j ln(P_{ij}) = \sum_i \sum_j ln\left(\frac{exp(V_{ij})}{\sum exp(V_{ij})}\right) \tag{4}$$

As in many patient choice papers such as Gowrisankaran et al. (2015) or Gutacker et al. (2016), we also include interactions with observable patient characteristics to capture some of the differences in preferences that may exist across patient groups. Distance, hospital quality and hospital characteristics are all interacted with age, sex and comorbidity status of patients.[38] Distance is also interacted with patients' rurality index to account for the varying opportunity costs of travelling that may exist across locations. In estimation, we also include a specification with hospital fixed effects to capture information common to patients that may not be directly observable to the researchers.

Once we have the patient preference parameters, we compute willingness to travel (WTT) for the quality measures (Gutacker et al., 2016; Moscelli et al., 2016). WTT is a measure analogous to willingness to pay that informs us on the extra distance patients are willing to travel to receive treatment at a hospital of better quality. It is computed as follows:

$$\begin{aligned} WTT = \left.\frac{\partial d_{ij}}{\partial Q_j}\right|_{u_{ij}} SD(Q) &= -\frac{\partial d_{ij}}{\partial u_{ij}}\frac{\partial u_{ij}}{\partial Q_j} SD(Q) \\ &= \frac{-\beta_i^q}{\beta_i^d} SD(Q) \end{aligned} \tag{5}$$

where $SD(Q)$ is the one standard deviation increase in quality. WTT is computed with respect to each quality measure used in estimation.

5.2 Counterfactuals

Using patient preferences we construct two counterfactuals to explore the welfare impact of the HSRC mergers. In the first, closed hospitals are removed from the choice set but the remaining hospitals are assumed to be unchanged, capturing the short-run effect. In the second, closed hospitals are also removed from the choice set and remaining hospitals are

[38] We capture comorbidity using the ADG Score based on the Johns Hopkins Aggregated Diagnosis Groups (ADGs). See Appendix B for a description of this system and details on the calculation of the score.

assigned their post-merger quality characteristics. This captures the long-run impact of mergers. We use values from 2005 for the post-merger hospital characteristics, four years after the end of the merger wave. Using data from 2005 leaves enough time for hospitals to adjust their characteristics, but avoids contamination from a subsequent policy that took place starting in 2006 (Gardner, 2006).

To compute the welfare effect of the mergers, we use McFadden (1996)'s change in consumer surplus. It is calculated by taking the difference in ex-ante expected utility between two scenarios. The expected utility is calculated over all alternatives in the choice set. We label the change in consumer surplus as δ_i and is calculated as follows:

$$\delta_i = \Delta E(CS_i) = \frac{1}{MU_d}\left[ln\left(\sum_{j=1}^{J^a} e^{V_{ij}^a}\right) - ln\left(\sum_{j=1}^{J^b} e^{V_{ij}^b}\right)\right] \tag{6}$$

where MU_d is the marginal utility of distance, b refers to pre-merger context and a refers to the post-merger environment, either the short-run or long-run. The price or cost coefficient enters the utility function and the negative of the coefficient tells us by how much utility would rise as a result of a decrease in price or cost Train (2009). In our case, we do not observe patient income and there are no hospital prices making distance travelled to the hospital the observable cost of treatment for patients. Therefore we divide the change in expected utility by the marginal utility of distance which is the negative of the distance coefficients.

A positive welfare change would indicate that patients are better off in the counterfactual environment, meaning that hospital restructuring was beneficial for the Ontario healthcare system. On the other hand, a negative welfare result would suggest that the mergers harmed patients.

6 Estimation and Results

We estimate our conditional logistic regression model by maximum likelihood on the two years of data prior to the start of the restructuring. The main specification includes hospital fixed effects and the interactions of patient characteristics detailed in the previous section. We also report results without fixed effects and interactions. In our main specification, time-invariant hospital characteristics are omitted as they are captured by the hospital fixed effects.

Similar to Gowrisankaran et al. (2015), we identify the coefficient on distance using variation in hospital choices by patients living near a hospital choosing that hospital compared to patients that also choose that hospital but live further. Since we include hospital fixed effects that absorb the component of utility driven by time-invariant and unobserved hospital-specific information, the coefficients on hospital quality are identified in a comparable fashion as the distance coefficients, although identification relies on the variation within hospital across the two years (Gutacker et al., 2016).

Recall that in our baseline case, the choice set consists of the closest 10 hospitals located within the 99th percentile of distance according to patient location. The outside option is treatment at a hospital outside the choice set. Patients are excluded when the choice set is empty (i.e. the choice hospital and closest hospitals are all in the outside option), as it is not possible to compute probabilities over alternatives when no choice is made, or when only their choice is in their set, as observables perfectly predict their choice. This is 31 patients or 308 patient-hospital years. Separately for each condition, we exclude hospitals that do not treat any patients in one or both pre-merger years.[39] Our final estimation sample consists of 38,342 patients admitted for AMI (or 409,181 patient-hospital pairs). This means 0.08% of patients for which we have no missing information are excluded due to the restrictions placed by the choice set.

At the end of the discussion of the model estimates, we include a variety of robustness checks that assess the stability of the parameters. In Section 6.2, we convert the coefficients to measures of willingness to travel for the average urban, suburban and rural patients, to give a sense of the trade-offs patients would be willing to make to be treated at a hospital of better quality.

6.1 Estimated coefficients

Table 6 reports the estimated parameters of the utility function for the average AMI patient. Results for pneumonia, sepsis and stroke are in the Online Appendix E. Column (4) is our main specification. Interactions of patient characteristics for patient location, age, sex and ADG score are included but not reported.[40] The average patient corresponds to a suburban patient with average age, sex and ADG score as described in Table 1. The interactions only slightly change the magnitude of the base coefficients and never the direction of how hospital quality or distance affects utility.

Results are consistent with previous findings in the literature. Unsurprisingly, distance is an important determinant of hospital choice, in the sense that the ex-ante (dis)utility from distance is relatively large in magnitude and highly significant. Travelling an additional ten kilometres reduces the level of utility by 0.911 utils. The average AMI patient also prefers better quality hospitals as reflected by the negative signs on most quality measures. Larger values reflect worse quality for mortality, readmission, ALC and HSMR. Shorter lengths of stay (LOS) represent better quality when not associated with higher readmissions. Condition-specific quality measures that have a negative impact on patient

[39]The specific number of hospitals cannot be reported because for some conditions it does not meet the minimum number of observations set by ICES to protect for re-identification risk.

[40]Patient location is interacted with distance while age, sex and the ADG score interact both distance and hospital characteristics. Full results available from the authors by request.

Table 6: Estimation results

	AMI							
	(1)		(2)		(3)		(4)	
	Choice		*Choice*		*Choice*		*Choice*	
Distance (10km)	-0.846***	(0.010)	-1.694***	(0.012)	-0.854***	(0.052)	-0.921***	(0.051)
Volume (1,000s)	0.0732***	(0.001)	0.0412	(0.081)	0.0611***	(0.009)	0.0770	(0.082)
Occupancy (%)	0.00387***	(0.000)	-0.00352**	(0.002)	0.00100	(0.002)	-0.00696**	(0.003)
Specialization - AMI (%)	0.424***	(0.012)	-0.0440	(0.045)	0.349***	(0.074)	-0.0198	(0.094)
Mortality - AMI (%)	-0.0106***	(0.001)	-0.00350**	(0.002)	-0.0253***	(0.006)	-0.0256***	(0.006)
Readmission - AMI (%)	-0.00900***	(0.001)	-0.000367	(0.001)	-0.0223***	(0.003)	-0.00962***	(0.003)
LOS - AMI (days)	-0.0276***	(0.002)	-0.0222***	(0.005)	-0.0435***	(0.014)	-0.0691***	(0.016)
ALC (days)	-0.0212***	(0.002)	-0.0119	(0.009)	-0.0149	(0.010)	0.00598	(0.014)
HSMR (%)	0.00586***	(0.001)	0.00704	(0.010)	0.0248***	(0.004)	0.0104	(0.011)
Closest site	1.387***	(0.016)	-	-	0.430***	(0.094)	-	-
Teaching status	-0.268***	(0.026)	-	-	0.765***	(0.179)	-	-
Urban site	-0.0118	(0.032)	-	-	0.665***	(0.195)	-	-
Rural site	-0.155***	(0.045)	-	-	-2.161***	(0.310)	-	-
Patient characteristics	No		Yes		No		Yes	
Hospital F.E.	No		Yes		No		Yes	
Observations	409,181		409,181		409,181		409,181	
Pseudo R-squared	0.4583		0.5137		0.5013		0.5260	
ll	-49,111.166		-46,644.556		-45,153.504		-42,946.838	

Notes: * p <0.05 ** p <0.01 *** p <0.001. Estimated coefficients of preferences of patients admitted with AMI. Standard errors in parentheses. Main specification column (4). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported. Results for pneumonia, sepsis and stroke are in the Online Appendix (E).

utility include 30-day excess mortality and readmission rates, and average length of stay. Seeking care at a hospital that treats more patients overall has a positive impact on utility, although not significantly. Instead, what matters most to patients is that hospitals not be congested as captured by the negative and significant coefficient on occupancy rate. Overall hospital quality measures are important determinants of patient utility, but not as much as distance in terms of magnitude.

Estimates of patient interactions suggest that there are differences between patient groups. Though patients in urban, suburban and rural markets all dislike distance, urban patients receive the most disutility and rural patients receive the least. Older patients are more sensitive to distance than the average person, which can be explain by reduced mobility. While patients with higher comorbidity as measured by the ADG Score are less sensitive. This may be because patients with pre-existing health conditions are perhaps more inclined to travel to specific hospitals where they know that their other conditions can be well managed. It can also be suggestive of better knowledge of the hospital system for such patients. Older patient dislike bigger hospitals, but are slightly less impacted by more congested hospitals and lower quality hospitals. In other words, their distaste for higher 30-day mortality and readmission rates, and average length of stay is smaller than the average patient. Sicker patients prefer bigger hospitals and are more sensitive to hospital congestion. There are no significant differences between males and females. Interactions change the magnitude of base coefficients, but are never large enough to change the direction of the effects of hospital quality or distance on utility.

Although studies in the U.K. have included polynomial terms of distance (Gutacker et al., 2016; Moscelli et al., 2016; Santos et al., 2015), with marginal disutility from distance increasing at first, then decreasing after a certain inflection point, we choose to omit the the square and cubic terms. In a theoretical paper, Mainardi (2007) refers to this inflection point as the *safety threshold*, reflecting that travelling large distances is unsafe but that the difference in safety is small for a low number of kilometres. Including a cubic term gives us this inflection point, but it occurs farther than the average distance travelled by patients in each location (Figure 6 in Appendix C). Without the cubic term, we also choose to omit distance squared for two reasons. First, marginal utility of distance is increasing at a constant rate without distance cubed, and second it allows us to use the closed form solution of McFadden (1996) to calculate the welfare effect of the mergers. Estimation results are invariant to the functional form of distance in the utility function (Table 21 in Appendix C).

Table 7: Estimation results - By arrival type

	AMI					
	(All) *Choice*		(Ambulance) *Choice*		(Other) *Choice*	
Distance (10km)	-0.921***	(0.051)	-0.719***	(0.087)	-1.060***	(0.065)
Volume (1,000s)	0.0780	(0.082)	0.176	(0.130)	-0.0294	(0.107)
Occupancy (%)	-0.00696**	(0.003)	-0.0109**	(0.004)	-0.000863	(0.004)
Specialization - AMI (%)	-0.0198	(0.094)	0.417***	(0.159)	-0.146	(0.121)
Mortality - AMI (%)	-0.0256***	(0.006)	-0.0259**	(0.011)	-0.0181**	(0.008)
Readmission - AMI (%)	-0.00962***	(0.003)	-0.0337***	(0.008)	-0.00940***	(0.003)
LOS - AMI (days)	-0.0691***	(0.016)	-0.110***	(0.026)	-0.0438**	(0.021)
ALC (days)	0.00598	(0.014)	0.0383*	(0.023)	-0.0144	(0.017)
HSMR (%)	0.0104	(0.011)	-0.00981	(0.018)	0.0172	(0.014)
Hospital F.E.	Yes		Yes		Yes	
Patient characteristics	Yes		Yes		Yes	
Observations	409,181		171,270		237,911	
Pseudo R-squared	0.526		0.540		0.525	
ll	-42,946.838		-17,467.933		-25,013.401	

Note: * p <0.1 ** p <0.05 *** p <0.01. Standard errors in parentheses. Hospital fixed effects and patient interactions included. All hospital characteristics lagged. Choice set 10 closest hospitals within 99th distance percentile. *All* column reports results for all patients regardless of arrival type–Column (4) of Table 6. *Ambulance* reports the estimations results on the subsample of patients who arrived to the hospital by ambulance, and *other* reports results for the subsample of patients who did not arrive by ambulance.

Our baseline specification includes both patients who arrive to the hospital by ambulance and those who do not. This means that preferences of paramedics are also reflected in the estimates. As discussed in Tay (2003), the model is still valid even when preference parameters are influenced by preferences of paramedics and healthcare practitioners as long as the determinants of hospital choice are aligned. Though including patients arriving by ambulance affects the interpretation of the model, excluding them reduces our sample size significantly and would make our counterfactuals less representative of the welfare change experienced by Ontario hospital patients. To test for the influence of paramedic preferences, we re-estimate the model by arrival type (ambulance or other).

Results are in Table 7. Generally, magnitudes and directions of coefficients that determine hospital choice are comparable for both groups. The one exception for AMI is hospital specialization, the share of patients treated for AMI. This hospital characteristic is positive and significant for patients arriving by ambulance, but negative and not significant for other patients. Paramedics may not diagnose a patient's illness, but do recognize symptoms and have the ability to transport the patient to a more appropriate hospital.[41] This can explain the difference in the specialization coefficients when we separate the sample according to arrival type. For AMI, pneumonia and sepsis, patients arriving by other transportations than ambulance are more sensitive to distance, while for stroke it is the opposite. This suggest that patients may have a better understanding of the symptoms associated with AMI, pneumonia and sepsis, and that receiving treatment as soon as possible is critical for survival. Overall, patients and paramedics have similar objective functions and we choose to include patients arriving to the hospital by ambulance in the specification used for the counterfactuals.

To verify the stability of our results, we perform a variety of robustness checks. First, we can vary the size of the choice set by including or excluding hospitals with only slight magnitude changes in the results.[42] The estimated coefficients also remain comparable when we change the percentile that restricts which patients and hospital alternatives are included in the estimation sample (Table 22 in Appendix C). Part of the reason that varying the size of the choice set does not greatly affect the results is that when the model assumptions are met, including irrelevant alternatives does not change the coefficients (Tay, 2003). As shown in Section 4, the vast majority of patients choose one of the closest five hospitals (87.6%, 91.4%, and 88.3% for urban, suburban, and rural AMI patients, respectively). So, while it may seem unrealistic that a rural patient would choose the 10th closest hospital, our sensitivity test reveals that allowing larger numbers of hospitals does not impact the conclusions of the model.

We also restrict our sample to patients with a single condition and to patients who visit the hospital only once. Additional patient interactions such as the number of hospital visits, the income quintile of the nearest census metropolitan area to the patient's residence are included.[43] We also test the importance of LOS and specialization in the model by omitting these variables one at a time. Lastly, our final check excludes specialization as a quality measure, but includes it as an interaction with the other hospital

[41] For example, paramedics in Toronto, the largest urban area in the province, may transport patients to one of the four nearest hospitals equipped to treat the patient. This decision depends on the nature and severity of the patient's condition (City of Toronto, 1998-2020. "Which hospital the ambulance will take you to". Accessed November 23, 2020 from `https://www.toronto.ca/311/knowledgebase/kb/docs/articles/toronto-paramedic-services/program-development-and-service-quality/professional-standards/professional-standards/which-hospital-the-ambulance-will-take-you-to.html`).

[42] Coefficients for average patient can be found in Figure 7 in Appendix C.

[43] The patient-level data does not report the actual income of patients, only the nearest census based neighbourhood income quintile.

quality measures. None of these changes significantly affect the results (See Table 23).

6.2 Estimates of willingness to travel

We estimate willingness to travel (WTT) separately for the average urban, suburban and rural patient with respect to each hospital quality measure. WTT can be interpreted as the additional kilometres a patient would be willing to travel to access a hospital where the quality measure of interest is one standard deviation higher. Since higher alternate-level-of-care days, hospital-standardized mortality ratio, standardized mortality rates and readmission rates and LOS are indicators of poor quality, we would expect the willingness to travel estimates to be negative. Although the mechanisms that lead to hospital size, specialization and occupancy determine whether these measures represent better or worse quality, AMI patients dislike smaller, busier and more specialized hospitals. Therefore, the willingness to travel estimates should be of the same signs as the preferences.

Table 8: Willingness to travel of the average patient

		AMI					
		Urban		*Subrban*		*Rural*	
Variable	S.d.(q)	WTT	S.e.	WTT	S.e.	WTT	S.e.
Volume (1,000s)	5.658	0.171	(0.179)	0.479	(0.503)	0.836	(0.879)
Mortality (%)	15.189	-0.151***	(0.037)	-0.423***	(0.106)	-0.737***	(0.194)
Readmission (%)	711.873	-2.657***	(0.782)	-7.441***	(2.210)	-12.97***	(3.960)
Occupancy(%)	25.23	-0.0681*	(0.027)	-0.191*	(0.076)	-0.332*	(0.135)
Specialization (%)	0.954	-0.00733	(0.035)	-0.0205	(0.097)	-0.0358	(0.169)
LOS (days)	5.058	-0.136***	(0.031)	-0.380***	(0.090)	-0.663***	(0.165)
ALC (days)	6.277	0.0146	(0.033)	0.0408	(0.093)	0.0711	(0.162)
HSMR (%)	8.001	0.0324	(0.034)	0.0907	(0.096)	0.158	(0.168)
Average distance (μ_d, 10km)		0.493		1.114		2.296	

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Willingness to travel computed with respect to each of the quality measures included in estimation according to equation 5. The average patient is willing to travel Xkm to a hospital with a quality measure one standard deviation higher. μ_d is the mean distance for each of the average AMI patient. The standard deviation of each quality measure is reported in the *S.d.(q)* column. The standard error of each WTT measure is obtained using the delta method.

As expected, the willingness to travel estimates are positive for volume, although not significant. Patients would be willing to travel farther to access care at a hospital that is less busy. The average urban AMI patient would travel an additional 0.68 km to receive care at a hospital that is one standard deviation less congested. Similarly, the average suburban patient would travel 1.91km and the average rural patient would travel an additional 3.32km. For the measures that are negatively correlated with quality, WTT is negative, except for HSMR and ALC, both of which have patients indifferent to the tradeoff between quality and distance. For example, to be treated at a hospital with one standard deviation better 30-day excess AMI mortality, the average urban patient would travel an additional 1.51km or 26.57km to receive care at a hospital with a better excess readmission rate. The WTT of suburban and rural patients for these measures are

4.23km or 74.41km and 7.37km or 129.7km respectively. Patients in each location would also travel longer distances to go to hospitals with better average lengths of stay–1.36km, 3.80km and 6.63km for urban, suburban and rural patients respectively. The WTT for specialization are small and not significant, patients would travel less than one kilometer to be treated at hospitals with better such measures.

7 The impact of hospital mergers on patient welfare: two counterfactuals

We use the estimates presented in the previous section to understand the impact of hospital mergers on patient welfare. To do so, we perform two counterfactuals. In the first, some hospitals are removed, but the characteristics of the remaining hospitals are the same. Therefore, the change in utility comes only from patients who have hospital sites that close in their choice set. This represents the short-run, in which hospital sites have closed, but quality has not adjusted. In the second counterfactual, since the quality of the remaining hospitals has changed, any patient may experience a change in utility. This scenario represents the long-run, in which hospital quality has changed as a result of the mergers and resources have been reallocated to the remaining hospitals and within hospitals. The welfare effects are calculated using the change in consumer surplus McFadden (1996) detailed in Section 5.

A shortcoming of this method is that changes to patient flows are not considered. In reality, hospitals remaining in a market after a merger may have to admit a greater number of patients than before, which could affect utility. The benefit of keeping the same patient pool across counterfactuals, allows us to be certain that any resulting welfare change is not caused by a change in the patient pool (i.e. sicker patients are admitted in 2005 relative to the pre-merger period) or preferences as a result of the shift from inpatient to outpatient care that occurred over time. In Section 7.2, we attempt to understand how changes in patients flow affect changes in hospital quality between the pre-merger period and the long-run post-merger period using Chandra et al. (2016)'s survival decomposition.

7.1 Counterfactual 1: Short-run welfare impact

In the first counterfactual hospitals have merged and closed, but hospitals have not had time to adapt therefore quality is unchanged. This counterfactual gives the short-run impact of mergers. Welfare results for AMI patients can be found in Table 10. Recall that in the short-run, the welfare change is only driven by the removal of hospitals from the choice set as a result of the closures directed by the restructuring commission. 63.4% of AMI patients have a hospital that will close in their choice set. On average, these patients see their expected utility decrease by 6.8% in a setting where hospitals have

Table 9: Counterfactuals - Share of patients impacted by the restructuring

	AMI				
	Closure	Merger	Merger (no closure)	Unchanged	Obs.
All	0.634	0.858	0.223	0.142	36,568
Urban	0.773	0.930	0.153	0.074	25,281
Suburban	0.400	0.698	0.298	0.302	9,108
Rural	0.291	0.786	0.495	0.215	3,953

Table 10: Counterfactual 1 - Short-run welfare impact of hospital mergers

	AMI					
Variable	Obs.	Mean	Median	S.d.	Min	Max
Overall						
Average welfare δ_i (%)	38,342	-0.027	-0.001	0.075	-4.455	0.000
Site closure(s) in choice set						
Average welfare δ_i (%)	24,325	-0.042	-0.015	0.091	-4.455	0.000
By location						
Overall						
Rural δ_i	3,953	-0.039	0.000	0.141	-1.049	0.000
Suburban δ_i	9,108	-0.013	0.000	0.056	-0.730	0.000
Urban δ_i	25,281	-0.028	-0.006	0.049	-0.385	0.000
Site closure(s) in choice set						
Rural δ_i	1,149	-0.137	-0.031	0.238	-1.049	-0.00
Suburban δ_i	3,642	-0.032	-0.001	0.085	-0.730	0.000
Urban δ_i	19,534	-0.037	-0.016	0.053	-0.385	0.000
Share patient worse off	0.599					

Notes: Welfare change measure using McFadden (1996)'s change in consumer surplus.

merged and resource reallocation or changes in competition have not occurred.[44] This reduction in expected utility is equivalent to increasing distance travelled to the hospital by 2.7% on average. The negative effect is expected because it is solely driven by the removal of options. Looking only at patients with a site closure in their choice set, we see that their expected utility falls by 10.7%, which is equivalent to increasing distance to the hospital by 4.2%. With the removal of some choices average distance to the hospital over a patient's choice set increasing. Patients affected by the closures are also seeing a change in average quality over their choice set. On average hospital quality over the choice set falls following the closure of some hospital sites. This is highlighted in Table 11 which shows a regression of the welfare impact on first differences of distance and hospital characteristics. For each variable, the difference is taken between the post-merger average value and the

[44]Welfare results not rescaled by marginal utility of distance available from authors.

pre-merger average value. The average is calculated over the hospitals in the choice set. The Δ Distance coefficient is negative for patients with site closures in their choice set indicating that average distance increased following the mergers leading to a reduction in welfare. All but one first differences of quality are showing that average hospital quality in the choice set worsens after the closures. Quality measures for which the average over the choice set decreases include ALC, excess mortality specific to AMI and excess readmission specific to AMI. Only one variables, HSMR, mitigates the short-run welfare loss.[45] Changes in volume, occupancy and specialization could indicate better or worse quality. Patients diagnosed with AMI prefer bigger hospitals that are less congested and treat less AMI patients. Following the closures, the average hospital in a patient's choice set is larger, more congested and more specialized. The latter two harming AMI patients.

Table 11: Counterfactual 1 - Decomposition of short-run welfare change

	AMI			
	Overall		*Closure in choice set*	
	δ_i		δ_i	
Δ Distance	-0.176***	(0.002)	-0.186***	(0.003)
Δ Volume	0.00261***	(0.001)	0.0142***	(0.001)
Δ HSMR	0.0209***	(0.000)	0.0129***	(0.001)
Δ Occupancy	-0.00483***	(0.000)	-0.00897***	(0.000)
Δ ALC	-0.0321***	(0.001)	-0.0465***	(0.001)
Δ Mortality - AMI	-0.00149***	(0.000)	-0.000603**	(0.000)
Δ Readmission - AMI	-0.00000688	(0.000)	-0.0000158**	(0.000)
Δ Specialization - AMI	0.0771***	(0.004)	0.166***	(0.005)
Δ LOS - AMI	0.00719***	(0.001)	0.0105***	(0.001)
Constant	-0.0201***	(0.000)	-0.0613***	(0.001)
Observations	38,342		24,325	
Adjusted R-squared	0.190		0.211	

Notes: * p <0.10 ** p <0.05 *** p <0.01. Standard errors in parentheses. Welfare decomposition using a first difference regression of welfare on hospital characteristics. The difference in characteristics is taken between the average post-merger hospital characteristic and the average pre-merger hospital characteristics for hospitals in the choice set.

We see in Table 10 that the short-run welfare impact is negative across all locations. Conditional on having fewer options in their choice set, the average rural patient see the largest impact with an average reduction in welfare of -13.2%, followed by urban (-11.2%) and suburban patients (-4.3%). The change in expected consumer surplus is equivalent to increasing distance by 13.7%, 3.2% and 3.7% for rural, suburban and urban patients respectively. Rural hospital access was an important factor considered by the HSRC when closing some sites. Even with this in mind, the site closures have an impact on rural patients and the welfare results suggest that access in the short-run is even more unequal across locations. In Table 12 we look at other patient characteristics. Males as

[45] LOS also decreases. A reduction in the average number of days spent in the hospital improves welfare, but in combination with a higher readmission rate could suggest that patients are discharged too quickly.

Table 12: Counterfactual 1 - Decomposition of short-run welfare change by patient characteristics

	AMI			
	Overall		*Closure in choice set*	
	δ_i		δ_i	
Urban patient	-0.0130***	(0.001)	-0.00132	(0.002)
Rural patient	-0.0235***	(0.001)	-0.101***	(0.003)
Male	0.000528***	(0.001)	0.00553***	(0.001)
Age	0.000175***	(0.000)	0.000101**	(0.000)
Health status	0.000343***	(0.001)	0.000546***	(0.000)
Constant	-0.0374***	(0.001)	-0.0569***	(0.002)
Observations	38,342		24,325	
Adj. R^2	0.013		0.055	

Notes: * p <0.05 ** p <0.01 *** p <0.001. Standard errors in parentheses. Regression of the welfare change on patient characteristics.

well as older and sicker patients are less impacted by the closures, with location remaining the patient characteristic with the most explanatory power for the welfare change.[46]

7.2 Counterfactual 2: Long-run welfare impact

Table 13: Descriptive Statistics - Pre-merger and post merger hospital characteristics - AMI

	1994		*1995*		*2005*		*Differences*	
Variable	Mean	S.d.	Mean	S.d.	Mean	S.d.	(1994-2005)	(1995-2005)
ALC (days)	6.961	5.405	8.860	6.884	12.139	7.875	-5.178***	-3.279***
HSMR(%)	100.215	3.030	100.289	3.282	101.044	4.036	-0.829**	-0.755*
Occupancy (%)	78.740	25.266	76.095	24.667	81.354	21.725	-2.614	-5.259**
Volume (1,000s)	5.220	5.625	5.465	5.685	5.258	5.751	-0.038	0.207
Specialization - AMI (%)	2.310	0.942	2.317	0.902	2.941	1.806	-0.631***	-0.624***
Mortality - AMI (%)	21.805	15.924	22.088	20.447	21.471	23.363	0.334	0.617
Readmission - AMI (%)	28.758	66.580	28.579	83.325	31.775	39.783	-3.017	-3.196
LOS -AMI (days)	8.382	4.426	8.910	6.885	8.198	4.575	0.184	0.712
Teaching status	0.156	0.364	0.163	0.370	0.136	0.344	0.02	0.027
Urban site	0.382	0.487	0.388	0.489	0.364	0.483	0.018	0.024
Suburban site	0.283	0.452	0.287	0.453	0.253	0.436	0.03	0.034
Rural site	0.335	0.473	0.326	0.470	0.383	0.488	-0.048	-0.057
Obs.	173		178		154			

Notes: * p <0.10 ** p <0.05 *** p <0.01. Only hospitals that treat AMI patients observed in our data included. See Table 63 in Online Appendix (E) for pneumonia sepsis and stroke.

In the second counterfactual, hospitals have merged and closed, and quality has potentially adjusted due to changes in competition. Resources from closed hospitals may have also been reallocated to other hospitals, potentially improving quality of care or increas-

[46]The results are similar for patients admitted with pneumonia, sepsis and stroke. The welfare changes is equivalent to increasing distance to the hospital by 3.4%, 3.5% and 3.7% respectively (See Tables 55 and 56).

ing the number of patients treated. This is captured by replacing the pre-merger hospital characteristics with hospital characteristics from 2005. The average hospital characteristics can be found in Table 13. Recall, that we focus on 2005 to ensure enough time has passed for merger-related adjustments to be completed but also avoid contamination of a subsequent policy implemented in 2006. This counterfactual captures the long-run impact of mergers. With quality updated, expected utility for all patients can change. Only half of the hospital measures included in our preferred specification change significantly between the pre- and post-merger period. Although all changes are small. Specialization and HSMR increase by less than one percentage point, occupancy increases by over 5 percentage points and the number of days spent in alternate-level-of-care increases by three days.

Table 14: Counterfactual 2 - Long-run welfare impact of hospital mergers

	AMI					
Variable	Obs.	Mean	Median	S.d.	Min	Max
Overall						
Average welfare δ_i (%)	38,342	-0.086	-0.058	0.187	-4.505	3.814
Site closure(s) in choice set						
Average welfare δ_i (%)	24,325	-0.084	-0.064	0.150	-4.505	2.232
Merger(s) (including closures) in choice set						
Average welfare δ_i (%)	32,879	-0.068	-0.050	0.154	-4.505	2.232
By location						
Overall						
Rural δ_i	3,953	-0.173	-0.127	0.345	-4.214	3.814
Suburban δ_i	9,108	-0.105	-0.090	0.232	-1.372	2.112
Urban δ_i	25,281	-0.066	-0.047	0.362	-0.578	0.362
Site closure(s) in choice set						
Rural δ_i	1,149	-0.313	-0.272	0.308	-1.528	2.232
Suburban δ_i	3,642	-0.163	-0.147	0.221	-1.372	1.866
Urban δ_i	19,543	-0.056	-0.053	0.079	-0.578	0.211
Merger(s) (including closures) in choice set						
Rural δ_i	3,105	-0.163	-0.123	0.293	-1.528	2.232
Suburban δ_i	6,360	-0.099	-0.092	0.207	-1.372	2.102
Urban δ_i	23,414	-0.046	-0.041	0.079	-0.578	0.211
Share patient worse off	0.747					

Notes: Welfare change measure using McFadden (1996)'s change in consumer surplus.

The mean and median welfare impact are still negative, but some patients are better off in the setting where hospitals have merged and quality has adjusted as seen in Table 14. The average expected utility decreases by 18.1%, which is equivalent to increasing distance to the hospital by 8.6%. Separating the welfare change by patient location, results are similar to the short-run with rural patients seeing the largest decrease in welfare (-17.3%). Although, unlike in the short-run, urban patients are the least impacted by the restructuring with an average welfare decrease equivalent to increasing distance to the hospital by 6.6%. The welfare effect for suburban patient is equivalent to increasing distance to the hospital by 10.5%. This is true overall, conditional on patients having site closures in their choice set as well as mergers in their choice set. Even if some patients benefit from the mergers, it is important to notice that in the long-run more patients are negatively impacted than in the short-run. 74.7% of patients are harmed by the mergers and closures in the long-run compared to 59.9% in the short-run.[47,48]

Table 15: Counterfactual 2 - Decomposition of long-run welfare change

	AMI					
	Overall		*Closure in choice set*		*Merger in choice set*	
	δ		δ		δ	
Δ Distance	-0.142***	(0.006)	-0.138***	(0.005)	-0.132***	(0.005)
Δ Volume	-0.0276***	(0.003)	-0.0326***	(0.002)	-0.0388***	(0.002)
Δ HSMR	-0.00903***	(0.001)	-0.00561***	(0.001)	-0.00134	(0.001)
Δ Occupancy	0.00598***	(0.001)	0.00777***	(0.001)	0.01000***	(0.001)
Δ ALC	-0.0267***	(0.002)	-0.0205***	(0.002)	-0.0128***	(0.002)
Δ Mortality - AMI	0.00866***	(0.001)	0.00828***	(0.000)	0.00781***	(0.000)
Δ Readmission - AMI	-0.00000551	(0.000)	-0.00000166	(0.000)	0.00000313	(0.000)
Δ Specialization - AMI	-0.117***	(0.010)	-0.155***	(0.008)	-0.202***	(0.008)
Δ LOS - AMI	0.0670***	(0.003)	0.0656***	(0.002)	0.0638***	(0.002)
Constant	-0.0803***	(0.001)	-0.0625***	(0.002)	-0.0404***	(0.001)
Observations	38,342		24,325		32,879	
Adjusted R-squared	0.042		0.107		0.099	

Notes: * p <0.10 ** p <0.05 *** p <0.01. Standard errors in parentheses. Welfare decomposition using a first difference regression of welfare on hospital characteristics. The difference in characteristics is taken between the average post-merger hospital characteristic and the average pre-merger hospital characteristics for hospitals in the choice set. Interactions between hospital and patient characteristics are omitted.

The results are driven by both hospital quality and distance. We repeat the welfare decomposition exercise that uses the first differences in hospital characteristics and distance to better understand the welfare impact. As in the short-run, average distance over the choice set increases following the closures of some hospital sites. This is as expected because hospitals sites closed by the HSRC are still removed and no hospital entered the market. The coefficients on the change in hospital characteristics display evidence of quality changes over the choice set, both improvements and worsening. As in the short-run, the coefficient on Δ ALC is negative indicating worse quality. The coefficient

[47] Figure 8 in Appendix shows the full distribution of the welfare change as well as the distribution omitting the top and bottom 5%.

[48] Results for sepsis follow very closely those of AMI patients. The average long-run welfare impact is positive for pneumonia and stroke patients, but the median effect is negative. As for AMI, the majority of patients are negatively impacted by the restructuring, but a small number of patients see a huge gain in welfare, skewing the distribution. The welfare distribution has a long right tail for these two conditions. See Tables 64 to 71 and Figures 18 to 20.

Table 16: Counterfactual 2 - Decomposition of long-run welfare change by patient characteristics

	AMI					
	Overall		*Closure in choice set*		*Merger in choice set*	
	δ_i		δ_i		δ_i	
Urban patient	0.0400***	(0.002)	0.0953***	(0.002)	0.0544***	(0.002)
Rural patient	-0.0677***	(0.004)	-0.162***	(0.005)	-0.0636***	(0.003)
Male	0.000754	(0.002)	-0.00895***	(0.002)	-0.00150	(0.002)
Age	-0.000328***	(0.000)	-0.000450***	(0.000)	-0.000119*	(0.000)
Health status	-0.000189	(0.000)	-0.000440***	(0.000)	-0.000665***	(0.000)
Constant	-0.0798***	(0.003)	-0.106***	(0.003)	-0.0776***	(0.003)
Observations	38,342		24,325		32,879	
Adjusted R-squared	0.031		0.157		0.056	

Notes: * p <0.05 ** p <0.01 *** p <0.001. Standard errors in parentheses. Regression of the welfare change on patient characteristics.

Δ LOS is also similar to that of the short-run, and accompanied by an increase in excess readmission, although not significant, also suggesting worse quality. Average HSMR over the choice set increases in the long-run, a sign of poor quality. The one measure that shows clear improvement in quality after the restructuring is the AMI-excess mortality rate. Relative to the pre-merger environment, hospitals are treating less patients, are less specialized, and are more congested, with the former two harming welfare according to preferences of AMI patients. The signs of the coefficients on all first differences are consistent across the three columns of Table 15, although for HSMR the effect is mostly coming from patients with site closures in their choice set. We do see that the coefficients for quality measures that improve for patients with site closures or mergers in their choice set are slightly smaller than overall, hinting at quality improvements coming from non-merger hospitals. The long-run effect across patient groups is different than that of the short-run. Location still explains most of the welfare impact, but older and sicker patients are also more negatively affected by the merger and closures. Overall, results suggest that in the long-run both hospital access and quality matter for patient welfare.

Since we find that hospital quality is an important component of the long-run welfare, we explore the impact of changes in patient flows on our long-run hospital characteristics. Our approach does not account for changes in patient flow that could occur as a result of the mergers, but this exercise allows us to understand the impact of patient reallocations on hospital outcomes between the pre- and post-merger period. We adapt Chandra et al. (2016)'s survival decomposition exercise to our setting and apply it to our various quality measures.[49] The idea is to breakdown the quality improvements to determine if they originate from the reallocation of patients from lower quality hospitals to higher quality hospitals or if they result from quality increases within hospitals. In our decomposition,

[49] Chandra et al. (2016)'s approach follows Foster et al. (2008) and Foster et al. (2001), a method first derived by Baily et al. (1992) .

we omit the "entry" term from Equation (7) of Chandra et al. (2016) because no hospital enter during our sample. This gives the following decomposition equation:

$$\Delta\bar{q}_t = \underbrace{\sum_{j\in C_t}\theta_{j,t-1}\Delta q_{j,t}}_{\text{within}} + \underbrace{\sum_{j\in C_t}(q_{j,t-1}-\bar{q}_{t-1})\Delta\theta_{j,t}}_{\text{between}} + \underbrace{\sum_{j\in C_t}\Delta q_{j,t}\Delta\theta_{j,t}}_{\text{cross}} - \underbrace{\sum_{j\in X_t}\theta_{j,t-1}(q_{j,t-1}-\bar{q}_{t-1})}_{\text{closures}} \tag{7}$$

where $\Delta\bar{q}_t$ is the difference in market-share-weighted average quality measure between two periods. $q_{j,t}$ is the quality measure of hospital j in period t and $\theta_{j,t}$ is that hospital's market share. The "within" term represent the changes associated with hospitals that exist throughout keeping market shares constant (changes in quality that would occur without reallocation of patients from low- to high-quality hospitals). The "between" term captures effects from the reallocation of patients to hospitals that were already high-quality. The "cross" term represents the reallocation of patients to hospitals that improved quality, in other words the covariance between quality changes and market share changes. Lastly, the "closure" term captures changes to quality directly caused by the closure of hospitals. C_t is the set of hospitals that treat patients in period t and $t-1$. X_t is the set of hospitals that close as a result of the mergers. We take the difference between $t-1=1995$, the last year before the merger wave for the hospital measures used in the estimation of Equation (1), and $t=2005$, our long-run period where we assume potential resource reallocation or changed in competition has occurred. We do this decomposition for the conditions-specific measures as well as occupancy, HSMR and ALC. Volume is not decomposed as it is used to calculate the market shares, θ. For condition-specific measures, markets shares are calculated using the volume from patients treated with the particular condition. For non-condition specific measures the overall hospital volume is used.

Results in Table 17 show that all components in the decomposition play a role in explaining the market-weighted changes in quality. But even if market shares had remained constant over time, quality would not have improved/worsened much more relative to Table 13. All within terms are small. In some cases quality improves, in others it worsens. It is important to remind ourselves that negative changes for mortality, readmission, ALC and HSMR indicate quality increases.[50] A negative change for LOS indicates quality improvements if not accompanied by more hospital readmissions caused by hospitals discharging patients too quickly.[51] The "cross" terms all show reallocation of patients

[50]A negative change in excess mortality rates signifies less patients die within 30-days of discharge, an improvement in quality.

[51]For specialization and occupancy, the mechanisms that brings about the changes determines whether a reduction or increase in the measure indicates an improvement. This is unobservable to us.

Table 17: Counterfactual 2 - Decomposition of quality changes

	AMI-specific quality measures							
	Contributions in percentage points				*Contributions in share of total*			
	Mortality	Readm.	Spec.	LOS (days)	Mortality	Readm.	Speci.	LOS
Total change	-0.890	9.876	0.694	-0.505	1.00	1.00	1.00	1.00
Within	0.740	12.450	0.163	-0.146	-0.831	1.261	0.235	0.289
Between	0.046	12.626	-0.089	-0.072	-0.052	1.278	-0.129	0.142
Cross	-1.864	-16.547	0.635	-0.201	2.095	-1.675	0.916	0.398
Closures	-0.188	-1.347	0.015	0.086	0.212	-0.136	0.022	-0.171

	Non-condition specific quality measures					
	Contributions in percentage points			*Contributions in share of total*		
	Occupancy	ALC (days)	HSMR	Occupancy	ALC	HSMR
Total change	-0.810	0.055	2.061	1.00	1.00	1.00
Within	-1.954	0.059	2.466	2.413	1.068	1.196
Between	1.850	-0.132	-0.079	-2.284	-2.389	-0.038
Cross	-0.274	-0.041	-0.167	-0.339	-0.733	-0.081
Closures	0.432	-0.169	0.159	-0.533	-0.533	0.077

Notes: Quality decomposition as in Chandra et al. (2016).

from lower quality hospitals to better quality hospitals. For example, the market-share-weighted mortality rate of AMI patients decreases by 0.890 percentage points between 1995 and 2005. Quality improvements within hospitals and reallocation of patients from low- to high-quality hospitals respectively increase AMI mortality by 0.740 and 0.046 percentage points. Reallocation of patients to hospitals that were already high quality decreases mortality by 1.864 percentage points.[52] The last term of the decomposition indicates that the closure of hospitals worsened quality by increasing the hospital mortality rate for AMI by 0.188 percentage points. This decomposition suggests that even though there are changes in hospital market shares, they do not mitigate or amplify the quality changes to a large extend. Therefore, not accounting for changes in patient flows should not be exacerbating or augmenting the long-run welfare impact that we find.

The government-directed mergers were forced in order reduce the cost of the health-care system, increase efficiency and improve the quality of care for current and future generations. We find little evidence for quality improvements with a negative impact on patients. Our findings are also consistent with results from Barker and Watt (2021) of hospital outcomes resulting from the same Ontario merger wave as in this paper. Using a matched differences-in-differences approach, they show that relative to non-merger hospitals, mergers involving closures did not lead to improvements in quality, but saw a financial improvement, while administrative mergers improved two of the quality measures studied. Overall, the merger wave had a negative impact on average patient welfare in the short-run and in the long-run. The long-run counterfactual highlights that both

[52] Better quality hospitals tend to attract sicker patients.

reduced access and hospital quality are important for patient welfare. Our results warrant further research into hospitals' responses, cost savings and the impact on patients in other parts of the healthcare to government-directed mergers given the negligible quality changes and the negative impact on patients. The impact on both hospital competition and productivity are key next step to understand whether the HSRC was successful in achieving it's goal, but disentangling the two scenarios is out of the scope of the paper.

8 Conclusion

In this paper, we estimate the parameters of the utility function of patients admitted to the hospital for AMI, pneumonia, sepsis or stroke who were treated at an Ontario acute care hospitals in 1995 and 1996. We find that distance is an important determinant of hospital choice, and that the average patient prefers a hospital that is larger in terms of volume, and of better quality as reflected by lower mortality and readmission rates and shorter average length of stay. There are differences in preferences for different patient groups, especially across urban, suburban and rural patients. For example, urban patients are more sensitive to distance and rural patients are less sensitive. We compute willingness to travel estimates with respect to quality and find that the average patient is willing to increase the distance travelled by a small amount to be treated at a hospital that is better in quality by one standard deviation. Although this is not the case for all quality measures. Our results are consistent with previously literature.

Using counterfactuals, we find that hospital restructuring harms patients in both the short- and long-run. In the short-run, patients' welfare decrease is equivalent to increasing distance to the hospital about 3% on average. Welfare decreases because patients now have access to fewer hospitals and patients with site closures in their choice set must travel farther on average. Quality of the patients' choice set also falls after the closure of some sites. In the long-run, the welfare impact varies by condition, but regardless of the condition the majority of patients are worse off. The average welfare decrease for AMI and sepsis patients is equivalent to increasing distance by 8.6% and 9.4%. Although the average welfare change is positive for pneumonia (13%) and stroke (12.2%), this is explain by a long right tail in the distribution (the median welfare impact is -2.4% and -1.7%). In the long-run both hospital quality and access are important for patient welfare. Both in the short and the long-run we find heterogenous effects across location and other patient characteristics.

Our study has two important limitations. First, we draw these conclusions using a subset of patients; for example, we cannot speak to welfare impacts associated with outpatient care—a growing part of hospital services (Sinclair et al., 2005). The impact of the restructuring on such patients is key to a better understanding of the long-run effect in order to determine the success or failure of the Health Services Restructuring

Commission. Second, we cannot quantify the welfare impact related to changes in the number of patients that die before hospital admission as a result of having to travel longer distances to reach the hospital or due increased hospital congestion. Finally, a better understanding of hospitals' responses (competition and productivity) to directed mergers is important. We recommend that further studies are conducted—perhaps using data that captures outpatient care and non-acute conditions—before the government proceeds with further mergers.

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Appendices

A Variable definitions

Table 18: Variable definitions

Variable	Source	Definition
Hospital-standardized mortality ratio (HSMR)[53]	DAD, ORGD	The number of observed deaths over the number of expected deaths (calculated using logistic regression), multiplied by 100. Calculated using the conditions responsible for 80% of in-hospital deaths.
Average ALC length of stay (days)	DAD	Average number of days an admitted patient remains in the hospital after they no longer require care, all cases. This is not available at the patient level, and therefore cannot be disaggregated by condition.
Distance (km)	DAD, PCCF	Geodesic distance between the patient and the hospital site of admission.
30-day (std) mortality	DAD, ORGD	The proportion of patients who die during their stay or within 30 days of discharge, indirectly standardized[54] by age, sex, arrival type (ambulance or other), and Johns Hopkins ADGs. Calculated by condition.
30-day (std) readmission	DAD, ORGD	The proportion of patients who are readmitted with the same condition within 30 days of discharge, indirectly standardized by age, sex, arrival type (ambulance or other), and Johns Hopkins ADGs. Calculated by condition.
Average length of stay (days)	DAD	Average number of days from admission to the hospital to discharge from the hospital, by condition.
Occupancy rate (%)	RPBD	The number of inpatient days in the period multiplied by 100, over the number of available beds in the period multiplied by the number of days in the period.[55]
Total beds	INST	The total number of funded beds in the hospital. This may be less than the physical number of beds.
Volume (discharges)	DAD	The number of discharges from the hospital.
Specialization	DAD	The volume for the specific condition as a percentage of the total volume of the hospital site.

Continued on next page

[53] "Hospital Standardized Mortality Ratio: Technical Notes." Canadian Institute for Health Information. Created November 2016. Last modified November 2016. Accessed March 9, 2019 from /https://secure.cihi.ca/free_products/CMDB_HFP_Methological_Notes_postingMar06.pdf

[54] See Naing (2000) for a review of direct vs. indirect standardization.

[55] "Canadian MIS Database–Hospital Financial Performance Indicators, 2006-2007 to 2010-2011: Methodological Notes." Canadian Institute for Health Information. Created 2012. Last modified 2012. Accessed March 9, 2019 from /https://secure.cihi.ca/free_products/CMDB_HFP_Methological_Notes_postingMar06.pdf

Table 18 – *continued from previous page*

Variable	Source	Definition
Teaching status	INST	The hospital site operates a teaching program.
Urban[56]	INST, RPDB	The hospital site or patient is classified as "Urban" based on the Rurality Index for Ontario.
Suburban[56]	INST, RPDB	The hospital site or patient is classified as "Suburban" based on the Rurality Index for Ontario.
Acute myocardial infarction (AMI)[57]	DAD	Also refered to as heart attack. Blockage of blood flow to the heart that can damage or destroy part of the heart muscle. Blockage often caused by buildup of cholesterol or fat that form plaque in arteries.
Pneumonia[57]	DAD	Infection that causes inflammation of the air sac of one or both lungs. Fluid or pus may fill the air sac causing cough with phlegm or pus, fever, chills, and difficulty breathing.
Sepsis[57]	DAD	Complication from infection that may result in organ damage and failure. Inflammatory responses throughout the body caused by the release of chemicals in the bloodstream to fight the infection.
Stroke[57]	DAD	Interruption or reduction of blood supply to the brain causing deprivation of oxygen and nutrients to the brain tissue, which may cause brain cells to die.

CMDB: Canadian Management Information System Database. *DAD*: Discharge Abstract Database. *INST*: ICES Institution Database. *ORGD*: Vital Statistics. *PCCF*: Postal Code Conversion File.

B Johns Hopkins Aggregated Diagnosis Groups (ADG) classification

We measure patient comorbidity status using John Hopkins Aggregated Diagnostic Groups (ADGs). These are a part of the Johns Hopkins Ambulatory Care Groups System, which was developed to help hospitals and other healthcare providers predict healthcare utilization and the costs of caring for patients.[58] There are currently 32 ADGs in use and each describes illnesses, conditions, or diseases according to five clinical dimensions: duration, severity, diagnostic certainty, etiology, and specialty care involvement. Based on these dimensions, patients are placed into one (or more) of the ADGs. There are several ways to use these ADGs to construct a measure of comorbidity (Austin and van Walraven, 2011). The sum of ADGs can be used, but this treats all categories as equal when some categories have a larger impact on outcomes such as mortality. We use the ADG Score, which assigns a weight to each ADG before summing across all categories. The weights

[56] "Measuring Rurality - RIO2008_Basic: Methodology and Results", Boris Kralj. Accessed March 7, 2019 from `https://www.oma.org/wp-content/uploads/2008rio-fulltechnicalpaper.pdf`

[57] "Diseases and Conditions", Mayo Clinic (1998-2018). Accessed November 7, 2018 from `https://www.mayoclinic.org/diseases-conditions`

[58] "The Johns Hopkins ACG System." John Hopkins Bloomberg School of Public Health. Accessed November 30, 2018 from `https://www.healthpartners.com/ucm/groups/public/@hp/@public/documents/documents/dev_057914.pdf`

we employ are from Austin and van Walraven (2011). A higher score is associated with a higher mortality risk.

C Additional Tables and Figure

Table 19: Acute care hospital mergers and closures directed by the HSRC

Year	Hospital	City	Closure	New Name
1997	Coburg District General Hospital	Coburg	-	Northumberland
	Port Hope and District Hospital	Port Hope	1997	Health Care Corp.
1997	Humber Memorial Hospital	Toronto	-	Humber River Regional Hospital
	Northwestern General Hospital	Toronto	-	
	York-Finch General Hospital	Toronto	-	
1997	Hamilton Civic Hosp. - General Division	Hamilton	-	
	Chedoke-MacMaster Hosp. - Chedoke Site	Hamilton	-	Health Science
	Chedoke-MacMaster Hosp. - McMaster Site	Hamilton	-	Corporation
	Hamilton Civic Hosp. - Henderson Division	Hamilton	-	
1997	Community Memorial Hospital	Port Perry	-	North Durham
	The Cottage Hospital	Uxbridge	-	Health Services
1997	Pembroke Civic Hospital	Pembroke	1997	Pembroke Regional
	Pembroke General Hospital	Pembroke	-	Hospital
1998	Durham Memorial Hospital	Durham	-	
	Kincardine and District Hospital	Kincardine	-	South Bruce Grey
	Country of Bruce General Hospital	Walkerton	-	Health Centre
	Chesley and District Memorial Hospital	Chesley	-	
1998	The Princess Margaret Hospital	Toronto	-	University Health Network
	The Toronto Hospital Corporation	Toronto	-	
	The Doctors' Hospital	Toronto	1998	
1998	The Mississauga Hospital	Mississauga	-	Trillium Health
	Queensway General Hospital	Etobicoke	1998	Centre
1998	Centre Grey General Hospital	Markdale	-	
	Meaford General Hospital	Meaford	-	
	Saugeen Memorial Hospital	Southampton	-	Grey Bruce Health
	Grey Bruce Regional Health Centre	Owen Sound	-	Services
	Bruce Peninsula Health Services (Unit I)	Wiarton	1998	
	Bruce Peninsula Health Services (Unit II)	Lion's Head	-	
1998	Oshawa General Hospital	Oshawa	-	
	North Durham Health Serv.-Uxbridge Site	Uxbridge	-	
	North Durham Health Serv.-Port Perry Site	Port Perry	-	Lakeridge Health
	Memorial Hospital	Bowmanville	-	Corporation
	Whitby General Hospital	Whitby	1998	
1998	Oakville Trafalgar Memorial	Oakville	-	Halton Healthcare
	Milton District Hospital	Milton	-	Services Corp.
1998	Sunnybrook Health Sciences Centre	North York	-	Sunnybrook and
	Women's College Hospital	Toronto	-	Women's College
	Orthopaedic and Artrithic Hospital	Toronto	1998[1]	Health Sciences
				Centre
1998	Ajax and Pickering General Hospital	Ajax	-	Rouge Valley
	Centenary Hospital Association	Scarborough	-	Health System
1998	The Etobicoke General Hospital	Etobicoke	-	William Osler Health Centre
	Peel Memorial Hospital	Brampton	-	
	Georgetown and District Memorial Hosp.	Georgetown	-	

Continued on next page

Table19 – *Continued from previous page*

Year	Hospital	City	Closure	New Name
1998	Belleville General Hospital	Belleville	-	Quinte Healthcare Corporation
	North Hastings District Hospital	Bancroft	-	
	Prince Edward County Memorial Hospital	Picton	-	
	Trenton Memorial Hospital	Trenton	-	
1999	Salvation Army Grace General Hospital	Ottawa	1999[2]	-
1999	Ottawa Civic Hospital	Ottawa	-	The Ottawa Hospital
	The Ottawa General Hospital	Ottawa	-	
	Riverside Hospital of Ottawa	Ottawa	2001	
1999	Sudbury General Hospital	Sudbury	-	Hopital Regional de Sudbury Regional Hospital
	Laurentian Hospital	Sudbury	-	
	Sudbury Memorial Hospital	sudbury	-	
1999	Scarborough General Hospital	Scarborough	-	The Scarborough Hospital
	Salvation Army Scarborough Grace Hosp.	Scarborough	-	
1999	St. Joseph's Hospital and Health Centre	Peterborough	1999	Peterborough Regional Health Centre
	Peterborough Civic Hospital	Peterborough	-	
2000	Douglas Memorial	Fort Erie	-	Niagara Health System
	The Greater Niagara General Hospital	Niagara Falls	-	
	Niagara-on-the-Lake General Hospital	Niagara-LK	-	
	Port Colborne General Hospital	Port Colborne	-	
	St. Catharines General Hospital	St. Catharines	-	
	Welland County General Hospital	Welland	-	
2001	North York Branson Hospital	North York	2001	North York General Hospital
	North York General Hospital	North York	-	
2001	Wellesley Central Hospital-Wellesley Site	Toronto	2001	St. Michael's Hospital
	Wellesley Central Hospital-Central Site	Toronto	2001	
	St. Michael's Hospital	Toronto	-	
2001	St. Joseph's Hospital	Brantford	2001	Brantford General Hospital
	The Brantford General Hospital	Brantford	-	
2003	Cornwall General	Cornwall	-	Cornwall Community Hospital
	Cornwall Community Hospital	Cornwall	-	

Notes: Merger list constructed using information in Sinclair et al. (2005) and the 2003 and 2006 Master Number System (MOHLTC, 2003, 2006). Year indicates the year in which the hospitals merged. Closure indicates hospital Site that were closed, and the year of the closure. Mergers without a closure date all consist of administrative mergers where all Sites remain open, but manage by a single board of directors.

[1] Closure of acute care located at 43 Wellesley.

[2] Acute care hospital closed. Services and reporting moved to The Ottawa Hospital and Queensway-Carlton Hospital. This closure is omitted from our analysis because no patients were admitted to The Salvation Army Grace Hospital with our conditions in 1994 and 1995 (our pre-merger period).

Figure 4: Histogram of proportion of patients travelling Xkm to choice hospital, by location

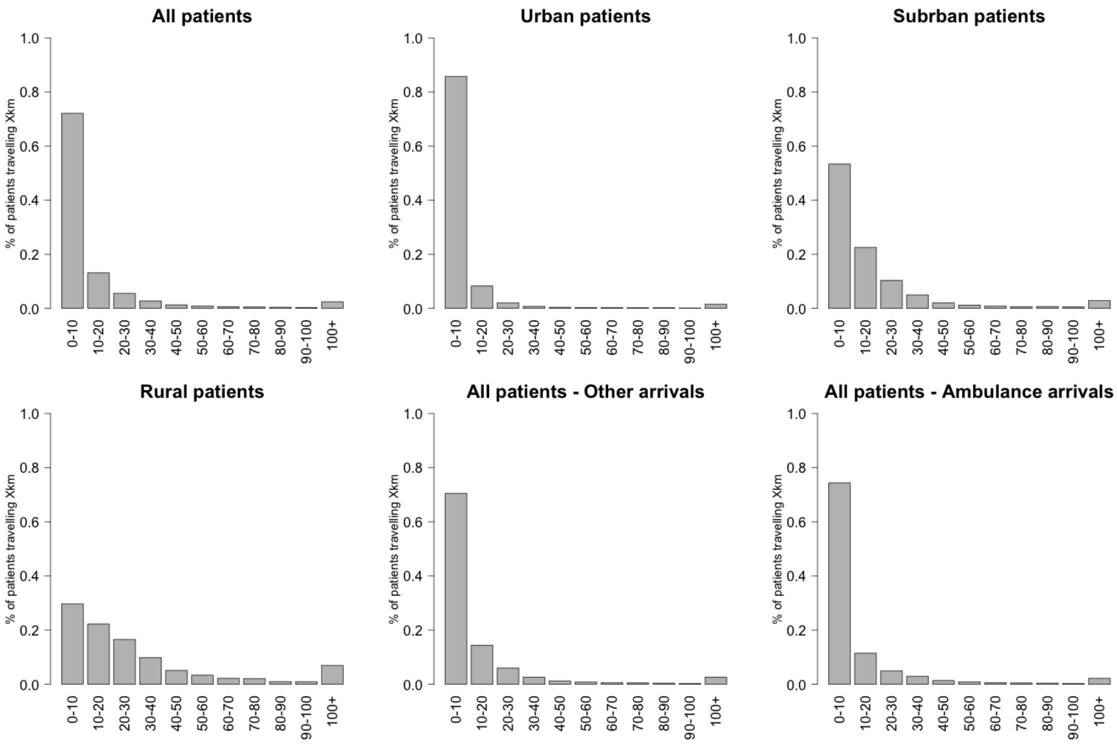


Figure 5: Histogram of the mean additional distance (10km) travelled when patients bypass the closest hospital

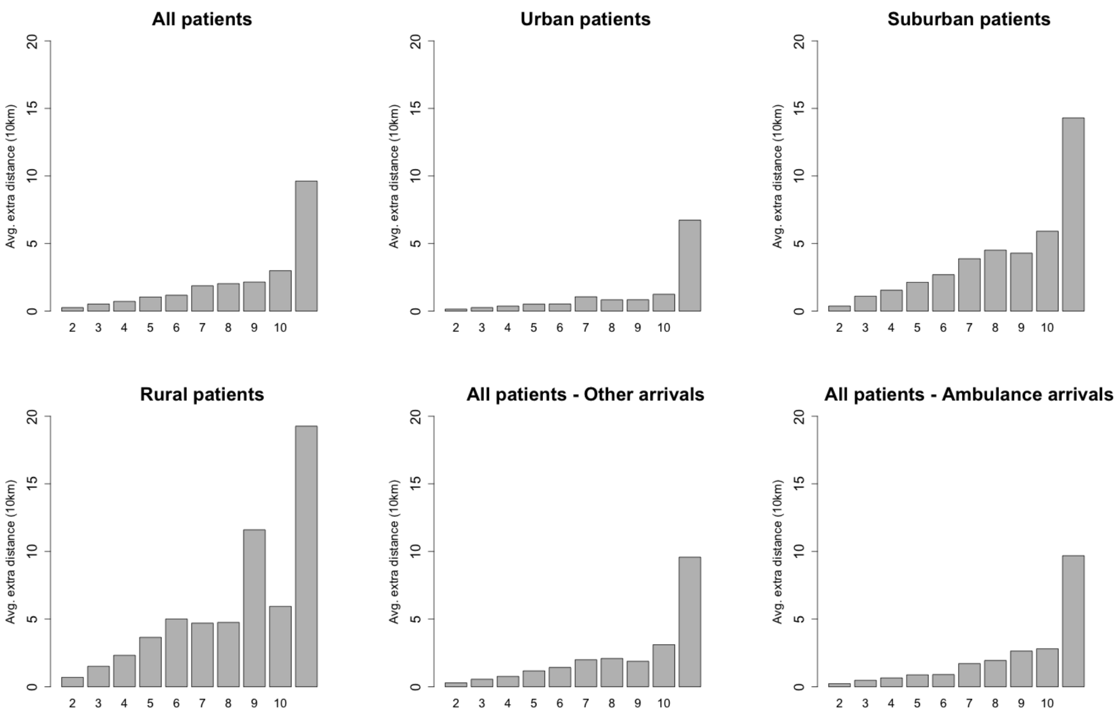


Table 20: Distance statistics for various exclusion criteria

		AMI			
Cutoff	Statistic	Urban	Suburban	Rural	All
None	Obs.	26,162	9,466	4,118	39,746
	Mean	9.80	19.82	38.20	15.13
	S.d.	38.55	49.24	78.86	47.74
	Min	0.04	0.06	0.06	0.04
	Max	2,688.86	1,002.89	1,322	2,688.86
p99	Obs.	25,900	9,371	4,076	39,347
	Mean	6.87	15.88	32.12	11.63
	S.d.	13.07	24.39	43.86	22.72
	Max	159.03	225.82	363.32	363.32
p95	Obs.	24,853	8,992	3,912	37,757
	Mean	4.77	11.89	25.06	8.57
	S.d.	3.97	12.57	24.83	12.34
	Max	22.91	66.14	130.78	130.78
p90	Obs.	23,545	8,519	3,706	35,770
	Mean	4.09	9.90	20.89	7.21
	S.d.	2.72	9.38	17.49	9.22
	Max	13.661	36.64	75.22	75.22

Note: This table summarizes distance between patients and their choice hospital. None includes all patients, p99/p95/p90 excludes patients that travelled a distance that exceeded that percentile, and 300km excludes patients that travelled more than 300km. Cutoff is constructed by location to reflect the varying opportunity cost of travel in different locations. Distances reported in kilometers. Minimum only reported once as it is identical across cutoff groups.

Table 21: Estimation results - distance function

	AMI					
	(1)		(2)		(3)	
	Choice		*Choice*		*Choice*	
Distance (10km)	-0.921***	(0.051)	-1.211***	(0.063)	-1.594***	(0.105)
$Distance^2$	-	-	0.0446***	(0.004)	0.123***	(0.017)
$Distance^3$	-	-	-	-	-0.00306***	(0.001)
Volume (1,000s)	0.0780	(0.082)	0.0959	(0.083)	0.0858	(0.084)
Occupancy (%)	-0.00696**	(0.003)	-0.00639**	(0.003)	-0.00610**	(0.003)
Specialization - AMI (%)	-0.0198	(0.094)	-0.0307	(0.094)	-0.0138	(0.096)
Mortality - AMI (%)	-0.0256***	(0.006)	-0.0266***	(0.006)	-0.0264***	(0.006)
Readmission - AMI (%)	-0.00962***	(0.003)	-0.0102***	(0.003)	-0.00986***	(0.003)
LOS - AMI (days)	-0.0691***	(0.016)	-0.0652***	(0.016)	-0.0611***	(0.016)
ALC (days)	0.00598	(0.014)	0.00781	(0.014)	0.00870	(0.014)
HSMR (%)	0.0104	(0.011)	0.0109	(0.011)	0.00863	(0.011)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	409,181		409,181		409,181	
Pseudo R-squared	0.5270		0.5413		0.5461	
ll	-42,946.838		-42,586.812		-41,199.296	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with AMI. Standard errors in parentheses. Main specification Column (1). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported. The specification in Column (2) includes the $distance^2$ between the patient and hospital. Column (3) includes a square and cubic terms for distance.

Table 22: Estimation results - distance cutoff

	AMI					
	(1)		(2)		(2)	
	Choice		*Choice*		*Choice*	
Distance (10km)	-0.921***	(0.051)	-1.700***	(0.102)	-1.41***	(0.073)
Volume (1,000s)	0.0780	(0.082)	0.0938	(0.103)	0.126	(0.097)
Occupancy (%)	-0.00696**	(0.003)	-0.00762**	(0.003)	-0.00782***	(0.003)
Specialization - AMI (%)	-0.0198	(0.094)	-0.0195	(0.113)	-0.0278	(0.104)
Mortality - AMI (%)	-0.0256***	(0.006)	-0.0361***	(0.007)	-0.0351***	(0.007)
Readmission - AMI (%)	-0.00962***	(0.003)	-0.0160***	(0.004)	-0.0129***	(0.003)
LOS - AMI (days)	-0.0691***	(0.016)	-0.173***	(0.039)	-0.177***	(0.036)
ALC (days)	0.00598	(0.014)	-0.0178	(0.018)	-0.0162	(0.016)
HSMR (%)	0.0104	(0.011)	0.189***	(0.019)	0.192***	(0.018)
Patient Characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	409,181		367,441		388,393	
Pseudo R-squared	0.526		0.695		0.658	
ll	-42,946.838		-24,807.410		-29,466.658	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with AMI. Standard errors in parentheses. Main specification Column (1). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported. The specification in Column (2) Choice set size 10 closest hospitals within 90th percentile of distance by location. Column (3) Choice set size 10 closest hospitals within 95th percentile of distance by location.

Figure 6: Marginal utility from distance (10km) for suburban, urban and rural patient.

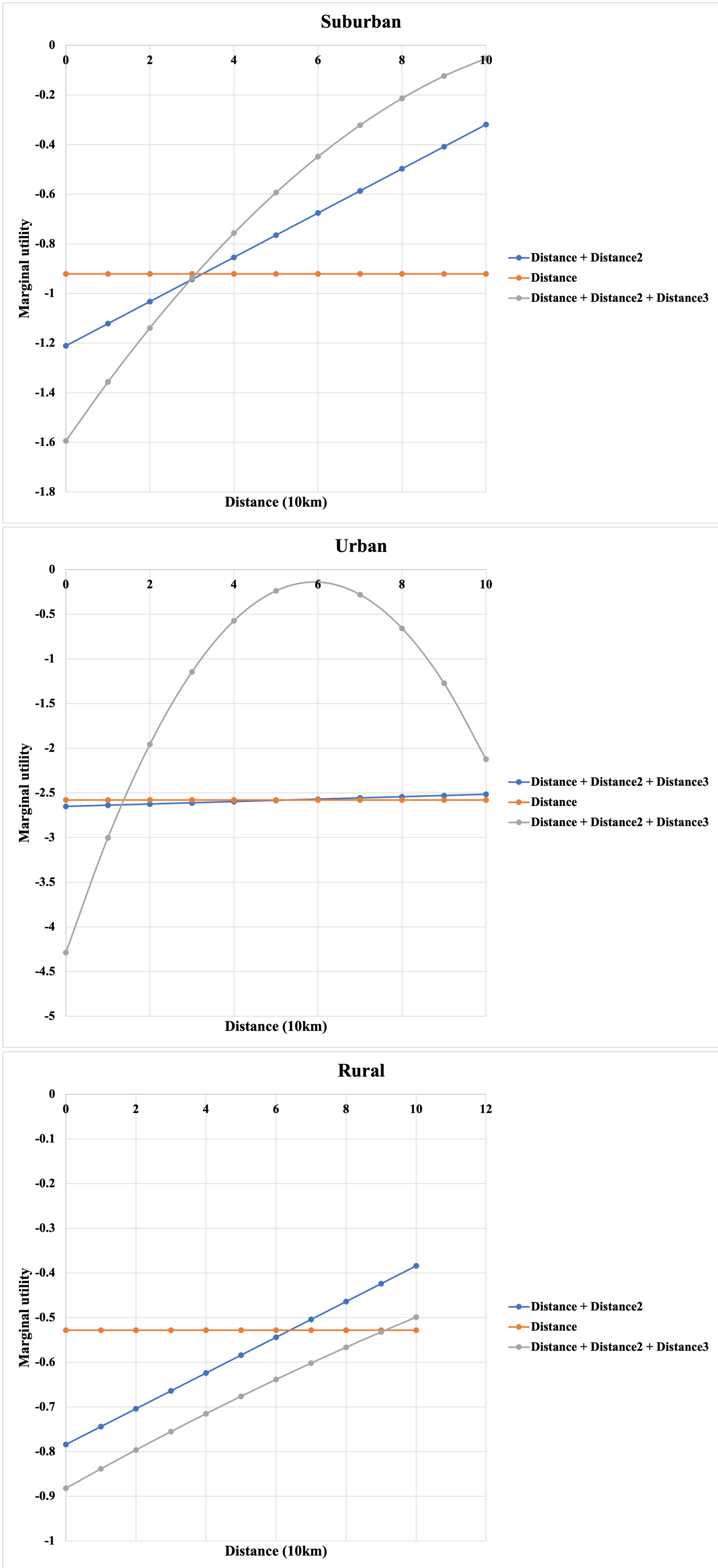
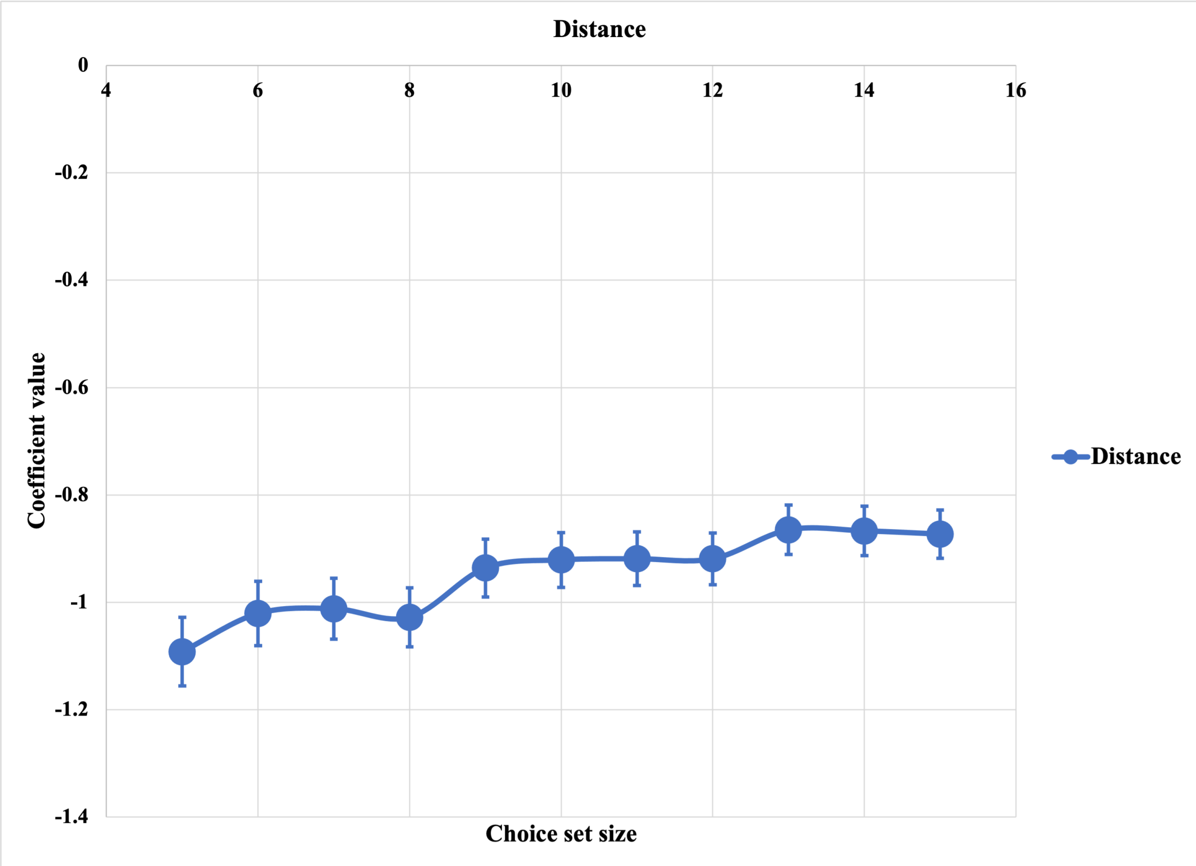


Figure 7: Coefficients for different size of choice set



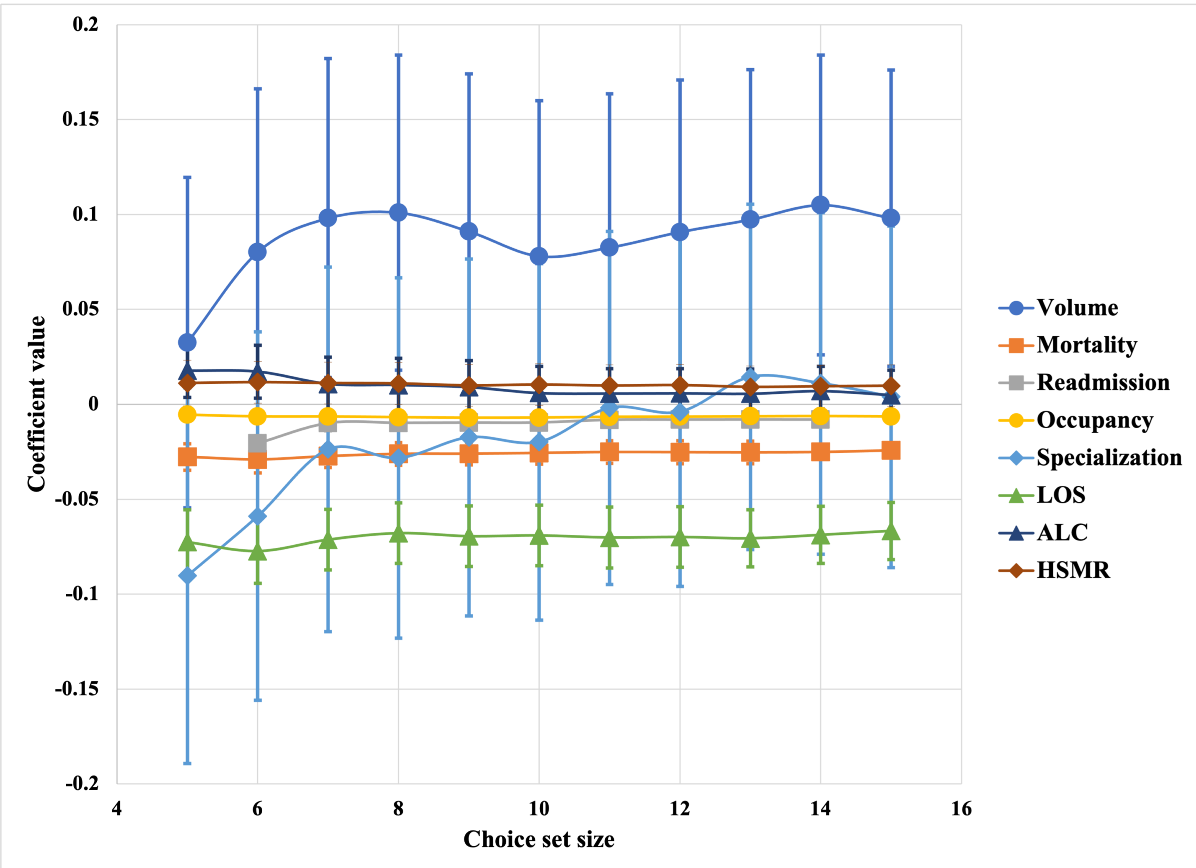
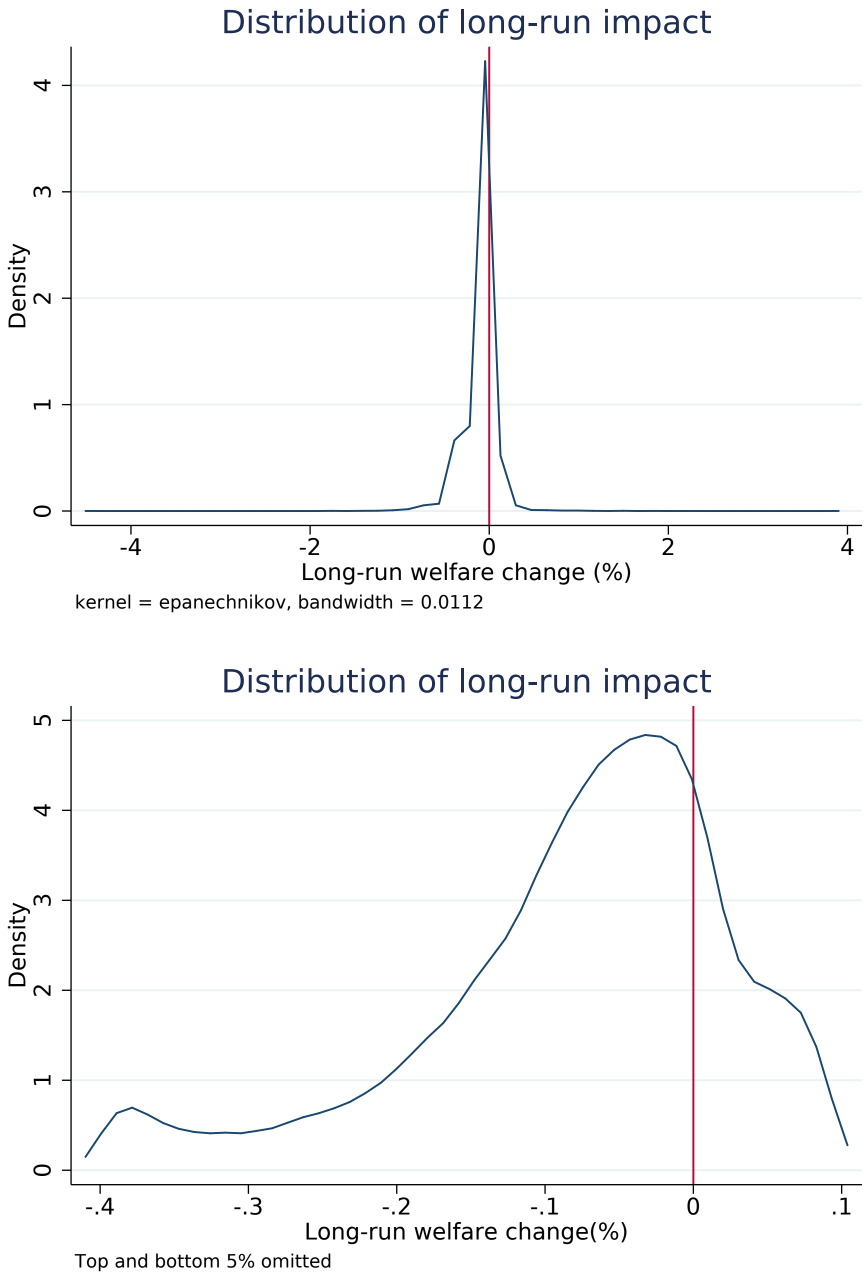


Table 23: Estimation results - Robustness checks

	AMI							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable	*Main*	*One condition*	*One visit*	*Visit number*	*Income quintile*	*No LOS*	*No spec.*	*Spec. interaction*
Distance (10km)	-0.921***	-0.936***	-0.943***	-0.919***	-0.849***	-0.923***	-0.921***	-0.923***
	(0.051)	(0.054)	(0.052)	(0.062)	(0.054)	(0.051)	(0.051)	(0.051)
Volume (1,000s)	0.0780	0.0733	0.0929	0.0761	0.0854	0.0487	0.0755	0.00978
	(0.082)	(0.086)	(0.084)	(0.082)	(0.082)	(0.082)	(0.081)	(0.089)
Mortality - AMI (%)	-0.0256***	-0.0283***	-0.0231***	-0.0328***	-0.0231***	-0.0253***	-0.0256***	-0.0359***
	(0.006)	(0.007)	(0.006)	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)
Readmission - AMI (%)	-0.00962***	-0.0180***	-0.00919***	-0.00984***	-0.00919***	-0.00907***	-0.00964***	-0.0207***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Occupancy (%)	-0.00696**	-0.00778***	-0.00738***	-0.00580*	-0.0118***	-0.00331	-0.00691**	-0.00682*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Specialization - AMI (%)	-0.0198	-0.0784	0.0110	-0.0890	0.128	-0.0228	-	-
	(0.094)	(0.098)	(0.096)	(0.109)	(0.097)	(0.093)	-	-
LOS - AMI (days)	-0.0691***	-0.0640***	-0.0696***	-0.0787***	-0.0804***	-	-0.0690***	-0.106***
	(0.016)	(0.017)	(0.016)	(0.018)	(0.016)	-	(0.016)	(0.021)
ALC (days)	0.00598	0.00253	0.00731	0.0151	0.00790	0.00511	0.00565	0.00363
	(0.014)	(0.014)	(0.014)	(0.015)	(0.014)	(0.014)	(0.013)	(0.022)
HSMR (%)	0.0104	0.0111	0.00718	0.0137	0.0118	0.00648	0.0102	0.0206*
	(0.011)	(0.012)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Patient characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	409,181	374,642	389,524	409,181	409,181	409,181	409,181	409,181
Pseudo R-squared	0.526	0.532	0.527	0.526	0.527	0.526	0.526	0.527
ll	-42,946.838	-38,836.800	-40,824.754	-42,941.155	-42,880.787	-42,964.105	-42,951.769	-42,936.337

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with AMI. Standard errors in parentheses. Main specification column (1). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported. Column (2) - (7): Patients with a single diagnosis during sample period, patients with a single hospital visit, additional patient interaction for visit number, additional patient interaction for income quintile of closest MSA, LOS omitted, specialization omitted and additional interaction for hospital specialization with condition specific variables.

Figure 8: Distributions of long-run welfare - AMI



D Selection in Quality Measures

Patients' hospital choice is determined by hospital characteristics. But hospital characteristics such as mortality and readmission rates or average-length-of-stay are determined using patient outcomes. This raises concerns of selection bias in these measures because of unobserved severity of illness. Although we observe some patient demographics and health status information, some remain unobservable such as the intensity of the diagnosis. If sicker patients choose to go to better quality hospital, omitting to control for hospital choice would create a selection bias in the hospital measures. To correct for selection, we follow the procedure proposed by Gowrisankaran and Town (1999). Formally, patient i's mortality is the following:

$$m_i = \beta^T \mathbf{c_i} + \gamma^{\mathbf{T}} \mathbf{X_i} + \mathbf{s_{it}} + \varepsilon_\mathbf{i} \tag{8}$$

where m_i is an indicator taking the value of one if the patient died, $\mathbf{C_i}$ is a vector of indicating the choice of hospital, $\mathbf{X_i}$ is a vector of patient characteristics, s_i is unobserved severity of illness and ε_i is an i.i.d. error term capturing residual mortality. While hospital choice is given by:

$$c_{ij} = f_j(\mathbf{Z}, \delta_\mathbf{i}, \mathbf{u_{ij}}) \tag{9}$$

where c_{ij} is a dummy indicating if i chose i, $\mathbf{Z}$ is a vector of hospital characteristics to the researcher (e.g. location), and $\delta_\mathbf{i}$ is a vector of patient characteristics that do not affect mortality (e.g. location of residence). u_{ij} is an unobserved component of hospital choice. If patient i chooses where to seek treatment according to how sick they are, s_i, then there is a correlation between u_{ij}, the unobserved component of hospital choice, and $s_i + \varepsilon_i$. If we do not account for this correlation, β and γ are inconsistent creating a selection bias in our hospital measures.

To correct for this bias, we can use instruments that are uncorrelated with mortality, but correlated with hospital choice. As in Gowrisankaran and Town (1999), we use distance between patients and alternative hospital and hospital location as instruments. We estimate the two equation simultaneously via simulated maximum likelihood. Once we have estimated the parameters for Equations 8 and 9, we obtained predicted probabilities for each patients that we use to calculate the hospital measures.[59]

Table 24: Descriptive Statistics - Hospital Measures

	AMI								
	Mortality (%)			*Readmission (%)*			*LOS (days)*		
Measure	Obs.	Mean	S.d	Obs.	Mean	S.d	Obs.	Mean	S.d
Raw	342	20.67	12.16	342	0.60	1.50	342	9.04	2.96
Standardized	342	25.35	35.09	342	3.75	17.96	342	9.24	6.09
IV-selection	342	59.13	155.81	342	6.94	37.11	342	9.11	6.97

Gowrisankaran and Town (1999) highlight that hospital measures have more variance once selection has been corrected. We also observe more variance in the selection-corrected hospital measures. In addition to the larger variance, the number of hospitals for which we can calculate the selection-corrected measures is less than the *Raw* or *Stan-*

[59]Since we require patient-level information to correct for the selection bias in the hospital measures, we can only do this with mortality and readmission rates, and average length of stay.

Table 25: Difference in means test between Standardized and IV-selection measures

	AMI	
	Difference (STD. − IV)	P-value
Mortality (%)	-32.893	0.556
Readmission (%)	-3.516	0.754
LOS (days)	0.082	0.743

dardized measures. Table 73 reports hospital measures raw, standardized (i.e. adjusted for patient characteristics), and selection-corrected (i.e. adjusting for patient characteristics and selection). In Table 74 we test how different the measures are to one another. All except two are not statistically different.

Finally, Table 26 reports patient preferences using the hospital measures calculated with different approaches. Overall, results are similar for each diagnosis. This gives us confidence that selection bias is not driving our results. We therefore choose to use the specification that uses hospital measures that correct for patient characteristics but not selection for our counterfactuals because of the increase variance in the measures and the loss of observations.

Table 26: Estimation results - controlling for selection

	AMI					
	Main		Raw		IV	
Variable	*Choice*		*Choice*		*Choice*	
Distance (10km)	-0.921***	(0.051)	-0.885***	(0.059)	-0.930***	(0.065)
Volume (1,000s)	0.0780	(0.082)	-0.277***	(0.091)	0.0947	(0.092)
Occupancy (%)	-0.00696**	(0.003)	0.0168***	(0.003)	-0.00974***	(0.004)
Specialization - AMI (%)	-0.0198	(0.094)	-0.287***	(0.097)	0.138	(0.103)
Mortality - AMI (%)	-0.0256***	(0.006)	0.0953***	(0.011)	-0.000373	(0.002)
Readmission - AMI (%)	-0.00962***	(0.003)	0.0126	(0.014)	0.00106	(0.002)
LOS - AMI (days)	-0.0691***	(0.016)	0.428***	(0.027)	-0.0928***	(0.015)
ALC (days)	0.00598	(0.014)	0.0265*	(0.015)	-0.0141	(0.016)
HSMR (%)	0.0104	(0.011)	0.00480	(0.012)	0.0355	(0.033)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	409,181		401,181		329,440	
Pseudo R-squared	0.526		0.610		0.602	
ll	-42,946.838		-35,328.438		-31,289.022	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Standard errors in parentheses. Hospital fixed effects and patient interactions included. Choice set 10 closest hospitals within 99th percentile of distance. Mortality, readmission, LOS and specialization are condition specific variables. *Main* is our base specification. *Raw* uses group-adjusted hospital mortality and readmission rates. *IV* uses the methodology proposed by Gowrisankaran and Town (1999) to correct for selection in the hospital quality measures (mortality and readmission rates).

E Online Appendix: Pneumonia, sepsis, and stroke

Table 27: Descriptive Statistics - Patient Characteristics

	Pneumonia		**Sepsis**		**Stroke**	
	Pre-Merger		*Pre-Merger*		*Pre-Merger*	
Variable	Mean	S.d.	Mean	S.d.	Mean	S.d.
AMI	0.042	0.201	0.036	0.186	0.033	0.180
Pneumonia	-	-	0.188	0.391	0.051	0.220
Sepsis	0.048	0.214	-	-	0.016	0.126
Stroke	0.020	0.141	0.025	0.157	-	-
Comorbidity	1.111	0.331	1.250	0.474	1.101	0.328
Death within 30 days	0.235	0.424	0.337	0.473	0.221	0.415
Readmission within 30 days	0.002	0.041	0.002	0.043	0.004	0.064
Total LOS (days)	14.136	25.064	19.731	33.488	19.298	34.128
Age	69.991	16.978	67.594	16.941	70.855	12.637
Gender (male = 1)	0.517	0.500	0.517	0.500	0.531	0.499
ADG score	17.219	11.747	22.722	11.970	19.260	9.540
Visit no. for patient	1.064	0.253	1.131	0.355	1.066	0.262
Multiple stays	0.062	0.241	0.124	0.330	0.063	0.243
Patient income quintile	2.811	1.409	2.824	1.403	2.869	1.414
Distance to choice (10km)	1.416	4.922	1.771	6.523	2.127	5.883
Urban	0.632	0.482	0.714	0.452	0.745	0.436
Suburban	0.246	0.430	0.202	0.402	0.178	0.383
Rural	0.122	0.327	0.084	0.277	0.077	0.266
Admission via Ambulance	0.445	0.497	0.483	0.500	0.499	0.500
Urban	0.478	0.500	0.507	0.500	0.525	0.499
Suburban	0.397	0.486	0.431	0.495	0.445	0.497
Rural	0.369	0.478	0.409	0.492	0.371	0.483
Observations	53,460		13,603		21,389	

Notes: The first four row report the proportion of patients who are diagnosed with more than one condition (e.g. 4.2% of pneumonia patients also have AMI, 4.7% also have sepsis and 2% also have a stroke). LOS-length of stay or the number of days the patient in hospital as an inpatient. ADG score - a measure of health status at the time of hospital admission. It is constructed using weights on each ADG according to their prediction of mortality. Distance is calculated as a straight line between the patient's residence and the hospital.

Table 28: Average distance to Nth closest hospital - Pneumonia, Sepsis and Stroke patients

	1	2	3	4	5	6	7	8	9	10	11+
						Pneumonia					
All	5.8	9.5	13.0	15.0	15.4	16.3	24.6	24.5	19.9	27.3	89.7
By arrival											
Ambulance	5.4	8.9	12.5	14.7	12.4	13.8	23.3	25.2	19.7	24.3	83.9
Other	6.1	10.1	13.5	15.4	17.9	18.8	25.3	24.0	20.0	29.3	93.1
By location											
Urban	3.4	5.5	6.5	7.7	7.9	7.8	11.6	13.4	11.2	12.5	63.4
Suburban	7.0	13.1	27.4	33.1	38.4	41.7	50.2	54.9	55.9	68.1	139.6
Rural	13.5	24.5	40.4	47.3	52.7	79.7	71.7	83.8	89.1	78.2	188.6
						Sepsis					
All	5.1	8.6	11.4	12.2	14.7	18.4	27.4	23.5	20.2	39.3	94.4
By arrival											
Ambulance	4.8	8.2	10.5	11.0	12.1	16.0	24.1	15.7	18.6	42.1	102.0
Other	5.5	9.0	12.2	13.2	17.0	20.8	28.9	28.8	21.1	37.9	90.3
By location											
Urban	3.3	5.4	6.6	7.7	7.6	9.3	15.2	11.0	11.8	19.8	70.1
Suburban	6.8	13.8	27.9	29.1	36.4	37.5	50.6	44.2	48.6	79.0	127.1
Rural	14.7	26.0	42.6	42.6	56.7	75.1	71.3	85.0	63.5	66.0	174.7
						Stroke					
All	4.5	8.5	10.8	14.9	17.6	23.1	34.1	32.7	32.1	57.2	87.6
By arrival											
Ambulance	4.2	8.1	9.8	13.4	14.1	12.6	24.8	25.1	22.0	30.0	91.5
Other	4.7	9.0	11.8	16.2	20.6	33.3	41.1	38.4	38.6	70.4	85.6
By location											
Urban	3.3	5.7	6.8	7.6	7.6	8.4	16.9	12.6	12.8	17.5	49.6
Suburban	7.2	15.0	26.8	32.8	39.8	44.6	55.4	58.2	85.5	99.9	118.8
Rural	13.7	26.7	39.4	55.0	62.0	86.7	88.4	82.5	81.6	95.0	179.6

Notes: Distance measured in kilometers (km).

Table 29: Distance statistics for various exclusion criteria

		Pneumonia				Sepsis			
Cutoff	Statistic	Urban	Suburban	Rural	All	Urban	Suburban	Rural	All
None	Obs.	35,023	13,748	6,739	55,510	9,997	2,850	1,195	14,042
	Mean	9.47	17.72	31.25	14.16	11.65	25.94	49.23	17.75
	S.d.	48.07	43.08	59.68	49.02	63.87	54.67	85.02	65.19
	Min	0.04	0.06	0.15	0.04	0.04	0.06	0.18	0.04
	Max	3,393.68	1,178.27	1,093.95	3,393.68	3,393.68	608.06	1,231.42	3,393.68
p99	Obs.	34,672	13,610	6,671	54,953	9,897	2,821	1,183	13,901
	Mean	6.33	14.39	26.74	10.80	7.61	21.53	43.37	13.48
	S.d.	9.92	21.04	35.47	19.23	13.63	31.96	58.27	27.24
	Max	111.31	175.13	302.35	302.35	163.86	278.94	440.56	440.56
p95	Obs.	33,271	13,060	6,402	52,733	9,497	2,710	1,135	13,339
	Mean	4.72	10.98	21.08	8.26	5.33	16.65	34.62	10.12
	S.d.	3.92	11.93	20.50	11.21	4.89	20.21	38.86	17.26
	Max	21.66	61.19	104.92	104.92	29.08	99.59	179.80	179.80
p90	Obs.	31,520	12,373	6,065	49,958	8,997	2,565	1,075	12,637
	Mean	4.06	9.11	17.73	6.97	4.48	13.21	28.54	8.30
	S.d.	2.77	8.97	14.95	8.51	3.29	14.10	28.22	12.88
	Max	13.66	35.20	67.57	67.57	15.85	61.93	121.35	121.35

		Stroke			
Cutoff	Statistic	Urban	Suburban	Rural	All
None	Obs.	16,615	4,014	1,692	22,321
	Mean	10.20	39.35	84.01	21.04
	S.d.	38.67	74.31	106.18	58.38
	Min	0.04	0.06	0.15	0.04
	Max	2,707.84	2,233.91	1,114.52	2,707.84
p99	Obs.	16,448	3,973	1,675	22,096
	Mean	7.64	34.02	77.20	17.65
	S.d.	11.71	44.92	79.72	36.58
	Max	94.53	318.33	501.73	501.73
p95	Obs.	15,784	3,813	1,607	21,204
	Mean	5.60	27.26	65.78	14.06
	S.d.	5.34	29.01	56.99	26.57
	Max	33.20	119.98	255.44	255.44
p90	Obs.	14,953	3,612	1,522	20,087
	Mean	4.65	23.18	58.24	12.04
	S.d.	3.45	23.87	48.24	22.63
	Max	16.69	90.76	174.50	174.50

Notes: This table summarizes distance between patients and their choice hospital. None includes all patients, p99/p95/p90 excludes patients that travelled a distance that exceeded that percentile. Cutoff is constructed by location to reflect the varying opportunity cost of travel in different locations. Distances reported in kilometers. Minimum only reported once as it is identical across cutoff groups.

Figure 9: Histogram of the proportion of pneumonia patients Xkm to choice hospital, overall, by location, and by arrival type

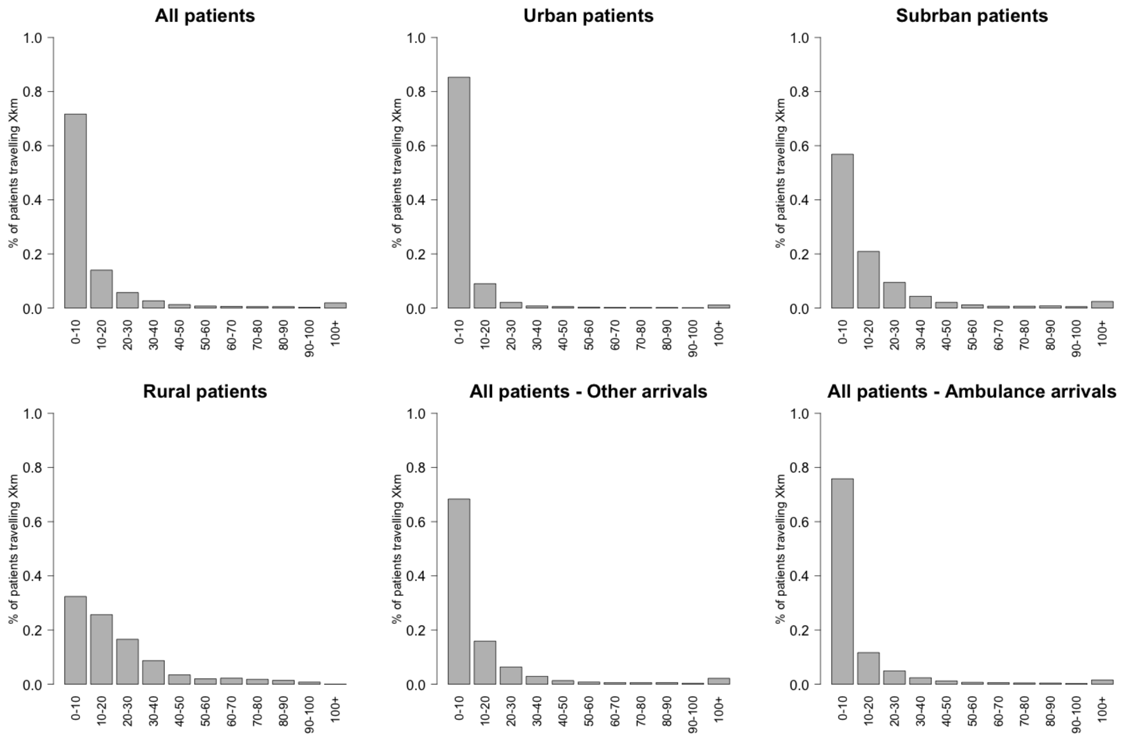


Figure 10: Histogram of the proportion of pneumonia patients choosing the Nth closest hospital, overall, by location, and by arrival type

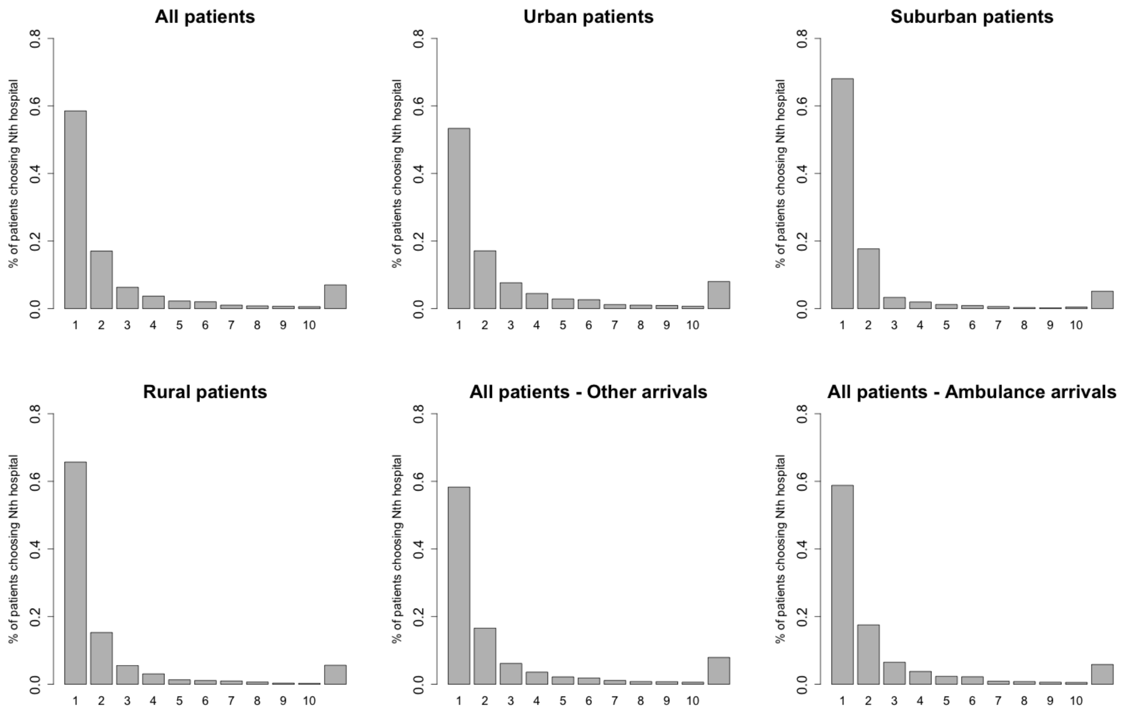


Figure 11: Histogram of the mean additional distance (10km) travelled when patients bypass the closest hospital

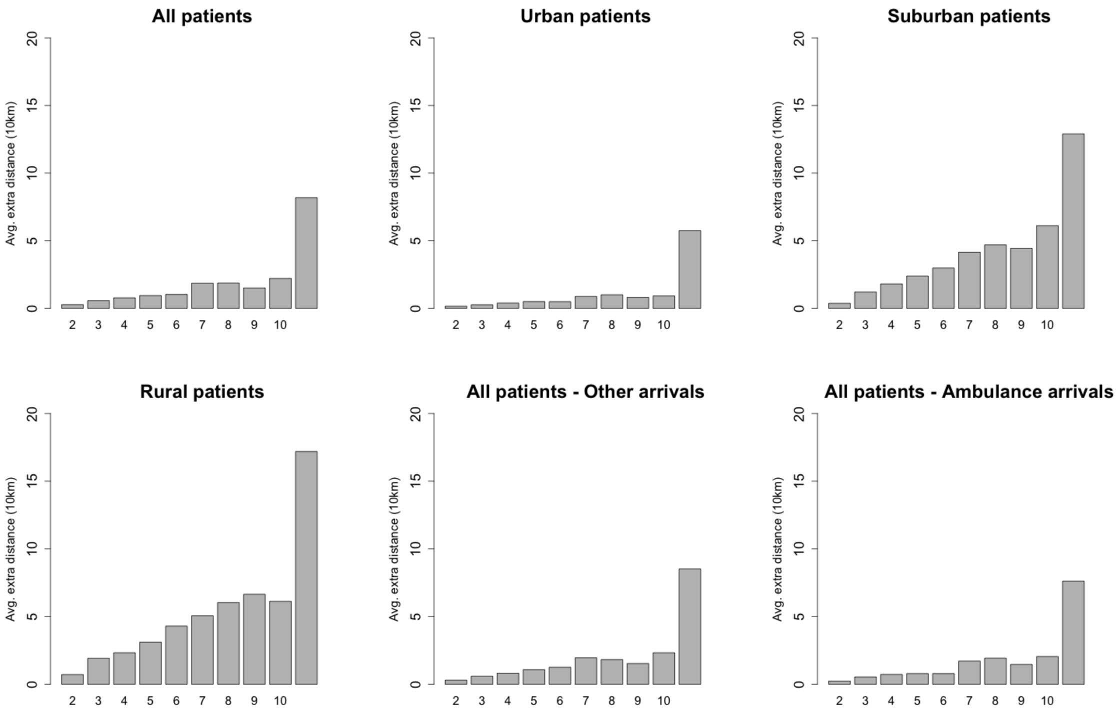


Figure 12: Histogram of the proportion of sepsis patients Xkm to choice hospital, overall, by location, and by arrival type

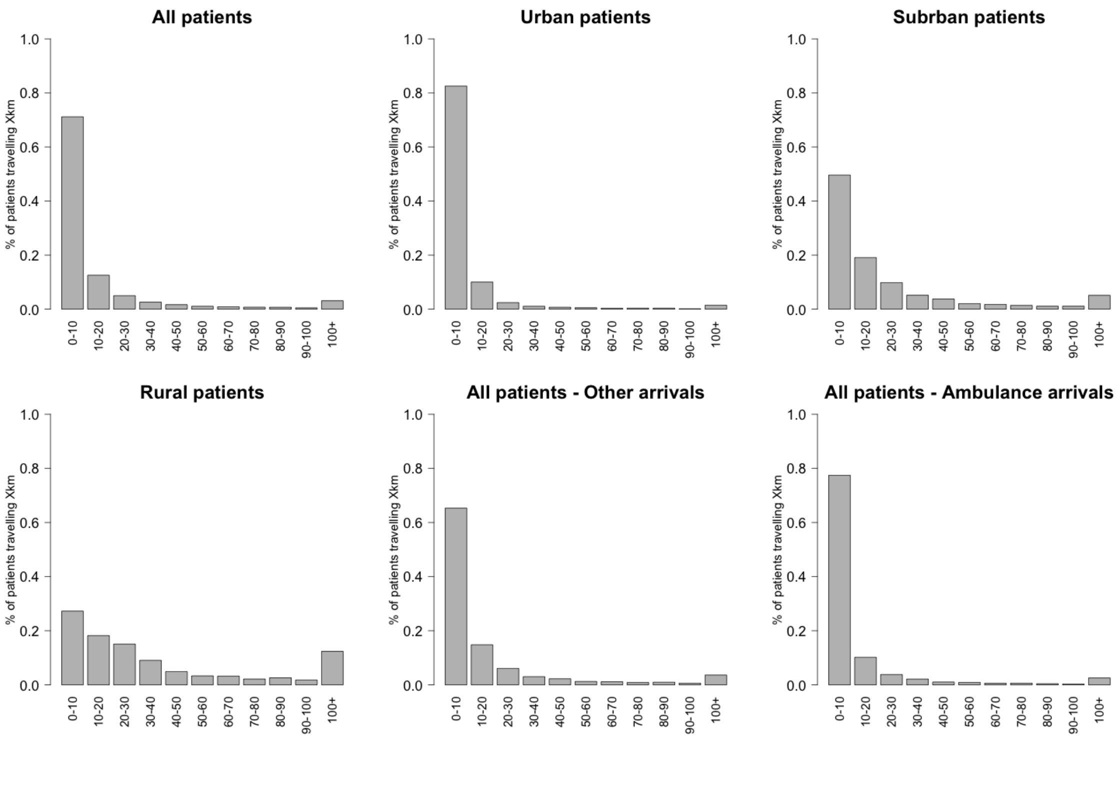


Figure 13: Histogram of the proportion of sepsis patients choosing the Nth closest hospital, overall, by location, and by arrival type

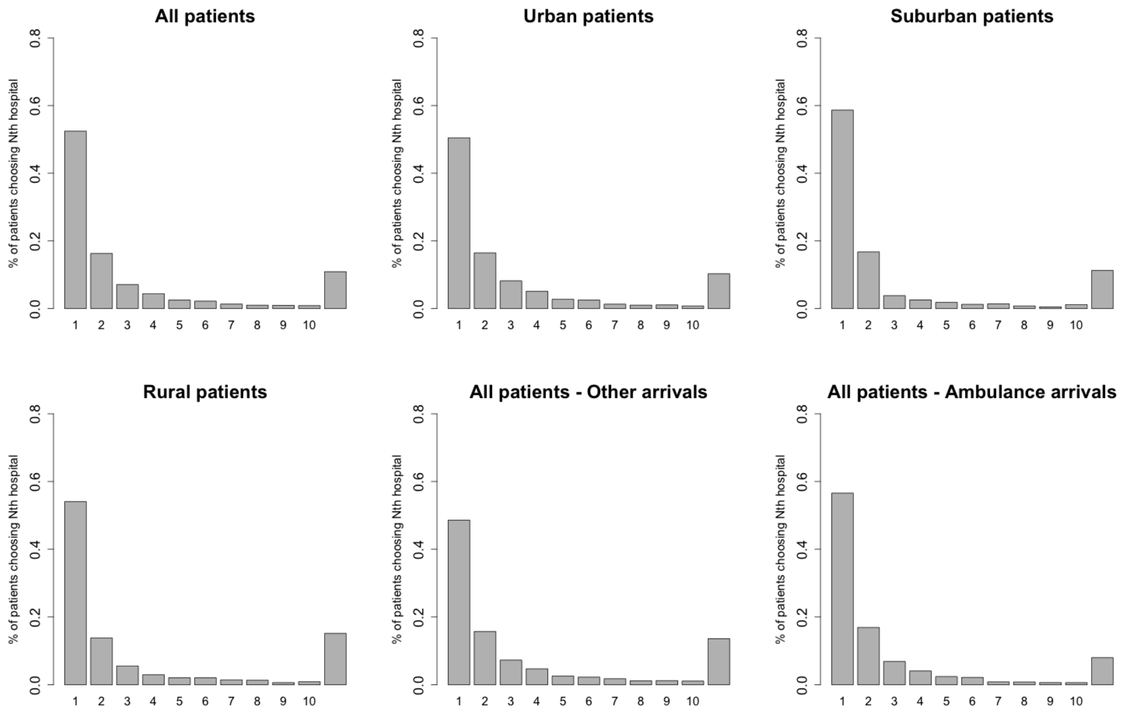


Figure 14: Histogram of the mean additional distance (10km) travelled when patients bypass the closest hospital

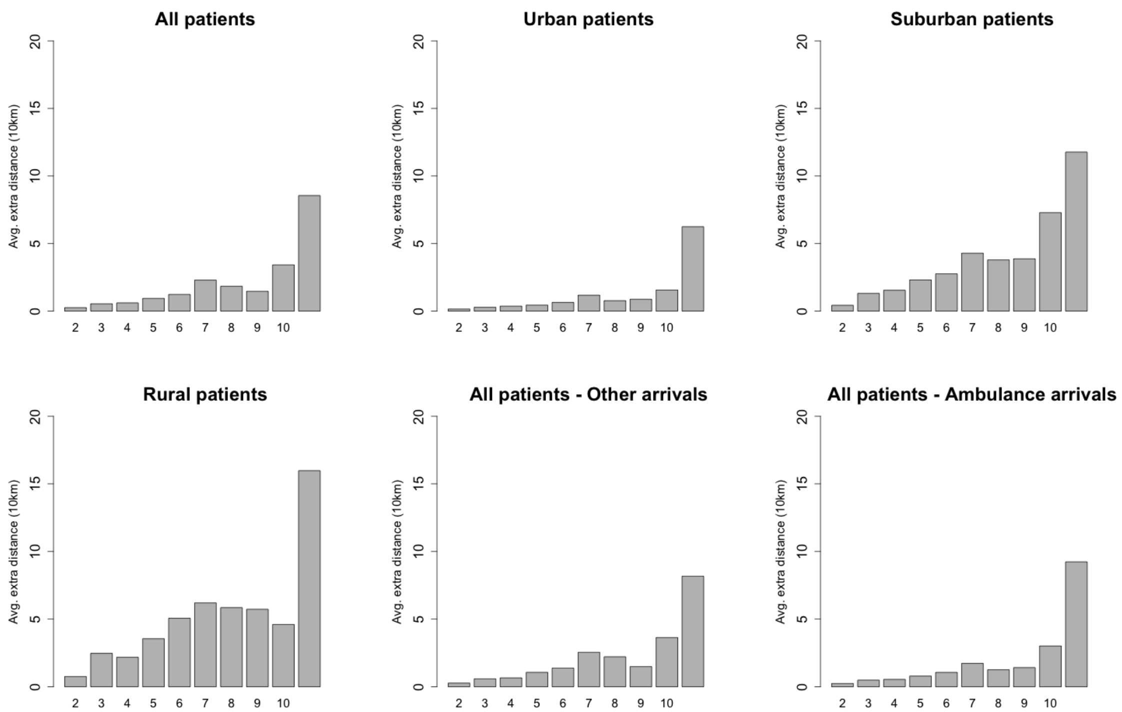


Figure 15: Histogram of the proportion of stroke patients Xkm to choice hospital, overall, by location, and by arrival type

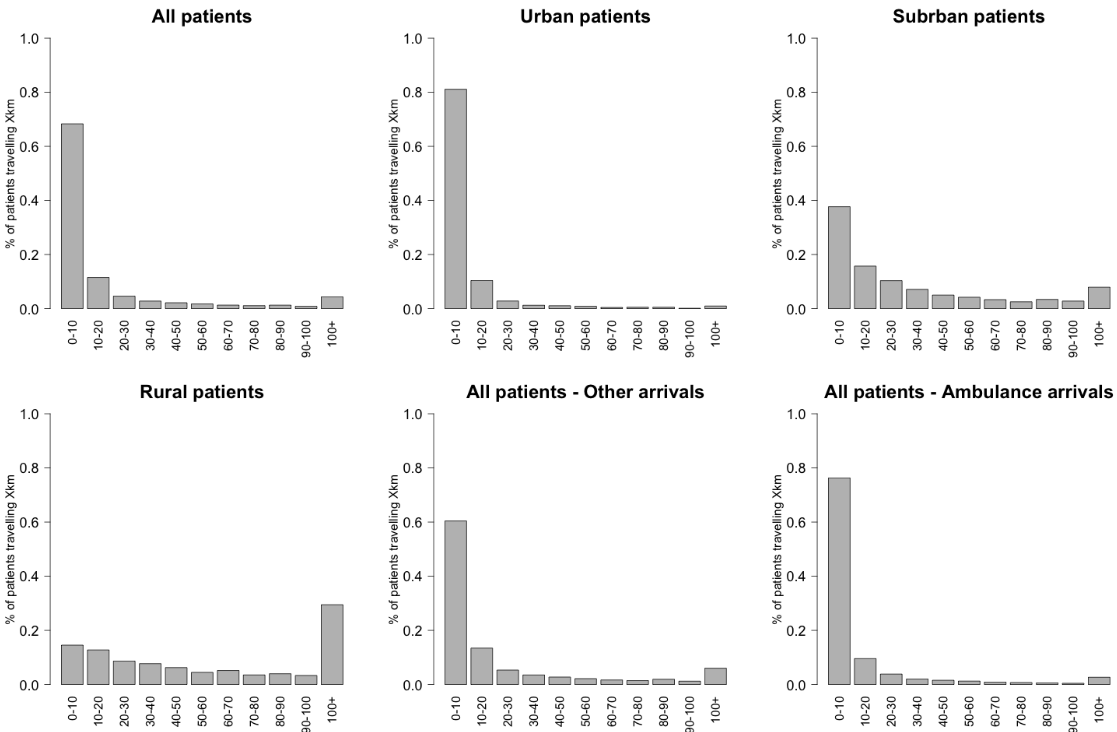


Figure 16: Histogram of the proportion of stroke patients choosing the Nth closest hospital, overall, by location, and by arrival type

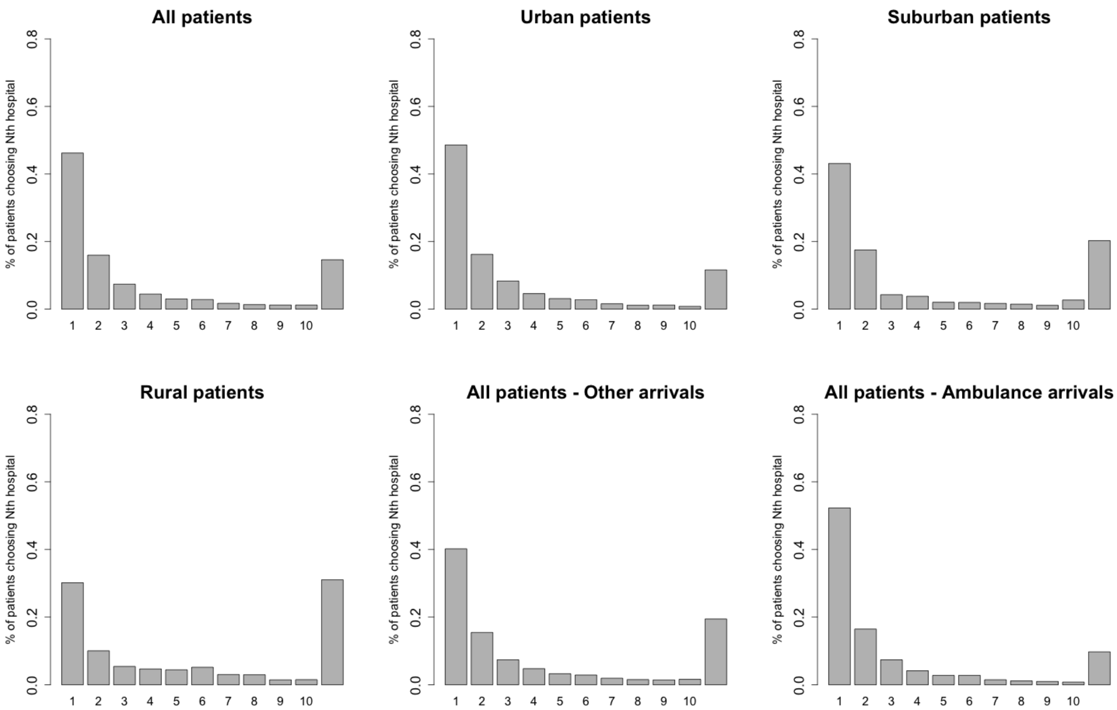


Figure 17: Histogram of the proportion of stroke patients choosing the Nth closest hospital, overall, by location, and by arrival type

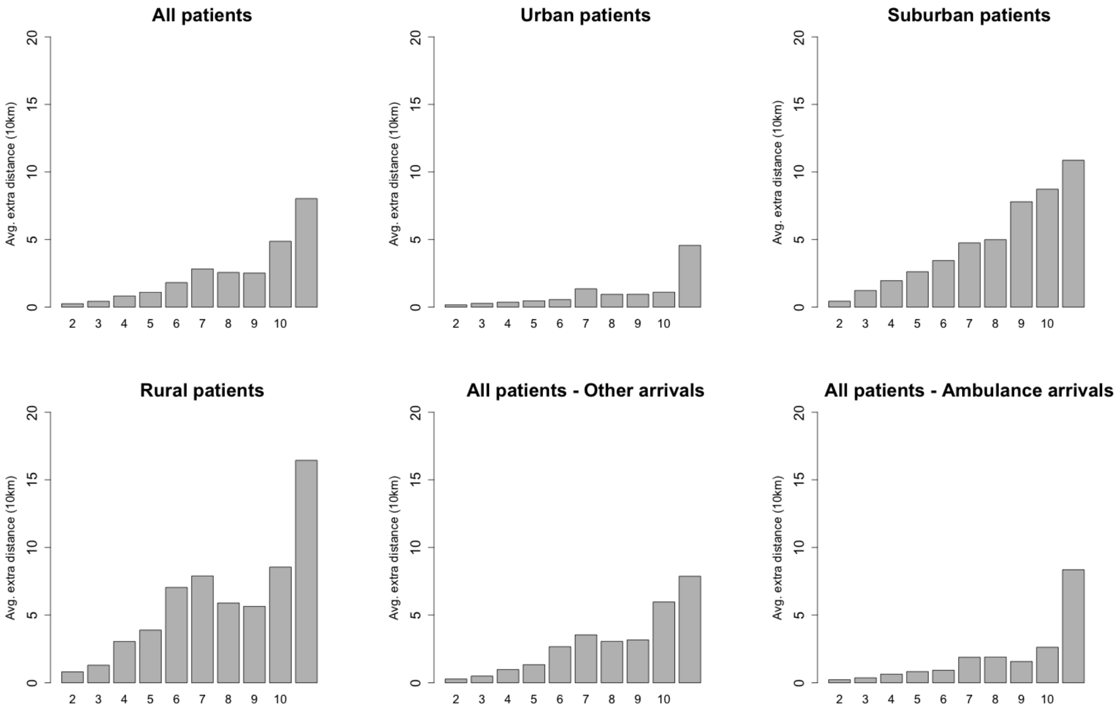


Table 30: Descriptive statistics - Hospitals before mergers

	Pneumonia			
	1995	*1996*	*Pre-Merger*	
Variable	Mean	Mean	Mean	S.d.
Teaching status	0.153	0.162	0.157	0.365
ALC (days)	7.014	8.841	7.948	6.390
HSMR (%)	100.169	100.376	100.275	4.087
Occupancy (%)	78.726	75.414	77.033	25.300
Volume (1,000s)	5.117	5.315	5.218	5.637
Specialization - Pneumonia (%)	3.904	3.564	3.730	1.667
Mortality rate - Pneumonia (%)	21.309	22.4 05	21.869	12.759
Readmission rate - Pneumonia (%)	8.504	19.125	13.932	54.342
LOS - Pneumonia (days)	11.559	11.657	11.609	8.390
Urban	0.379	0.384	0.381	0.486
Suburban	0.282	0.281	0.282	0.450
Rural	0.339	0.335	0.337	0.473
Observations	175	185	358	
	Sepsis			
Teaching status	0.170	0.174	0.172	0.378
ALC (days)	7.140	8.567	7.871	5.964
HSMR (%)	100.226	100.519	100.376	3.671
Occupancy (%)	81.443	78.215	79.789	23.788
Volume (1,000s)	5.620	5.921	5.774	5.926
Specialization - Sepsis (%)	0.702	0.683	0.692	0.400
Mortality rate - Sepsis (%)	38.259	35.292	36.729	53.316
Readmission rate - Sepsis (%)	27.999	37.197	32.741	133.233
LOS - Sepsis (days)	13.036	15.118	14.109	15.213
Urban	0.415	0.413	0.414	0.493
Suburban	0.302	0.299	0.301	0.459
Rural	0.283	0.287	0.285	0.452
Observations	156	165	322	
	Stroke			
Teaching status	0.159	0.161	0.160	0.367
ALC (days)	7.355	8.886	8.145	6.269
HSMR (%)	100.270	100.164	100.215	2.692
Occupancy (%)	83.002	78.619	80.747	23.710
Volume (1,000s)	5.803	5.927	5.867	5.727
Specialization - Stroke (%)	0.845	0.912	0.880	0.739
Mortality rate - Stroke (%)	31.313	31.229	31.269	41.158
Readmission rate - Stroke (%)	24.246	51.730	438.661	134.927
LOS - Stroke (days)	15.740	16.215	15.988	14.441
Urban	0.417	0.416	0.417	0.494
Suburban	0.311	0.311	0.311	0.464
Rural	0.272	0.273	0.272	0.446
Observations	147	160	308	

Notes: All variables are lagged. LOS is the average inpatient length of stay. Mortality rates are within 30 days of discharges meaning they include inpatient deaths and deaths within 30 days after discharges. Readmission rates are calculated based on hospital readmissions within 30 days following discharge.

Table 31: Descriptive Statistics - Hospitals selected for closure

	Pneumonia				
	Not selected to close		*Selected to close*		
Variable	Mean	S.d.	Mean	S.d.	Difference
Teaching institution	0.140	0.348	0.462	0.519	-0.322**
ALC (days)	8.797	7.177	9.426	6.329	-0.629
HSMR(%)	100.651	4.623	96.747	5.984	3.904**
Occupancy (%)	75.707	25.563	71.594	24.323	4.113
Volume (1,000s)	5.310	5.818	5.382	4.266	-0.072
Specialization - Pneumonia (%)	3.596	1.490	3.143	2.287	0.453
Mortality - Pneumonia (%)	22.449	13.043	21.825	13.844	0.624
Readmission - Pneumonia (%)	20.276	73.842	3.894	5.415	16.382***
LOS - Pneumonia (days)	11.271	7.600	16.763	12.269	-5.492
Urban site	0.355	0.480	0.769	0.439	-0.414***
Suburban site	0.291	0.455	0.154	0.376	0.137
Rural site	0.355	0.480	0.077	0.277	0.278
Observations	172		13		
	Sepsis				
Teaching institution	0.154	0.362	0.455	0.522	-0.301
ALC (days)	8.406	6.414	10.846	5.787	-2.44
HSMR(%)	100.678	4.371	98.259	3.624	2.419
Occupancy (%)	78.787	23.816	70.197	25.297	8.59
Volume (1,000s)	5.916	6.294	5.990	4.374	-0.074
Specialization - Sepsis (%)	0.684	0.385	0.661	0.506	0.023
Mortality - Sepsis (%)	33.023	33.427	67.263	132.823	-34.24
Readmission - Sepsis (%)	39.064	171.466	10.894	29.513	28.17*
LOS - Sepsis (days)	14.683	17.797	21.257	26.330	-6.574
Urban site	0.391	0.490	0.727	0.467	-0.336**
Suburban site	0.308	0.463	0.182	0.405	0.126
Rural site	0.301	0.460	0.091	0.302	0.210*
Observations	156		11		
	Stroke				
Teaching institution	0.147	0.355	0.364	0.505	-0.217
ALC (days)	8.801	6.909	10.050	6.299	-1.249
HSMR(%)	100.325	2.643	97.958	3.606	2.367
Occupancy (%)	79.014	24.085	73.266	26.267	5.748
Volume (1,000s)	5.948	5.863	5.646	4.583	0.302
Specialization - Stroke (%)	0.905	0.807	1.007	0.520	-0.102
Mortality - Stroke (%)	31.814	42.744	23.253	19.317	8.561
Readmission - Stroke (%)	43.775	125.861	160.202	512.392	-116.427
LOS - Stroke (days)	15.727	15.501	22.856	19.322	-7.129
Urban site	0.393	0.490	0.727	0.467	-0.334**
Suburban site	0.320	0.468	0.182	0.405	0.138
Rural site	0.287	0.454	0.091	0.302	0.196*
Observations	150		11		

Notes: * p <0.10 ** p <0.05 *** p <0.01. Variable definitions in Appendix A. All variables are lagged, except teaching status and hospital location which are indicators and time-invariant.

Table 32: Descriptive Statistics - Hospitals selected for merger

	Pneumonia				
	Not selected to merge		*Selected to merge*		
Variable	Mean	S.d.	Mean	S.d.	Difference
Teaching institution	0.100	0.301	0.277	0.451	-0.177
ALC (days)	8.918	7.530	8.699	6.305	0.219
HSMR (%)	100.970	5.275	99.280	3.615	1.690**
Occupancy (%)	73.544	25.899	78.893	24.366	-5.349
Volume (1,000s)	4.244	4.858	7.293	6.621	-3.049***
Specialization - Pneumonia (%)	3.651	1.534	3.403	1.593	0.248
Mortality - Pneumonia (%)	21.136	13.180	24.749	12.608	-3.613*
Readmission - Pneumonia (%)	26.515	87.465	5.482	10.440	21.033**
LOS - Pneumonia (%)	9.683	6.069	15.302	9.949	-5.619***
Urban site	0.242	0.430	0.646	0.482	-0.404
Suburban site	0.325	0.470	0.200	0.403	0.125
Rural site	0.433	0.498	0.154	0.364	0.279
Observations	120		65		
	Sepsis				
Teaching institution	0.104	0.306	0.295	0.460	-0.191
ALC (days)	8.544	6.623	8.608	6.010	-0.064
HSMR (%)	101.108	4.982	99.495	2.726	1.613***
Occupancy (%)	76.950	23.972	80.428	23.904	-3.478
Volume (1,000s)	4.582	4.809	8.248	7.508	-3.666***
Specialization - Sepsis (%)	0.627	0.352	0.780	0.441	-0.153
Mortality - Sepsis (%)	34.345	37.714	36.922	59.492	-2.577
Readmission - Sepsis (%)	50.419	204.931	14.439	45.991	35.98*
LOS - Sepsis (%)	13.019	18.627	18.733	17.707	-5.714*
Urban site	0.264	0.443	0.672	0.473	-0.408
Suburban site	0.368	0.485	0.180	0.388	0.188
Rural site	0.368	0.485	0.148	0.358	0.22
Observations	105		60		
	Stroke				
Teaching institution	0.110	0.314	0.246	0.434	-0.136
ALC (days)	8.852	7.185	8.941	6.344	-0.089
HSMR (%)	100.567	2.711	99.503	2.762	1.064**
Occupancy (%)	77.761	23.964	80.049	24.716	-2.288
Volume (1,000s)	4.918	4.873	7.582	6.723	-2.664***
Specialization - Stroke (%)	0.778	0.778	1.133	0.765	-0.355***
Mortality - Stroke (%)	33.223	49.822	27.961	22.331	5.262
Readmission - Stroke (%)	52.245	145.636	50.885	224.531	1.36
LOS - Stroke (%)	13.712	14.401	20.317	17.258	-6.605**
Urban site	0.280	0.451	0.639	0.484	-0.359
Suburban site	0.370	0.485	0.213	0.413	0.157
Rural site	0.350	0.479	0.148	0.358	0.202
Observations	100		60		

Notes: * p <0.10 ** p <0.05 *** p <0.01. Variable definitions in Appendix A. All variables are lagged, except teaching status and hospital location which are indicators and time-invariant.

Table 33: Estimation results

	Pneumonia							
	(1)		(2)		(3)		(4)	
	Choice		*Choice*		*Choice*		*Choice*	
Distance	-0.829***	(0.008)	-1.676***	(0.010)	-0.671***	(0.030)	-0.963***	(0.030)
Volume (1,000s)	0.0753***	(0.001)	0.0763	(0.069)	0.0640***	(0.005)	0.0938	(0.070)
Occupancy (%)	0.00456***	(0.000)	-0.000684	(0.001)	0.00261*	(0.001)	-0.00411**	(0.002)
Specialization - Pneumonia (%)	0.123***	(0.006)	-0.0564**	(0.025)	0.0236	(0.024)	-0.222***	(0.036)
Mortality - Pneumonia (%)	-0.00463***	(0.001)	-0.00165	(0.001)	-0.0114***	(0.002)	-0.0153***	(0.004)
Readmission - Pneumonia (%)	-0.00357***	(0.000)	0.0000983	(0.001)	-0.00236	(0.002)	0.000164	(0.003)
LOS - Pneumonia (days)	-0.00622***	(0.001)	-0.00370*	(0.002)	-0.0113**	(0.004)	-0.00204	(0.005)
ALC (days)	-0.00351**	(0.001)	-0.00256	(0.007)	-0.000742	(0.006)	-0.0115	(0.009)
HSMR (%)	0.00488***	(0.000)	-0.0108	(0.008)	0.00627***	(0.002)	-0.0141*	(0.009)
Closest site	1.376***	(0.013)	-	-	0.812***	(0.060)	-	-
Teaching status	-0.295***	(0.021)	-	-	1.682***	(0.111)	-	-
Urban site	-0.167***	(0.027)	-	-	0.0212	(0.120)	-	-
Rural site	0.132***	(0.036)	-	-	-1.584***	(0.193)	-	-
Patient characteristics	No		No		Yes		Yes	
Hospital F.E.	No		Yes		No		Yes	
Observations	576,953		576,953		576,953		576,953	
Pseudo R-squared	0.4583		0.5035		0.4802		0.517	
ll	-71,203.620		-65,771.408		-65,995.732		-61,331.529	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with pneumonia. Standard errors in parentheses. Main specification column (4). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported.

Table 34: Estimation results

	Sepsis							
Variable	(1)		(2)		(3)		(4)	
	Choice		*Choice*		*Choice*		*Choice*	
Distance (10km)	-0.663***	(0.015)	-1.561***	(0.020)	-0.543***	(0.056)	-0.724***	(0.057)
Volume (1,000s)	0.0789***	(0.002)	0.153	(0.135)	0.0698***	(0.008)	0.176	(0.133)
Occupancy (%)	0.00353***	(0.001)	-0.00197	(0.003)	-0.00145	(0.003)	-0.00595	(0.004)
Specialization - Sepsis (%)	0.516***	(0.032)	-0.512***	(0.137)	0.797***	(0.139)	0.152	(0.205)
Mortality - Sepsis (%)	-0.000830*	(0.000)	-0.00164**	(0.001)	0.00113	(0.002)	0.00249	(0.002)
Readmission - Sepsis (%)	-0.00151***	(0.000)	0.0000529	(0.000)	-0.00611***	(0.002)	-0.00247	(0.002)
LOS - Sepsis (days)	-0.00506***	(0.001)	-0.000673	(0.003)	-0.0164***	(0.005)	0.000818	(0.006)
ALC (days)	-0.00440*	(0.002)	0.0205	(0.016)	-0.0131	(0.011)	-0.0160	(0.019)
HSMR (%)	-0.00558***	(0.001)	0.000602	(0.016)	-0.00800**	(0.004)	-0.0243	(0.017)
Closest site	1.555***	(0.026)	-	-	0.710***	(0.123)	-	-
Teaching status	-0.197***	(0.041)	-	-	2.394***	(0.211)	-	-
Urban site	-0.00694	(0.049)	-	-	0.139	(0.235)	-	-
Rural site	-0.0755	(0.075)	-	-	-1.862***	(0.452)	-	-
Patient characteristics	No		No		Yes		Yes	
Hospital F.E.	No		Yes		No		Yes	
Observations	141,872		141,872		141,872		141,872	
Pseudo R-squared	3763		0.4459		0.4277		0.4640	
ll	-19,845.610		-18,573.316		-18,228.347		-17,045.942	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with sepsis. Standard errors in parentheses. Main specification column (4). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported.

Table 35: Estimation results

Variable	Stroke (1) Choice		(2) Choice		(3) Choice		(4) Choice	
Distance (10km)	-0.358***	(0.009)	-1.382***	(0.016)	-0.0768	(0.047)	-0.360***	(0.051)
Volume (1,000s)	0.0651***	(0.002)	0.0958	(0.091)	0.0591***	(0.010)	0.167*	(0.093)
Occupancy (%)	0.00597***	(0.001)	-0.00621***	(0.002)	-0.000617	(0.003)	-0.0130***	(0.004)
Specialization - Stroke (%)	0.768***	(0.013)	-0.227***	(0.078)	1.443***	(0.085)	0.807***	(0.116)
Mortality - Stroke (%)	-0.00270***	(0.001)	-0.000931	(0.001)	-0.00711	(0.005)	-0.00168	(0.005)
Readmission - Stroke (%)	0.000312**	(0.000)	0.00166***	(0.000)	0.00103	(0.001)	0.00409***	(0.001)
LOS - Stroke (days)	-0.00759***	(0.001)	-0.00108	(0.002)	-0.0253***	(0.007)	-0.000824	(0.007)
ALC (days)	-0.00825***	(0.002)	-0.00526	(0.013)	0.000216	(0.015)	-0.0622***	(0.020)
HSMR (%)	-0.0230***	(0.001)	-0.0294**	(0.014)	-0.0567***	(0.005)	-0.0694***	(0.015)
Closest site	1.895***	(0.021)	-	-	1.338***	(0.141)	-	-
Teaching status	-0.0336	(0.030)	-	-	3.826***	(0.210)	-	-
Urban site	0.338***	(0.039)	-	-	0.910***	(0.276)	-	-
Rural site	-0.443***	(0.066)	-	-	-2.867***	(0.586)	-	-
Patient characteristics	No		No		Yes		Yes	
Hospital F.E.	No		Yes		No		Yes	
Observations	214,761		214,761		214,761		214,761	
Pseudo R-squared	0.3601		0.4325		0.4105		0.4430	
ll	-31,407.712		-29,852.130		-28,965.549		-27,359.664	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with stroke. Standard errors in parentheses. Main specification column (4). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported.

Table 36: Willingness to travel of the average patient

Variable	S.d.(q)	Pneumonia *Urban* WTT	S.e.	*Subrban* WTT	S.e.	*Rural* WTT	S.e.
Volume (1,000s)	5.643	0.220	(0.164)	0.550	(0.411)	0.876	(0.655)
Mortality (%)	25.069	-0.160***	(0.038)	-0.398***	(0.095)	-0.635***	(0.153)
Readmission (%)	64.916	0.00442	(0.069)	0.0110	(0.173)	0.0176	(0.275)
Occupancy(%)	26.089	-0.0446*	(0.022)	-0.111*	(0.054)	-0.177*	(0.087)
Specialization (%)	1.664	-0.154***	(0.025)	-0.383***	(0.063)	-0.611	(0.102)
LOS (days)	7.282	-0.00620	(0.015)	-0.0155	(0.037)	-0.0246	(0.060)
ALC (days)	6.906	-0.0329	(0.026)	-0.0822	(0.066)	-0.131	(0.104)
HSMR (%)	8.001	-0.0544	(0.033)	-0.136	(0.083)	-0.216	(0.132)
Average distance (μ_d, 10km)		0.489		1.060		2.035	

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Willingness to travel computed with respect to each of the quality measures included in estimation according to equation 5. The average patient is willing to travel Xkm to a hospital with a quality measure one standard deviation higher. μ_d is the mean distance for each of the average AMI patient. The standard deviation of each quality measure is reported in the *S.d.(q)* column. The standard error of each WTT measure is obtained using the delta method.

Table 37: Willingness to travel of the average patient

		Sepsis					
		Urban		*Subrban*		*Rural*	
Variable	S.d.(q)	WTT	S.e.	WTT	S.e.	WTT	S.e.
Volume (1,000s)	5.729	0.515	(0.374)	1.538	(1.123)	2.786	(2.064)
Mortality (%)	61.494	0.0708	(0.067)	0.211	(0.201)	0.383	(0.368)
Readmission (%)	140.771	-0.174	(0.121)	-0.520	(0.365)	-0.942	(0.673)
Occupancy(%)	25.082	-0.0758	(0.050)	-0.226	(0.152)	-0.410	(0.280)
Specialization (%)	0.437	0.0368	(0.044)	0.110	(0.131)	0.199	(0.238)
LOS (days)	14.905	0.0103	(0.047)	0.0306	(0.126)	0.0555	(0.229)
ALC (days)	6.254	-0.0500	(0.059)	-0.149	(0.175)	-0.270	(0.319)
HSMR (%)	9.497	-0.127	(0.081)	-0.380	(0.246)	-0.688	(0.455)
Average distance (μ_d, 10km)		0.460		1.174		2.024	

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Willingness to travel computed with respect to each of the quality measures included in estimation according to equation 5. The average patient is willing to travel Xkm to a hospital with a quality measure one standard deviation higher. μ_d is the mean distance for each of the average AMI patient. The standard deviation of each quality measure is reported in the *S.d.(q)* column. The standard error of each WTT measure is obtained using the delta method.

Table 38: Willingness to travel of the average patient

		Stroke					
		Urban		*Subrban*		*Rural*	
Variable	S.d.(q)	WTT	S.e.	WTT	S.e.	WTT	S.e.
Volume (1,000s)	5.741	0.544	(0.306)	3.295	(1.939)	13.610	(12.632)
Mortality (%)	42.050	-0.0374	(0.130)	-0.227	(0.788)	-0.936	(3.302)
Readmission (%)	118.818	0.276***	(0.052)	1.671***	(0.424)	6.903	(5.224)
Occupancy(%)	26.846	-0.201***	(0.060)	-1.220***	(0.430)	-5.038	(4.074)
Specialization (%)	0.707	0.325***	(0.047)	1.971***	(0.429)	8.140	(6.026)
LOS (days)	145.203	-0.00835	(0.061)	-0.0560	(0.372)	-0.209	(1.546)
ALC (days)	6.755	-0.241***	(0.076)	-1.459**	(0.510)	-6.025	(4.720)
HSMR (%)	8.342	-0.336***	(0.073)	-2.040***	(0.571)	-8.424	(6.521)
Average distance (μ_d, 10km)		0.463		1.567		2.694	

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Willingness to travel computed with respect to each of the quality measures included in estimation according to equation 5. The average patient is willing to travel Xkm to a hospital with a quality measure one standard deviation higher. μ_d is the mean distance for each of the average AMI patient. The standard deviation of each quality measure is reported in the *S.d.(q)* column. The standard error of each WTT measure is obtained using the delta method.

Table 39: Estimation results - By arrival type

	Pneumonia					
	(All)		(Ambulance)		(Other)	
	Choice		*Choice*		*Choice*	
Distance (10km)	-0.963***	(0.030)	-0.706***	(0.062)	-1.051***	(0.036)
Volume (1,000s)	0.0938	(0.070)	0.0844	(0.102)	0.113	(0.099)
Occupancy (%)	-0.00411**	(0.002)	-0.00894**	(0.004)	0.00138	(0.003)
Specialization - Pneumonia (%)	-0.222***	(0.036)	-0.129*	(0.071)	-0.221***	(0.044)
Mortality - Pneumonia (%)	-0.0153***	(0.004)	0.00285	(0.007)	-0.0171***	(0.004)
Readmission - Pneumonia (%)	0.000164	(0.003)	-0.0140**	(0.007)	0.0000647	(0.003)
LOS - Pneumonia (days)	-0.00204	(0.005)	0.0276***	(0.009)	-0.00260	(0.006)
ALC (days)	-0.0115	(0.009)	-0.0107	(0.017)	0.00108	(0.011)
HSMR (%)	-0.0141*	(0.009)	-0.0298**	(0.014)	-0.0145	(0.011)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	576,964		256,597		320,367	
Pseudo R-squared	0.517		0.536		0.510	
ll	-61,331.529		-26,182.573		-34,499.925	

Note: * p <0.10 ** p <0.05 *** p <0.01. Standard errors in parentheses. Hospital fixed effects and patient interactions included. All hospital characteristics lagged. Choice set 10 closest hospitals within 99th distance percentile. *All* column reports results for all patients regardless of arrival type–Column (4) of Table 33. *Ambulance* reports the estimations results on the subsample of patients who arrived to the hospital by ambulance, and *other* reports results for the subsample of patients who did not arrive by ambulance.

Table 40: Estimation results - By arrival type

	Sepsis					
	(All)		(Ambulance)		(Other)	
	Choice		*Choice*		*Choice*	
Distance (10km)	-0.746***	(0.057)	-0.619***	(0.112)	-0.919***	(0.071)
Volume (1,000s)	0.176	(0.133)	-0.0625	(0.190)	0.433**	(0.195)
Occupancy (%)	-0.00595	(0.004)	-0.00768	(0.007)	-0.00384	(0.006)
Specialization - Sepsis (%)	0.152	(0.205)	-0.0195	(0.385)	0.0611	(0.257)
Mortality - Sepsis (%)	0.00249	(0.002)	0.000834	(0.005)	0.00375	(0.003)
Readmission - Sepsis (%)	-0.00247	(0.002)	-0.0164***	(0.006)	-0.00203	(0.002)
LOS - Sepsis (days)	0.000818	(0.006)	0.0343***	(0.010)	-0.0196**	(0.008)
ALC (days)	-0.0160	(0.019)	-0.00695	(0.033)	-0.00285	(0.025)
HSMR (%)	-0.0243	(0.017)	-0.0177	(0.028)	-0.0291	(0.023)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	141,877		68,315		73,562	
Pseudo R-squared	0.464		0.508		0.445	
ll	-17,045.942		-7,534.253		-9,156.294	

Note: * p <0.1 ** p <0.05 *** p <0.01. Standard errors in parentheses. Hospital fixed effects and patient interactions included. All hospital characteristics lagged. Choice set 10 closest hospitals within 99th distance percentile. *All* column reports results for all patients regardless of arrival type–Column (4) of Table 34. *Ambulance* reports the estimations results on the subsample of patients who arrived to the hospital by ambulance, and *other* reports results for the subsample of patients who did not arrive by ambulance.

Table 41: Estimation results - By arrival type

	Stroke					
	(All)		(Ambulance)		(Other)	
	Choice		*Choice*		*Choice*	
Distance (10km)	-0.360***	(0.051)	-0.410***	(0.084)	-0.368***	(0.066)
Volume (1,000s)	0.167*	(0.093)	0.366***	(0.137)	0.0244	(0.134)
Occupancy (%)	-0.0130***	(0.004)	-0.0234***	(0.006)	-0.00139	(0.005)
Specialization - Stroke (%)	0.807***	(0.116)	1.115***	(0.179)	0.517***	(0.160)
Mortality - Stroke (%)	-0.00168	(0.005)	0.0150**	(0.007)	-0.0123	(0.008)
Readmission - Stroke (%)	0.00409***	(0.001)	0.00438***	(0.001)	0.00429***	(0.001)
LOS - Stroke (days)	-0.000824	(0.007)	-0.00970	(0.010)	0.0154	(0.010)
ALC (days)	-0.0622***	(0.020)	0.00991	(0.029)	-0.0937***	(0.029)
HSMR (%)	-0.0694***	(0.015)	-0.0997***	(0.023)	-0.0632***	(0.021)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	214,758		106,779		107,979	
Pseudo R-squared	0.443		0.504		0.415	
ll	-27,359.664		-12,098.893		-14,438.694	

Note: * p <0.1 ** p <0.05 *** p <0.01. Standard errors in parentheses. Hospital fixed effects and patient interactions included. All hospital characteristics lagged. Choice set 10 closest hospitals within 99th distance percentile. *All* column reports results for all patients regardless of arrival type–Column (4) of Table 35. *Ambulance* reports the estimations results on the subsample of patients who arrived to the hospital by ambulance, and *other* reports results for the subsample of patients who did not arrive by ambulance.

Table 42: Estimation results - distance function

	Pneumonia					
	(1)		(2)		(3)	
	Choice		*Choice*		*Choice*	
Distance (10km)	-0.957***	(0.030)	-0.929***	(0.037)	-1.325***	(0.069)
Distance^2	-	-	-0.00468*	(0.003)	0.0770***	(0.012)
Distance^3	-	-	-	-	-0.00156***	(0.000)
Volume (1,000s)	0.0949	(0.070)	0.0982	(0.070)	0.101	(0.070)
Occupancy (%)	-0.00424**	(0.002)	-0.00407**	(0.002)	-0.00331*	(0.002)
Specialization - Pneumonia (%)	-0.224***	(0.036)	-0.227***	(0.036)	-0.236***	(0.037)
Mortality - Pneumonia (%)	-0.0151***	(0.004)	-0.0152***	(0.004)	-0.0147***	(0.004)
Readmission - Pneumonia (%)	0.000123	(0.003)	0.000271	(0.003)	0.000971	(0.003)
LOS - Pneumonia (days)	-0.00199	(0.005)	-0.00162	(0.005)	0.0000480	(0.005)
ALC (days)	-0.0116	(0.009)	-0.0112	(0.009)	-0.00935	(0.009)
HSMR (%)	-0.0144*	(0.009)	-0.0148*	(0.009)	-0.0168*	(0.009)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	576,953		576,953		576,953	
Pseudo R-squared	0.5161		0.5279		0.5328	
ll	-61,376.085		-61,071.396		-59,275.685	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with pneumonia. Standard errors in parentheses. Main specification Column (1). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported. The specification in Column (2) includes the $distance^2$ between the patient and hospital. Column (3) includes a square and cubic term for distance.

Table 43: Estimation results - distance function

	Sepsis					
	(1)		(2)		(3)	
	Choice		*Choice*		*Choice*	
Distance (10km)	-0.746***	(0.057)	-0.957***	(0.070)	-0.752***	(0.130)
Distance^2	-	-	0.0311***	(0.004)	-0.00209	(0.023)
Distance^3	-	-	-	-	0.000932	(0.001)
Volume (1,000s)	0.176	(0.133)	0.170	(0.134)	0.203	(0.135))
Occupancy (%)	-0.00595	(0.004)	-0.00644	(0.004)	-0.00479	(0.004)
Specialization - Sepsis (%)	0.152	(0.205)	0.164	(0.206)	0.157	(0.209)
Mortality - Sepsis (%)	0.00249	(0.002)	0.00243	(0.002)	0.00198	(0.002)
Readmission - Sepsis (%)	-0.00247	(0.002)	-0.00247	(0.002)	-0.00262	(0.002)
LOS - Sepsis (days)	0.000818	(0.006)	0.000774	(0.006)	0.00251	(0.006)
ALC (days)	-0.0160	(0.019)	-0.0168	(0.019)	-0.0102	(0.020)
HSMR (%)	-0.0243	(0.017)	-0.0237	(0.018)	-0.0282	(0.018)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	141,877		141,877		141,877	
Pseudo R-squared	0.4664		0.4694		0.4822	
ll	-17,045.942		-16,945.639		-16,465.850	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with sepsis. Standard errors in parentheses. Main specification Column (1). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported. The specification in Column (2) includes the *distance*^{2} between the patient and hospital. Column (3) includes a square and a cubic term for distance.

Table 44: Estimation results - distance function

	Stroke					
	(1)		(2)		(3)	
	Choice		*Choice*		*Choice*	
Distance (10km)	-0.345***	(0.051)	-0.691***	(0.077)	-0.443***	(0.145)
Distance^2	-	-	0.0307***	(0.005)	-0.00870	(0.023)
Distance^3	-	-	-	-	0.000709	(0.001)
Volume (1,000s)	0.165*	(0.093)	0.164*	(0.094)	0.166*	(0.097)
Occupancy (%)	-0.0129***	(0.004)	-0.0137***	(0.004)	-0.0128***	(0.004)
Specialization - Stroke (%)	0.819***	(0.116)	0.821***	(0.117)	0.964***	(0.119)
Mortality - Stroke (%)	-0.00163	(0.005)	-0.000840	(0.005)	-0.00884	(0.006)
Readmission - Stroke (%)	0.00410***	(0.001)	0.00411***	(0.001)	0.00381***	(0.001)
LOS - Sepsis (days)	-0.000584	(0.007)	-0.00162	(0.007)	0.00167	(0.007)
ALC (days)	-0.0630***	(0.020)	-0.0656***	(0.020)	-0.0752***	(0.020)
HSMR (%)	-0.0698***	(0.015)	-0.0675***	(0.015)	-0.0708***	(0.016)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	214,759		214,759		214,759	
Pseudo R-squared	0.441		0.4649		0.405	
ll	-27,375.783		-27,199.985		-31,177.815	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with stroke. Standard errors in parentheses. Main specification Column (1). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported. The specification in Column (2) omits the *distance*^{2} between the patient and hospital. Column (3) includes a cubic term for distance.

Table 45: Estimation results - Choice set size

	Pneumonia										
	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12	(13)	(14)	(15
	Choice	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*
Distance (10km)	-1.125***	-1.129***	-1.070***	-1.035***	-1.019***	-0.963***	-0.904***	-0.842***	-0.792***	-0.764***	-0.758***
	(0.038)	(0.037)	(0.034)	(0.033)	(0.032)	(0.030)	(0.029)	(0.028)	(0.027)	(0.026)	(0.026)
Volume (1,000s)	0.0202	0.0696	0.0706	0.0736	0.0901	0.0938	0.0992	0.108	0.108	0.117*	0.124*
	(0.075)	(0.074)	(0.073)	(0.072)	(0.071)	(0.070)	(0.069)	(0.068)	(0.068)	(0.067)	(0.067)
Occupancy (%)	-0.00214	-0.00265	-0.00307	-0.00320	-0.00386*	-0.00411**	-0.00430**	-0.00482**	-0.00550***	-0.00579***	-0.00605***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Specialization - Pneumonia (%)	-0.214***	-0.220***	-0.217***	-0.219***	-0.226***	-0.222***	-0.221***	-0.226***	-0.231***	-0.229***	-0.224***
	(0.038)	(0.037)	(0.037)	(0.036)	(0.036)	(0.036)	(0.035)	(0.035)	(0.035)	(0.035)	(0.034)
Mortality - Pneumonia (%)	-0.0170***	-0.0148***	-0.0155***	-0.0149***	-0.0153***	-0.0153***	-0.0149***	-0.0147***	-0.0130***	-0.0104***	-0.00760**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Readmission - Pneumonia (%)	0.000987	0.000732	0.000625	0.000483	0.000335	0.000164	0.000136	0.00000197	-0.0000109	0.000127	0.000624
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
LOS - Pneumonia (days)	-0.00677	-0.00703	-0.00605	-0.00350	-0.00244	-0.00204	-0.000999	-0.00196	-0.00109	-0.00102	-0.000828
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
ALC (days)	-0.00419	-0.00747	-0.00781	-0.00986	-0.00968	-0.0115	-0.0141	-0.0128	-0.0145	-0.0164*	-0.0194**
	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
HSMR (%)	-0.0153*	-0.0163*	-0.0162*	-0.0154*	-0.0149*	-0.0141*	-0.0137	-0.0139*	-0.0136	-0.0141*	-0.0153*
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Patient characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	317,144	369,947	422,456	474,571	526,026	576,964	626,680	675,879	725,381	774,900	824,435
Pseudo R-squared	0.441	0.464	0.482	0.495	0.508	0.517	0.521	0.524	0.527	0.532	0.536
ll	-53,166.310	-55,384.675	-57,179.331	-58,786.796	-60,028.021	-61,331.529	-62,815.815	-64,399.192	-65,656.805	-66,673.712	-67,568.275

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with pneumonia. Standard errors in parentheses. Size of choice set varies across rows from 5 to 15. The first column labeled (5) has a choice set of 6 hospitals within the 99th percentile of distance and the outside option.

Table 46: Estimation results - Choice set size

	Sepsis										
	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12	(13)	(14)	(15)
	Choice	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*
Distance (10km)	-0.927***	-0.887***	-0.759***	-0.768***	-0.784***	-0.746***	-0.634***	-0.576***	-0.574***	-0.522***	-0.522***
	(0.082)	(0.076)	(0.068)	(0.064)	(0.062)	(0.057)	(0.052)	(0.047)	(0.045)	(0.044)	(0.043)
Volume (1,000s)	0.140	0.160	0.168	0.148	0.177	0.176	0.152	0.166	0.155	0.178	0.156
	(0.143)	(0.141)	(0.139)	(0.137)	(0.136)	(0.133)	(0.132)	(0.130)	(0.129)	(0.128)	(0.127)
Occupancy (%)	-0.00328	-0.00396	-0.00406	-0.00365	-0.00485	-0.00595	-0.00593	-0.00570	-0.00637	-0.00692*	-0.00647*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Specialization - Sepsis (%)	0.171	0.202	0.250	0.251	0.255	0.152	0.223	0.219	0.315	0.342*	0.443**
	(0.231)	(0.225)	(0.219)	(0.215)	(0.211)	(0.205)	(0.200)	(0.195)	(0.191)	(0.190)	(0.188)
Mortality - Sepsis (%)	0.00176	0.00192	0.00244	0.00258	0.00270	0.00249	0.00306	0.00311	0.00292	0.00314	0.00352*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Readmission - Sepsis (%)	-0.00166	-0.00193	-0.00218	-0.00233	-0.00242	-0.00247	-0.00252	-0.00261	-0.00254	-0.00248	-0.00243
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
LOS - Sepsis (days)	-0.00211	-0.00243	-0.00170	-0.000708	0.000380	0.000818	0.00149	0.00255	0.00357	0.00191	0.00176
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)
ALC (days)	-0.0125	-0.0121	-0.0115	-0.0143	-0.0159	-0.0160	-0.0221	-0.0259	-0.0304*	-0.0310*	-0.0330*
	(0.020)	(0.020)	(0.020)	(0.020)	(0.019)	(0.019)	(0.019)	(0.019)	(0.018)	(0.018)	(0.018)
HSMR (%)	-0.0278	-0.0275	-0.0350*	-0.0252	-0.0247	-0.0243	-0.0221	-0.0233	-0.0245	-0.0248	-0.0247
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.017)	(0.017)	(0.017)	(0.016)	(0.016)	(0.016)
Patient characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	77,904	90,805	103,713	116,589	129,166	141,877	154,419	166,952	179,524	192,061	204,716
Pseudo R-squared	0.392	0.414	0.431	0.447	0.460	0.464	0.462	0.456	0.457	0.463	0.468
ll	-14,385.722	-15,081.751	-15,675.646	-16,107.017	-16,483.416	-17,045.942	-17,726.613	-18,493.292	-18,990.833	-19,282.664	-19,559.530

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with sepsis. Standard errors in parentheses. Size of choice set varies across rows from 5 to 15. The first column labeled (5) has a choice set of 5 hospitals within the 99th percentile of distance and the outside option.

Table 47: Estimation results - Choice set size

	Stroke										
	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12	(13)	(14)	(15)
	Choice	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*	*Choice*
Distance (10km)	-0.586***	-0.625***	-0.544***	-0.535***	-0.527***	-0.360***	-0.167***	-0.0980**	-0.116***	-0.0739**	-0.111***
	(0.088)	(0.076)	(0.067)	(0.062)	(0.057)	(0.051)	(0.045)	(0.041)	(0.038)	(0.037)	(0.036)
Volume (1,000s)	0.118	0.162*	0.134	0.147	0.139	0.167*	0.153*	0.184**	0.158*	0.174**	0.191**
	(0.100)	(0.099)	(0.097)	(0.096)	(0.095)	(0.093)	(0.092)	(0.090)	(0.089)	(0.088)	(0.088)
Occupancy (%)	-0.00420	-0.00606	-0.00771*	-0.00828**	-0.0101**	-0.0130***	-0.0130***	-0.0141***	-0.0158***	-0.0172***	-0.0177***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Specialization - Stroke (%)	0.759***	0.793***	0.793***	0.827***	0.839***	0.807***	0.833***	0.834***	0.817***	0.815***	0.835***
	(0.125)	(0.123)	(0.121)	(0.120)	(0.118)	(0.116)	(0.114)	(0.111)	(0.110)	(0.109)	(0.109)
Mortality - Stroke (%)	-0.00248	-0.00264	-0.00340	-0.00430	-0.00245	-0.00168	-0.00237	-0.00420	-0.00381	-0.00347	-0.00413
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Readmission - Stroke (%)	0.00446***	0.00421***	0.00415***	0.00405***	0.00417***	0.00409***	0.00399***	0.00390***	0.00374***	0.00371***	0.00381***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LOS - Stroke (days)	0.00832	0.00610	0.00539	0.00334	0.00109	-0.000824	-0.000334	-0.000990	-0.00111	-0.00176	-0.00148
	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
ALC (Days)	-0.0415**	-0.0521**	-0.0544***	-0.0569***	-0.0599***	-0.0622***	-0.0692***	-0.0701***	-0.0761***	-0.0757***	-0.0762***
	(0.021)	(0.021)	(0.020)	(0.020)	(0.020)	(0.020)	(0.019)	(0.019)	(0.019)	(0.019)	(0.018)
HSMR (%)	-0.0769***	-0.0724***	-0.0739***	-0.0734***	-0.0737***	-0.0694***	-0.0669***	-0.0648***	-0.0571***	-0.0553***	-0.0570***
	(0.016)	(0.016)	(0.016)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.014)	(0.014)	(0.014)
Patient characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	120,036	139,584	158,819	177,787	196,281	214,758	232,818	251,041	269,466	287,990	306398
Pseudo R-squared	0.383	0.407	0.417	0.432	0.440	0.443	0.442	0.435	0.429	0.433	0.436
ll	-22,654.077	-23,709.811	-24,909.271	-25,614.884	-26,441.657	-27,359.664	-28,361.703	-29,611.278	-30,777.904	-31,363.253	-31,917.040

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with stroke. Standard errors in parentheses. Size of choice set varies across rows from 5 to 15. The first column labeled (5) has a choice set of 6 hospitals within the 99th percentile of distance and the outside option.

Table 48: Estimation results - distance cutoff

	Pneumonia					
	(1)		(2)		(3)	
	Choice		*Choice*		*Choice*	
Distance (10km)	-0.963***	(0.030)	-1.775***	(0.064)	-1.271***	(0.045)
Volume (1,000s)	0.0938	(0.070)	0.0153	(0.082)	0.0309	(0.078)
Occupancy (%)	-0.00411**	(0.002)	0.000113	0.002)	-0.00143	(0.002)
Specialization - Pneumonia (%)	-0.222***	(0.036)	-0.180***	(0.044)	-0.147***	(0.040)
Mortality - Pneumonia (%)	-0.0153***	(0.004)	-0.0306***	(0.004)	-0.0281***	(0.004)
Readmission - Pneumonia (%)	0.000164	(0.003)	0.00802***	(0.003)	0.00599**	(0.002)
LOS - Pneumonia (days)	-0.00204	(0.005)	0.0266**	(0.012)	0.0265**	(0.011)
ALC (days)	-0.0115	(0.009)	-0.0528***	(0.012)	-0.0460***	(0.011)
HSMR (%)	-0.0141*	(0.009)	0.163***	(0.012)	0.165***	(0.011)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	576,964		518,398		541,974	
Pseudo R-squared	0.517		0.678		0.644	
ll	-61,331.529		-36,635.231		-42,673.631	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with Pneumonia. Standard errors in parentheses. Main specification Column (1). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported. The specification in Column (2) choice set size 10 closest hospitals within 90th percentile of distance by location. Column (3) choice set size 10 closest hospitals within 95th percentile of distance by location.

Table 49: Estimation results - distance cutoff

	Sepsis					
	(1)		(2)		(3)	
	Choice		*Choice*		*Choice*	
Distance (10km)	-0.746***	(0.057)	-1.077***	(0.091)	-0.824***	(0.073)
Volume (1,000s)	0.176	(0.133)	0.0348	(0.166)	0.119	(0.157)
Occupancy (%)	-0.00595	(0.004)	-0.00698	(0.005)	-0.00551	(0.005)
Specialization - Sepsis (%)	0.152	(0.205)	0.151	(0.243)	0.150	(0.231)
Mortality - Sepsis (%)	0.00249	(0.002)	-0.000361	(0.002)	0.00183	(0.002)
Readmission - Sepsis (%)	-0.00247	(0.002)	-0.00168	(0.002)	-0.00249	(0.002)
LOS - Sepsis (days)	0.000818	(0.006)	-0.00378	(0.014)	-0.00273	(0.014)
ALC (days)	-0.0160	(0.019)	-0.0668***	(0.024)	-0.0573**	(0.022)
HSMR (%)	-0.0243	(0.017)	0.142***	(0.019)	0.142***	(0.019)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	141,877		127,248		134,695	
Pseudo R-squared	0.464		0.630		0.609	
ll	-17,045.942		-10,565.826		-11,820.791	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with Sepsis. Standard errors in parentheses. Main specification Column (1). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported. The specification in Column (2) choice set size 10 closest hospitals within 90th percentile of distance by location. Column (3) choice set size 10 closest hospitals within 95th percentile of distance by location.

Table 50: Estimation results - distance cutoff

	Stroke					
	(1)		(2)		(3)	
	Choice		*Choice*		*Choice*	
Distance (10km)	-0.360***	(0.051)	-0.305***	(0.090)	-0.177**	(0.079)
Volume (1,000s)	0.167*	(0.093)	0.191	(0.119)	0.171	(0.116)
Occupancy (%)	-0.0130***	(0.004)	-0.0156***	(0.005)	-0.0162***	(0.004)
Specialization - Stroke (%)	0.807***	(0.116)	0.924***	(0.141)	0.906***	(0.135)
Mortality - Stroke (%)	-0.00168	(0.005)	-0.00129	(0.006)	0.00114	(0.005)
Readmission - Stroke (%)	0.00409***	(0.001)	0.00346***	(0.001)	0.00340***	(0.001)
LOS - Stroke (days)	-0.000824	(0.007)	-0.0213	(0.018)	-0.0383**	(0.017)
ALC (days)	-0.0622***	(0.020)	-0.129***	(0.025)	-0.114***	(0.024)
HSMR (%)	-0.0694***	(0.015)	0.181***	(0.028)	0.177***	(0.027)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	214,758		192,495		203,847	
Pseudo R-squared	0.443		0.626		0.610	
ll	-27,359.664		-16,473.471		-18,187,258	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Estimated coefficients of preferences of patients admitted with Stroke. Standard errors in parentheses. Main specification Column (1). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported. The specification in Column (2) choice set size 10 closest hospitals within 90th percentile of distance by location. Column (3) choice set size 10 closest hospitals within 95th percentile of distance by location.

Table 51: Estimation results - Robustness checks

	Pneumonia							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable	*Main*	*One condition*	*One visit*	*Visit number*	*Income quintile*	*No LOS*	*No spec.*	*Spec. interaction*
Distance (10km)	-0.963***	-0.977***	-0.968***	-0.828***	-0.913***	-0.963***	-0.955***	-0.955***
	(0.030)	(0.032)	(0.031)	(0.044)	(0.035)	(0.030)	(0.030)	(0.030)
Volume (1,000s)	0.0938	0.0789	0.0999	0.0945	0.103	0.0920	0.0985	0.161**
	(0.070)	(0.074)	(0.072)	(0.070)	(0.070)	(0.070)	(0.070)	(0.073)
Occupancy (%)	-0.00411**	-0.00253	-0.00423**	-0.00295	-0.00909***	-0.00351*	-0.00112	-0.00941***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Specialization - Pneumonia (%)	-0.222***	-0.202***	-0.214***	-0.257***	-0.178***	-0.231***	-	-
	(0.036)	(0.037)	(0.037)	(0.044)	(0.038)	(0.035)	-	-
Mortality - Pneumonia (%)	-0.0153***	-0.0178***	-0.0160***	-0.0183***	-0.00942**	-0.0152***	-0.0118***	-0.0153***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)
Readmission - Pneumonia (%)	0.000164	0.000522	-0.0000115	-0.00246	0.00197	0.000152	0.0000170	-0.00567
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
LOS - Pneumonia (days)	-0.00204	-0.00293	-0.00160	-0.00732	-0.00473	-	0.00120	-0.00960
	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	-	(0.005)	(0.007)
ALC (days)	-0.0115	-0.0120	-0.00712	0.00238	-0.00275	-0.0124	-0.0194**	-0.0177
	(0.009)	(0.010)	(0.009)	(0.011)	(0.010)	(0.009)	(0.009)	(0.018)
HSMR (%)	-0.0141*	-0.0173*	-0.0138	-0.0142	-0.0148*	-0.0144*	-0.0235***	-0.0115
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)
Patient characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	576,964	515,828	541,013	576,964	576,964	576,964	576,964	576,964
Pseudo R-squared	0.517	0.523	0.518	0.517	0.517	0.516	0.516	0.516
ll	-61,331.529	-54,099.268	-57,346.816	-61,314.635	-61,246.393	-61,344.856	-61,368.508	-61,359.606

Notes: * p <0.05 ** p <0.01 *** p <0.001. Estimated coefficients of preferences of patients admitted with pneumonia. Standard errors in parentheses. Main specification column (1). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported. Column (2) - (7): Patients with a single diagnosis during sample period, patients with a single hospital visit, additional patient interaction for visit number, additional patient interaction for income quintile of closest MSA, LOS omitted, specialization omitted and additional interaction for hospital specialization with condition specific variables.

Table 52: Estimation results - Robustness checks

	Sepsis							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable	*Main*	*One condition*	*One visit*	*Visit number*	*Income quintile*	*No LOS*	*No spec.*	*Spec. interaction*
Distance (10km)	-0.746***	-0.789***	-0.800***	-0.660***	-0.745***	-0.744***	-0.737***	-0.736***
	(0.057)	(0.064)	(0.060)	(0.070)	(0.065)	(0.057)	(0.057)	(0.057)
Volume (1,000s)	0.176	0.135	0.159	0.169	0.174	0.172	0.0717	0.197
	(0.133)	(0.152)	(0.141)	(0.133)	(0.133)	(0.133)	(0.130)	(0.145)
Occupancy (%)	-0.00595	-0.000550	-0.00746*	-0.00535	-0.0106**	-0.00605	-0.00676*	-0.00511
	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)
Specialization - Sepsis (%)	0.152	-0.00762	0.156	0.230	-0.00258	0.159	-	-
	(0.205)	(0.230)	(0.215)	(0.226)	(0.214)	(0.200)	-	-
Mortality - Sepsis (%)	0.00249	0.00197	0.00263	0.00122	0.00175	0.00270	0.00113	-0.00121
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Readmission - Sepsis (%)	-0.00247	-0.00178	-0.00214	-0.00256	-0.00242	-0.00247	-0.00294*	-0.00125
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
LOS - Sepsis (days)	0.000818	0.000972	0.000319	0.00109	0.00191	-	0.00737	0.00721
	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)	-	(0.006)	(0.007)
ALC (days)	-0.0160	-0.0233	-0.00314	-0.0271	-0.00588	-0.0154	-0.0192	-0.000676
	(0.019)	(0.022)	(0.020)	(0.020)	(0.020)	(0.019)	(0.019)	(0.030)
HSMR (%)	-0.0243	-0.0313	-0.0269	-0.0262	-0.0194	-0.0245	-0.0206	-0.00991
	(0.017)	(0.020)	(0.019)	(0.018)	(0.018)	(0.017)	(0.017)	(0.019)
Patient characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	141,877	109,080	124,222	141,877	141,877	141,877	141,877	141,877
Pseudo R-squared	0.464	0.468	0.463	0.464	0.465	0.464	0.463	0.463
ll	-17,045.942	-13,012.905	-14,959.964	-17,038.698	-17,028.387	-17,052.012	-17,078.536	-17,067.126

Notes: * p <0.05 ** p <0.01 *** p <0.001. Estimated coefficients of preferences of patients admitted with sepsis. Standard errors in parentheses. Main specification column (1). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported. Column (2) - (7): Patients with a single diagnosis during sample period, patients with a single hospital visit, additional patient interaction for visit number, additional patient interaction for income quintile of closest MSA, LOS omitted, specialization omitted and additional interaction for hospital specialization with condition specific variables.

Table 53: Estimation results - Robustness checks

	Stroke							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable	*Main*	*One condition*	*One visit*	*Visit number*	*Income quintile*	*No LOS*	*No spec.*	*Spec. interaction*
Distance (10km)	-0.360***	-0.356***	-0.354***	-0.293***	-0.307***	-0.360***	-0.297***	-0.299***
	(0.051)	(0.053)	(0.052)	(0.060)	(0.054)	(0.051)	(0.050)	(0.050)
Volume (1,000s)	0.167*	0.156	0.196**	0.175*	0.170*	0.163*	0.182*	0.171*
	(0.093)	(0.098)	(0.096)	(0.094)	(0.094)	(0.093)	(0.093)	(0.095)
Occupancy (%)	-0.0130***	-0.0123***	-0.0150***	-0.0145***	-0.0181***	-0.0129***	-0.0219***	-0.0221***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Specialization - Stroke (%)	0.807***	0.872***	0.783***	0.864***	0.739***	0.809***	-	-
	(0.116)	(0.121)	(0.120)	(0.128)	(0.120)	(0.116)	-	-
Mortality - Stroke (%)	-0.00168	-0.00157	-0.00295	-0.00102	-0.000269	-0.00171	-0.0158***	-0.0143**
	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)
Readmission - Stroke (%)	0.00409***	0.00397***	0.00392***	0.00427***	0.00414***	0.00410***	0.00244***	0.00272***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LOS - Stroke (days)	-0.000824	0.00279	-0.00316	-0.00301	-0.000941	-	-0.00567	-0.00850
	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)	-	(0.007)	(0.008)
ALC (days)	-0.0622***	-0.0722***	-0.0592***	-0.0704***	-0.0455**	-0.0632***	-0.0425**	-0.0108
	(0.020)	(0.021)	(0.020)	(0.021)	(0.020)	(0.019)	(0.019)	(0.023)
HSMR (%)	-0.0694***	-0.0723***	-0.0686***	-0.0693***	-0.0656***	-0.0696***	-0.0446***	-0.0398**
	(0.015)	(0.016)	(0.016)	(0.015)	(0.015)	(0.015)	(0.015)	(0.017)
Patient characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	214,758	194,889	201,218	214,758	214,758	214,758	214,758	214,758
Pseudo R-squared	0.443	0.442	0.443	0.443	0.444	0.443	0.441	0.441
ll	-27,359.664	-24853.262	-25,634.178	-27,352.334	-27,324.455	-27,361.397	-27,471.520	-27,464.060

Notes: * p <0.05 ** p <0.01 *** p <0.001. Estimated coefficients of preferences of patients admitted with stroke. Standard errors in parentheses. Main specification column (1). All hospital characteristics lagged. Choice set size 10 closest hospitals within 99th percentile of distance by location. Fixed effects and patient interactions included but not reported. Column (2) - (7): Patients with a single diagnosis during sample period, patients with a single hospital visit, additional patient interaction for visit number, additional patient interaction for income quintile of closest MSA, LOS omitted, specialization omitted and additional interaction for hospital specialization with condition specific variables.

Table 54: Counterfactuals - Share of patients impacted by the restructuring

	Closure	Merger	Merger (no closure)	Unchanged	Obs.
			Pneumonia		
All	0.634	0.862	0.357	0.138	53,364
Urban	0.792	0.938	0.145	0.062	33,804
Suburban	0.429	0.715	0.285	0.285	13,132
Rural	0.291	0.786	0.495	0.215	6,428
			Sepsis		
All	0.660	0.869	0.199	0.131	13,585
Urban	0.795	0.917	0.122	0.083	9,713
Suburban	0.381	0.723	0.342	0.277	2,750
Rural	0.287	0.804	0.517	0.196	1,122
			Stroke		
All	0.696	0.893	0.197	0.107	21,374
Urban	0.796	0.929	0.133	0.071	15,934
Suburban	0.523	0.998	0.475	0.002	3,733
Rural	0.391	0.966	0.575	0.034	1,566

Table 55: Counterfactual 1 - Short-run welfare impact of hospital mergers

Variable	Obs.	Mean	Median	S.d.	Min	Max
			Pneumonia			
Overall						
Average welfare δ_i (%)	53,363	-0.034	-0.002	0.087	-2.640	0.000
Site closure(s) in choice set						
Average welfare δ_i (%)	34,311	-0.052	-0.023	0.104	-2.640	0.000
Share patient worse off	0.635					
			Sepsis			
Overall						
Average welfare δ_i (%)	13,585	-0.035	-0.005	0.084	-3.456	0.000
Site closure(s) in choice set						
Average welfare δ_i (%)	9,092	-0.052	-0.022	0.098	-3.456	0.000
Share patient worse off	0.660					
			Stroke			
Overall						
Average welfare δ_i (%)	21,374	-0.037	-0.009	0.074	-5.167	0.000
Site closure(s) in choice set						
Average welfare δ_i (%)	14,883	-0.045	-0.026	0.086	-5.167	0.000
Share patient worse off	0.690					

Notes: The short-run welfare change calculated using McFadden (1996)'s logsum change in consumer welfare.

Table 56: Counterfactual 1 - Short-run welfare impact of hospital mergers by location

Variable	Obs.	Mean	Median	S.d.	Min	Max
			Pneumonia			
Overall						
Rural	6,428	-0.053	0.000	0.185	-1.557	0.000
Suburban	13,132	-0.019	0.000	0.072	-0.771	0.000
Urban	33,804	-0.033	-0.013	0.051	-0.427	0.000
Site closure(s) in choice set						
Rural	1,885	-0.183	-0.038	0.308	-1.557	0.000
Suburban	5,640	-0.045	-0.005	0.104	-0.771	0.000
Urban	26,792	-0.043	-0.025	0.054	-0.427	0.000
			Sepsis			
Overall						
Rural	1,122	-0.051	0.000	0.171	-1.101	0.000
Suburban	2,750	-0.015	0.000	0.047	-0.576	0.000
Urban	9,713	-0.036	-0.011	0.059	-0.490	0.000
Site closure(s) in choice set						
Rural	322	-0.188	-0.072	0.287	-1.101	-0.000
Suburban	1,047	-0.039	-0.006	0.070	-0.576	0.000
Urban	7,723	-0.045	-0.033	0.063	-0.490	0.000
			Stroke			
Overall						
Rural	1,566	-0.033	0.000	0.070	-0.479	0.000
Suburban	3,733	-0.026	0.000	0.080	-1.669	0.000
Urban	15,934	-0.029	-0.014	0.039	-0.336	0.000
Site closure(s) in choice set						
Rural	612	-0.084	-0.064	0.091	-0.479	-0.000
Suburban	1,952	-0.063	-0.039	0.115	-1.669	0.000
Urban	12,678	-0.036	-0.024	0.040	-0.336	0.000

Table 57: Counterfactual 1 - Decomposition of short-run welfare change

	Pneumonia			
	Overall		*Closure in choice set*	
	δ_i		δ_i	
Δ Distance	-0.245***	(0.002)	-0.248***	(0.003)
Δ Volume	-0.0202***	(0.001)	0.0124***	(0.001)
Δ HSMR	0.0111***	(0.000)	0.00687***	(0.000)
Δ Occupancy	-0.00274***	(0.000)	-0.00829***	(0.000)
Δ ALC	-0.0291***	(0.001)	-0.0349***	(0.001)
Δ Mortality - Pneumonia	0.000617***	(0.000)	-0.000759***	(0.000)
Δ Readmission - Pneumonia	-0.00719***	(0.000)	-0.00380***	(0.001)
Δ Specialization - Pneumonia	0.0793***	(0.002)	0.106***	(0.003)
Δ LOS - Pneumonia	0.0130***	(0.000)	0.00599***	(0.001)
Constant	-0.0221***	(0.000)	-0.0626***	(0.001)
Observations	53,363		34,316	
Adjusted R-squared	0.235		0.237	

Notes: * p <0.10 ** p <0.05 *** p <0.01. Standard errors in parentheses. Welfare decomposition using a first difference regression of welfare on hospital characteristics. The difference in characteristics is taken between the average post-merger hospital characteristic and the average pre-merger hospital characteristics for hospitals in the choice set.

Table 58: Counterfactual 1 - Decomposition of short-run welfare change

	Sepsis			
	Overall		*Closure in choice set*	
	δ		δ	
Δ Distance	-0.205***	(0.004)	-0.215***	(0.005)
Δ Volume	-0.0228***	(0.002)	0.00230	(0.002)
Δ HSMR	0.0102***	(0.001)	0.00380***	(0.001)
Δ Occupancy	-0.000652*	(0.000)	-0.00478***	(0.000)
Δ ALC	-0.00799***	(0.001)	-0.0144***	(0.002)
Δ Mortality - Sepsis	0.0000469	(0.000)	-0.000443***	(0.000)
Δ Readmission - Sepsis	-0.000276**	(0.000)	-0.000921***	(0.000)
Δ Specialization - Sepsis	0.0440**	(0.019)	0.0808***	(0.022)
Δ LOS - Sepsis	-0.00472***	(0.001)	-0.00379***	(0.001)
Constant	-0.0256***	(0.001)	-0.0633***	(0.002)
Observations	13,585		9,092	
Adjusted R-squared	0.164		0.169	

Notes: * p <0.10 ** p <0.05 *** p <0.01. Standard errors in parentheses. Welfare decomposition using a first difference regression of welfare on hospital characteristics. The difference in characteristics is taken between the average post-merger hospital characteristic and the average pre-merger hospital characteristics for hospitals in the choice set.

Table 59: Counterfactual 1 - Decomposition of short-run welfare change

	Stroke			
	Overall		*Closure in choice set*	
	δ		δ	
Δ Distance	-0.161***	(0.003)	-0.154***	(0.004)
Δ Volume	0.000643	(0.001)	0.0153***	(0.002)
Δ HSMR	-0.000657*	(0.000)	-0.00522***	(0.000)
Δ Occupancy	-0.00334***	(0.000)	-0.00600***	(0.000)
Δ ALC	0.000653	(0.001)	-0.00282*	(0.002)
Δ Mortality - Stroke	-0.00896***	(0.000)	-0.00518***	(0.000)
Δ Readmission - Stroke	-0.000147***	(0.000)	-0.0000576***	(0.000)
Δ Specialization - Stroke	-0.0422***	(0.016)	0.0266	(0.018)
Δ LOS - Stroke	0.00662***	(0.000)	0.00223***	(0.000)
Constant	-0.0251***	(0.001)	-0.0552***	(0.001)
Observations	21,374		14,883	
Adjusted R-squared	0.150		0.163	

Notes: * p <0.10 ** p <0.05 *** p <0.01.Standard errors in parentheses. Welfare decomposition using a first difference regression of welfare on hospital characteristics. The difference in characteristics is taken between the average post-merger hospital characteristic and the average pre-merger hospital characteristics for hospitals in the choice set.

Table 60: Counterfactual 1 - Decomposition of short-run welfare change by patient characteristics

	Pneumonia			
	Overall		*Closure in choice set*	
	δ_i		δ_i	
Urban patient	-0.00981***	(0.001)	0.00698***	(0.001)
Rural patient	-0.0291***	(0.001)	-0.133***	(0.003)
Male	0.00154*	(0.001)	-0.000819	(0.001)
Age	0.000160***	(0.000)	0.0000832**	(0.000)
Health status	0.0000279	(0.000)	0.000168***	(0.000)
Constant	-0.0362***	(0.001)	-0.0581***	(0.002)
Observations	53,363		34,316	
Adjusted R-squared	0.009		0.088	

Notes: * p <0.05 ** p <0.01 *** p <0.001. Standard errors in parentheses. Regression of the welfare change on patient characteristics.

Table 61: Counterfactual 1 - Decomposition of short-run welfare change by patient characteristics

	Sepsis			
	Overall		*Closure in choice set*	
	δ_i		δ_i	
Urban patient	-0.0143***	(0.002)	0.00480	(0.003)
Rural patient	-0.0284***	(0.003)	-0.137***	(0.007)
Male	0.00329*	(0.001)	0.00187	(0.002)
Age	0.0000848*	(0.000)	-0.0000245	(0.000)
Health status	0.000428***	(0.000)	0.000622***	(0.000)
Constant	-0.0389***	(0.002)	-0.0639***	(0.003)
Observations	13,585		9,092	
Adjusted R-squared	0.011		0.064	

Notes: * p <0.05 ** p <0.01 *** p <0.001. Standard errors in parentheses. Regression of the welfare change on patient characteristics.

Table 62: Counterfactual 1 - Decomposition of short-run welfare change by patient characteristics

	Stroke			
	Overall		*Closure in choice set*	
	δ_i		δ_i	
Urban patient	0.0000738	(0.001)	0.0284***	(0.002)
Rural patient	-0.00451	(0.003)	-0.0192***	(0.005)
Male	0.00685***	(0.001)	0.00754***	(0.001)
Age	0.000112***	(0.000)	-0.0000502	(0.000)
Health status	0.000141*	(0.000)	0.000161*	(0.000)
Constant	-0.0431***	(0.001)	-0.0682***	(0.002)
Observations	21,374		14,883	
Adjusted R-squared	0.007		0.030	

Notes: * p <0.05 ** p <0.01 *** p <0.001. Standard errors in parentheses. Regression of the welfare change on patient characteristics.

Table 63: Descriptive Statistics - Pre-merger and post merger hospital characteristics

				Pneumonia				
	1994		*1995*		*2005*		*Differences*	
Variable	Mean	S.d.	Mean	S.d.	Mean	S.d.	(1994-2005)	(1995-2005)
Teaching status	0.153	0.361	0.162	0.370	0.133	0.341	0.02	0.029
ALC (days)	7.014	5.406	8.841	7.107	12.094	7.962	-5.08***	-3.253***
HSMR(%)	100.169	3.161	100.376	4.816	104.182	38.795	-4.013	-3.806
Occupancy (%)	78.726	25.118	75.414	25.435	80.754	22.028	-2.028	-5.34**
Volume (1,000s)	5.117	5.570	5.315	5.713	5.106	5.707	0.011	0.209
Specialization - Pneumonia (%)	3.904	1.765	3.564	1.555	4.119	3.029	-0.215	-0.555**
Mortality - Pneumonia (%)	21.309	12.447	22.405	13.063	24.110	15.388	-2.801*	-1.705
Readmission - Pneumonia (%)	8.504	26.095	19.125	71.323	7.124	15.763	1.38	12.001**
LOS - Pneumonia (days)	11.559	8.713	11.657	8.092	12.200	9.010	-0.641	-0.543
Urban site	0.379	0.486	0.384	0.488	0.361	0.482	0.018	0.023
Suburban site	0.282	0.451	0.281	0.451	0.259	0.440	0.023	0.022
Rural site	0.339	0.475	0.335	0.473	0.380	0.487	-0.041	-0.045
Obs.	177		185		158			
				Sepsis				
Teaching status	0.170	0.377	0.174	0.380	0.151	0.359	0.019	0.023
ALC (days)	7.140	5.409	8.567	6.387	12.159	7.769	-5.019***	-3.592***
HSMR(%)	100.226	2.778	100.519	4.358	101.100	3.630	-0.874**	-0.581
Occupancy (%)	81.443	23.598	78.215	23.933	82.653	15.765	-1.21	-4.438*
Volume (1,000s)	5.620	5.668	5.921	6.176	5.803	5.836	-0.183	0.118
Specialization - Sepsis (%)	0.702	0.410	0.683	0.393	1.217	1.310	-0.515***	-0.534***
Mortality - Sepsis (%)	38.259	59.636	35.292	46.745	38.063	34.095	0.196	-2.771
Readmission - Sepsis (%)	27.999	86.013	37.197	165.960	42.665	250.325	-14.666	-5.468
LOS - Sepsis (days)	13.036	10.714	15.118	18.448	14.929	15.385	-1.893	0.189
Urban site	0.415	0.494	0.413	0.494	0.403	0.492	0.012	0.01
Suburban site	0.302	0.461	0.299	0.459	0.281	0.451	0.021	0.018
Rural site	0.283	0.452	0.287	0.454	0.317	0.467	-0.034	-0.03
Obs.	159		167		139			
				Stroke				
Teaching status	0.159	0.367	0.161	0.369	0.139	0.347	0.02	0.022
ALC (days)	7.355	5.487	8.886	6.858	12.135	7.894	-4.78***	-3.249***
HSMR(%)	100.270	2.613	100.164	2.771	101.909	11.500	-1.639*	-1.745*
Occupancy (%)	83.002	23.049	78.619	24.197	82.128	21.175	0.874	-3.509
Volume (1,000s)	5.803	5.697	5.927	5.773	5.364	5.775	0.439	0.563
Specialization - Stroke (%)	0.845	0.681	0.912	0.790	1.866	1.860	-1.021***	-0.954***
Mortality - Stroke (%)	31.313	40.826	31.229	41.586	33.774	30.778	-2.461	-2.545
Readmission - Stroke (%)	24.346	52.780	51.730	178.967	26.962	123.388	-2.616	24.768
LOS - Stroke (days)	15.740	12.807	16.215	15.822	33.456	136.754	-17.716	-17.241
Urban site	0.417	0.495	0.416	0.494	0.377	0.486	0.04	0.039
Suburban site	0.311	0.465	0.311	0.464	0.258	0.439	0.053	0.053
Rural site	0.272	0.446	0.273	0.447	0.364	0.483	-0.092	-0.091
Obs.	151		161		151			

Notes: * p <0.10 ** p <0.05 *** p <0.01. Only hospitals that treat pneumonia, sepsis or stroke patients observed in our data included.

Table 64: Counterfactual 2 - Long-run welfare impact of hospital mergers

			Pneumonia			
Variable	Obs.	Mean	Median	S.d.	Min	Max
Overall						
Average welfare δ_i (%)	53,364	0.134	-0.024	1.790	-2.661	126.084
Site closure(s) in choice set						
Average welfare δ_i (%)	34,317	0.168	-0.043	2.200	-2.661	126.084
Merger(s) (including closures) in choice set						
Average welfare δ_i (%)	45,993	0.139	-0.025	1.920	-2.661	126.084
Share patient worse off	0.680					
			Sepsis			
Overall						
Average welfare δ_i (%)	13,585	-0.094	-0.096	0.271	-3.211	5.412
Site closure(s) in choice set						
Average welfare δ_i (%)	9,092	-0.085	-0.095	0.196	-3.211	2.211
Merger(s) (including closures) in choice set						
Average welfare δ_i (%)	11,799	-0.071	-0.080	0.250	-3.211	5.412
Share patient worse off	0.758					
			Stroke			
Overall						
Average welfare δ_i (%)	21,374	0.122	-0.017	0.591	-2.428	10.424
Site closure(s) in choice set						
Average welfare δ_i (%)	14,883	0.014	-0.027	0.386	-2.241	8.027
Merger(s) (including closures) in choice set						
Average welfare δ_i (%)	19,096	0.042	-0.024	0.461	-2.428	9.389
Share patient worse off	0.736					

Notes: The long-run welfare change calculated using McFadden (1996)'s logsum change in consumer welfare. Hospital characteristics of 2005 used as post-merger characteristics.

Table 65: Counterfactual 2 - Long-run welfare impact of hospital mergers by location

			Pneumonia			
Variable	Obs.	Mean	Median	S.d.	Min	Max
Overall						
Rural	6,428	0.199	-0.019	2.995	-2.066	105.238
Suburban	13,132	0.204	0.012	2.072	-0.896	126.084
Urban	33,804	0.107	-0.033	1.372	-0.421	32.980
Site closure(s) in choice set						
Rural	1,885	0.583	-0.078	5.477	-1.244	105.238
Suburban	5,640	0.263	-0.027	3.078	-0.886	126.084
Urban	26,792	0.136	-0.042	1.547	-0.421	32.980
Merger(s) in choice set (including closures)						
Rural	4,897	0.254	-0.024	3.446	-1.244	105.238
Suburban	9,389	0.194	-0.003	2.429	-0.886	126.084
Urban	31,701	0.119	-0.029	1.419	-0.421	32.980
			Sepsis			
Overall						
Rural	1,122	-0.141	-0.129	0.394	-2.243	2.017
Suburban	2,750	-0.098	-0.103	0.455	-2.484	5.412
Urban	9,713	-0.093	-0.097	0.156	-0.762	0.876
Site closure(s) in choice set						
Rural	322	-0.301	-0.264	0.342	-1.414	0.608
Suburban	1,047	-0.062	-0.076	0.347	-1.596	2.211
Urban	7,723	-0.083	-0.096	0.139	-0.502	0.539
Merger(s) in choice set (including closures)						
Rural	902	-0.125	-0.108	0.387	-2.243	2.017
Suburban	1,987	-0.060	-0.074	0.456	-2.484	5.412
Urban	8,910	-0.072	-0.082	0.138	-0.502	0.544
			Stroke			
Overall						
Rural	1,566	0.140	-0.134	0.916	-2.150	10.424
Suburban	3,733	0.538	0.207	1.098	-1.123	9.389
Urban	15,934	0.024	-0.022	0.219	-0.450	2.601
Site closure(s) in choice set						
Rural	612	0.122	-0.006	0.839	-2.150	4.796
Suburban	1,952	0.250	0.053	0.954	-1.123	8.027
Urban	12,678	-0.024	-0.030	0.109	-0.445	1.020
Merger(s) in choice set (including closures)						
Rural	1,513	-0.002	-0.161	0.675	-2.150	4.796
Suburban	3,725	0.335	0.103	0.987	-1.123	9.389
Urban	14,795	-0.016	-0.027	0.119	-0.445	1.371

Table 66: Counterfactual 2 - Decomposition of long-run welfare change

	Pneumonia					
	Overall		*Closure in choice set*		*Merger in choice set*	
	δ		δ		δ	
Δ Distance	-0.305***	(0.049)	-0.289***	(0.060)	-0.303***	(0.053)
Δ Volume	-0.389***	(0.020)	-0.528***	(0.028)	-0.406***	(0.022)
Δ HSMR	0.00312	(0.007)	0.0212**	(0.009)	0.00528	(0.008)
Δ Occupancy	0.0129***	(0.005)	0.0366***	(0.006)	0.0157***	(0.005)
Δ ALC	-0.461***	(0.018)	-0.436***	(0.022)	-0.458***	(0.019)
Δ Mortality - Pneumonia	-0.0424***	(0.004)	-0.0365***	(0.005)	-0.0417***	(0.004)
Δ Readmission - Pneumonia	0.115***	(0.011)	0.101***	(0.014)	0.114***	(0.012)
Δ Specialization - Pneumonia	1.566***	(0.052)	1.453***	(0.065)	1.553***	(0.056)
Δ LOS - Pneumonia	0.0873***	(0.011)	0.117***	(0.014)	0.0909***	(0.012)
Constant	0.169***	(0.010)	0.343***	(0.021)	0.190***	(0.013)
Observations	53,363		34,316		45,992	
Adjusted R-squared	0.038		0.041		0.039	

Notes: * p <0.10 ** p <0.05 *** p <0.01. Standard errors in parentheses. Welfare decomposition using a first difference regression of welfare on hospital characteristics. The difference in characteristics is taken between the average post-merger hospital characteristic and the average pre-merger hospital characteristics for hospitals in the choice set.

Table 67: Counterfactual 2 - Decomposition of long-run welfare change

	Sepsis					
	Overall		*Closure in choice set*		*Merger in choice set*	
	δ		δ		δ	
Δ Distance	-0.0814***	(0.015)	-0.0703***	(0.010)	-0.0681***	(0.014)
Δ Volume	-0.0449***	(0.007)	-0.0727***	(0.005)	-0.0781***	(0.006)
Δ HSMR	0.00126	(0.002)	0.00835***	(0.001)	0.00974***	(0.002)
Δ Occupancy	-0.0166***	(0.001)	-0.0121***	(0.001)	-0.0112***	(0.001)
Δ ALC	-0.0373***	(0.005)	-0.0302***	(0.003)	-0.0288***	(0.005)
Δ Mortality - Sepsis	-0.00153***	(0.000)	-0.000991***	(0.000)	-0.000885**	(0.000)
Δ Readmission - Sepsis	0.00291***	(0.000)	0.00363***	(0.000)	0.00377***	(0.000)
Δ Specialization - Sepsis	-0.471***	(0.066)	-0.512***	(0.044)	-0.520***	(0.060)
Δ LOS - Sepsis	0.0142***	(0.002)	0.0132***	(0.001)	0.0130***	(0.002)
Constant	-0.0857***	(0.003)	-0.0439***	(0.003)	-0.0358***	(0.003)
Observations	13,585		9,092		11,799	
Adjusted R-squared	0.058		0.183		0.096	

Notes: * p <0.10 ** p <0.05 *** p <0.01. Standard errors in parentheses. Welfare decomposition using a first difference regression of welfare on hospital characteristics. The difference in characteristics is taken between the average post-merger hospital characteristic and the average pre-merger hospital characteristics for hospitals in the choice set.

Table 68: Counterfactual 2 - Decomposition of long-run welfare change

	Stroke					
	Overall		*Closure in choice set*		*Merger in choice set*	
	δ		δ		δ	
Δ Distance	-0.446***	(0.028)	-0.412***	(0.018)	-0.417***	(0.022)
Δ Volume	-0.275***	(0.012)	-0.199***	(0.008)	-0.211***	(0.009)
Δ HSMR	0.0409***	(0.003)	0.0174***	(0.002)	0.0210***	(0.002)
Δ Occupancy	0.0390***	(0.003)	0.0253***	(0.002)	0.0274***	(0.002)
Δ ALC	-0.00981	(0.011)	-0.0277***	(0.007)	-0.0250***	(0.009)
Δ Mortality - Stroke	-0.0132***	(0.003)	0.00628***	(0.002)	0.00331	(0.002)
Δ Readmission - Stroke	-0.000849***	(0.000)	-0.000389***	(0.000)	-0.000459***	(0.000)
Δ Specialization - Stroke	-1.393***	(0.134)	-1.038***	(0.087)	-1.092***	(0.105)
Δ LOS - Stroke	0.0354***	(0.003)	0.0127***	(0.002)	0.0162***	(0.003)
Constant	0.241***	(0.005)	0.0860***	(0.005)	0.110***	(0.005)
Observations	21,374		14,883		19,096	
Adjusted R-squared	0.071		0.090		0.060	

Notes: * p <0.10 ** p <0.05 *** p <0.01. Standard errors in parentheses. Welfare decomposition using a first difference regression of welfare on hospital characteristics. The difference in characteristics is taken between the average post-merger hospital characteristic and the average pre-merger hospital characteristics for hospitals in the choice set.

Table 69: Counterfactual 2 - Decomposition of long-run welfare change by patient characteristics

	Pneumonia					
	Overall		*Closure in choice set*		*Merger in choice set*	
	δ_i		δ_i		δ_i	
Urban patient	-0.138***	(0.018)	-0.202***	(0.031)	-0.131***	(0.022)
Rural patient	0.0192	(0.027)	0.306***	(0.059)	0.0621	(0.034)
Male	-0.0259	(0.016)	-0.0461	(0.024)	-0.0364*	(0.018)
Age	-0.00306***	(0.000)	-0.00290***	(0.001)	-0.00274***	(0.000)
Health status	0.0241***	(0.001)	0.0327***	(0.001)	0.0260***	(0.001)
Constant	0.0425	(0.023)	-0.0235	(0.034)	-0.000313	(0.026)
Observations	53,363		34,316		45,992	
Adjusted R-squared	0.022		0.029		0.022	

Notes: * p <0.05 ** p <0.01 *** p <0.001. Standard errors in parentheses. Regression of the welfare change on patient characteristics.

Table 70: Counterfactual 2 - Decomposition of long-run welfare change by patient characteristics

	Sepsis					
	Overall		*Closure in choice set*		*Merger in choice set*	
	δ_i		δ_i		δ_i	
Urban	0.0289***	(0.006)	0.00156	(0.006)	0.0146*	(0.006)
Rural	-0.0148	(0.010)	-0.212***	(0.013)	-0.0341**	(0.011)
Male	0.0109*	(0.005)	0.0108**	(0.004)	0.0193***	(0.005)
Age	-0.00216***	(0.000)	-0.00132***	(0.000)	-0.00194***	(0.000)
Health status	0.00177***	(0.000)	0.00184***	(0.000)	0.00224***	(0.000)
Constant	-0.0207***	(0.006)	-0.0419***	(0.005)	-0.0146*	(0.006)
Observations	13,585		9,092		11,799	
Adjusted R-squared	0.031		0.058		0.032	

Notes: * p <0.05 ** p <0.01 *** p <0.001. Standard errors in parentheses. Regression of the welfare change on patient characteristics.

Table 71: Counterfactual 2 - Decomposition of long-run welfare change by patient characteristics

	Stroke					
	Overall		*Closure in choice set*		*Merger in choice set*	
	δ_i		δ_i		δ_i	
Urban patient	-0.415***	(0.011)	-0.220***	(0.010)	-0.290***	(0.010)
Rural patient	-0.302***	(0.020)	-0.0764***	(0.021)	-0.278***	(0.017)
Male	0.0645***	(0.008)	0.0321***	(0.007)	0.0440***	(0.007)
Age	0.00220***	(0.000)	0.00153***	(0.000)	0.00184***	(0.000)
Health status	-0.000245	(0.000)	-0.000909**	(0.000)	-0.000777*	(0.000)
Constant	0.253***	(0.010)	0.0873***	(0.008)	0.134***	(0.008)
Observations	21,374		14,883		19,096	
Adjusted R-squared	0.069		0.036		0.051	

Notes: * p <0.05 ** p <0.01 *** p <0.001. Standard errors in parentheses. Regression of the welfare change on patient characteristics.

Figure 18: Distributions of long-run welfare- Pneumonia

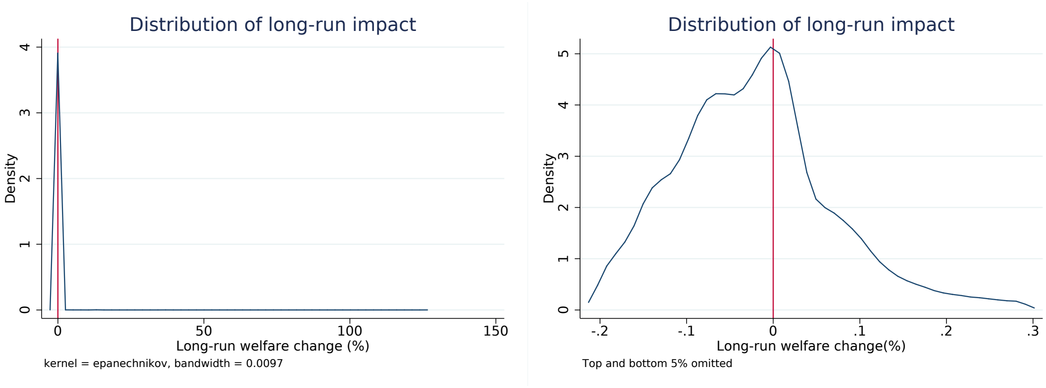


Figure 19: Distributions of long-run welfare - Sepsis

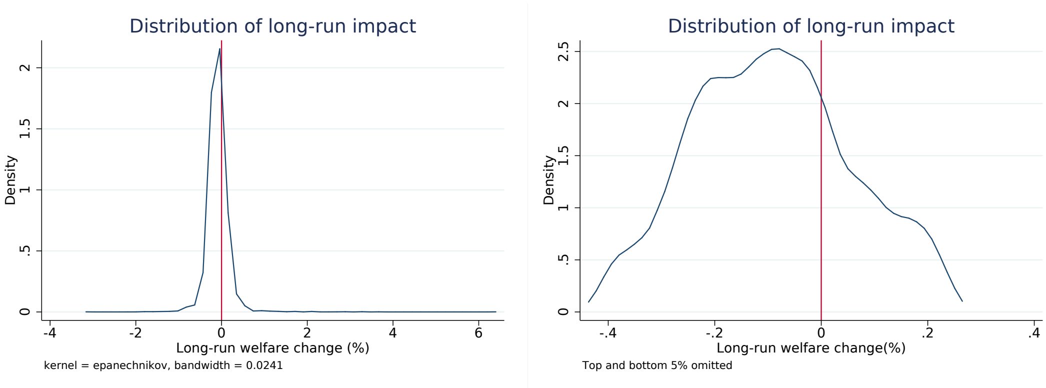


Figure 20: Distributions of long-run welfare - Stroke

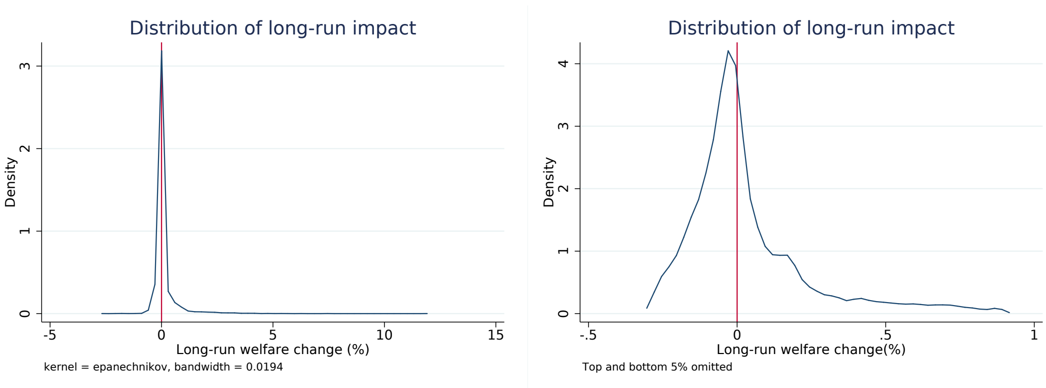


Table 72: Counterfactual 2 - Decomposition of quality changes

	Pneumonia-specific quality measures							
	Contributions in percentage points				*Contributions in share of total*			
	Mortality	Readmission	Specialization	LOS	Mortality	Readmission	Specialization	LOS
Total change	0.805	0.173	0.601	-0.362	1.00	1.00	1.00	1.00
Within	1.184	0.756	-0.015	-0.006	1.472	4.379	-0.025	0.015
Between	0.230	-1.479	-0.169	0.265	0.286	-8.564	-0.281	-0.732
Cross	-0.540	-0.658	0.788	-0.324	-0.671	-3.809	1.310	0.896
Closures	-0.070	-1.553	0.002	0.297	0.087	-8.994	0.004	-0.821
	Sepsis-specific quality measures							
Total change	4.009	3.367	0.545	-1.421	1.00	1.00	1.00	1.00
Within	5.212	3.643	0.307	-0.871	1.30	1.082	0.563	0.613
Between	-0.853	0.599	-0.042	-0.496	-0.213	0.178	-0.077	0.349
Cross	-0.498	-4.806	0.311	0.080	-0.124	-1.427	0.570	-0.057
Closures	-0.148	-3.930	0.030	0.134	-0.037	-1.167	0.056	-0.094
	Stroke-specific quality measures							
Total change	2.626	5.109	1.135	-2.621	1.00	1.00	1.00	1.00
Within	2.011	1.127	0.064	-2.441	0.766	0.221	0.056	0.932
Between	5.588	5.080	-0.299	-1.237	2.128	0.994	-0.263	0.472
Cross	-5.769	-4.509	1.400	1.037	-2.197	-0.883	1.233	-0.396
Closures	-0.796	-3.411	0.030	-0.020	-0.303	-0.668	0.026	0.008

Notes: Quality decomposition as in Chandra et al. (2016).

Table 73: Descriptive Statistics - Hospital Measures

	Pneumonia								
	Mortality (%)			*Readmission (%)*			*LOS (days)*		
Measure	Obs.	Mean	S.d	Obs.	Mean	S.d	Obs.	Mean	S.d
Raw	354	19.71	8.48	354	0.25	0.16	354	11.25	4.11
Standardized	354	24.41	57.51	354	8.49	97.20	354	11.35	8.23
IV-selection	354	43.80	58.65	354	23.86	322.82	354	10.72	8.02
	Sepsis								
Raw	318	28.39	19.68	318	0.25	1.51	318	13.65	7.88
Standardized	318	45.16	155.20	318	8.84	84.59	318	13.99	15.55
IV-selection	318	87.99	226.92	318	29.38	294.69	318	13.42	20.05
	Stroke								
Raw	296	22.96	17.03	296	0.84	3.89	296	15.88	8.47
Standardized	296	30.78	37.60	296	22.00	223.78	296	17.12	16.37
IV-selection	296	109.45	407.37	296	52.73	535.63	296	17.87	19.95

Table 74: Difference in means test between Standardized and IV-selection measures

	Difference (STD. – IV)	P-value
	Pneumonia	
Mortality (%)	-19.39***	0.000
Readmission (%)	-15.37	0.3914
LOS(days)	0.63	0.303
	Sepsis	
Mortality (%)	-42.83***	0.001
Readmission (%)	-20.54	0.233
LOS(days)	0.57	0.689
	Stroke	
Mortality (%)	-78.67***	0.001
Readmission (%)	-30.73	0.363
LOS(days)	-0.75	0.617

Table 75: Estimation results - controlling for selection

	Pneumonia					
	Main		Raw		IV	
Variable	*Choice*		*Choice*		*Choice*	
Distance (10km)	-0.963***	(0.030)	-0.993***	(0.034)	-1.045***	(0.039)
Volume (1,000s)	0.0938	(0.070)	-0.338***	(0.077)	0.145*	(0.076)
Occupancy (%)	-0.00411**	(0.002)	0.0254***	(0.002)	-0.00510**	(0.002)
Specialization - Pneumonia (%)	-0.222***	(0.036)	-0.454***	(0.037)	-0.228***	(0.039)
Mortality - Pneumonia (%)	-0.0153***	(0.004)	0.111***	(0.006)	-0.00234*	(0.001)
Readmission - Pneumonia (%)	0.000164	(0.003)	0.0848***	(0.019)	0.00236	(0.002)
LOS - Pneumonia (days)	-0.00204	(0.005)	0.237***	(0.010)	0.000498	(0.005)
ALC (days)	-0.0115	(0.009)	-0.129***	(0.010)	-0.0348***	(0.010)
HSMR (%)	-0.0141*	(0.009)	0.00396	(0.009)	0.0569***	(0.020)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	576,964		576,964		464,791	
Pseudo R-squared	0.517		0.589		0.595	
ll	-61,331.529		-52,101.793		-44,461.512	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Standard errors in parentheses. Hospital fixed effects and patient interactions included. Choice set 10 closest hospitals within 99th percentile of distance. Mortality, readmission, LOS and specialization are condition specific variables. *Main* is our base specification. *Raw* uses group-adjusted hospital mortality and readmission rates. *IV* uses the methodology proposed by Gowrisankaran and Town (1999) to correct for selection in the hospital quality measures (mortality and readmission rates).

Table 76: Estimation results - controlling for selection

	Sepsis					
	Main		Raw		IV	
Variable	*Choice*		*Choice*		*Choice*	
Distance (10km)	-0.746***	(0.057)	-0.746***	(0.064)	-0.801***	(0.075)
Volume (1,000s)	0.176	(0.133)	-0.472***	(0.153)	0.0503	(0.150)
Occupancy (%)	-0.00595	(0.004)	-0.0139***	(0.005)	-0.0110**	(0.005)
Specialization - Sepsis (%)	0.152	(0.205)	0.717***	(0.214)	0.0316	(0.229)
Mortality - Sepsis (%)	0.00249	(0.002)	0.0708***	(0.007)	-0.00241**	(0.001)
Readmission - Sepsis (%)	-0.00247	(0.002)	0.0258	(0.027)	0.00334**	(0.001)
LOS - Sepsis (days)	0.000818	(0.006)	0.185***	(0.012)	0.00146	(0.006)
ALC (days)	-0.0160	(0.019)	-0.0212	(0.022)	-0.0637***	(0.022)
HSMR (%)	-0.0243	(0.017)	-0.0326*	(0.019)	0.128***	(0.043)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	141,877		141,877		113,161	
Pseudo R-squared	0.464		0.556		0.558	
ll	-17,045.942		-14,119.513		-11975.248	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Standard errors in parentheses. Hospital fixed effects and patient interactions included. Choice set 10 closest hospitals within 99th percentile of distance. Mortality, readmission, LOS and specialization are condition specific variables. *Main* is our base specification. *Raw* uses group-adjusted hospital mortality and readmission rates. *IV* uses the methodology proposed by Gowrisankaran and Town (1999) to correct for selection in the hospital quality measures (mortality and readmission rates).

Table 77: Estimation results - controlling for selection

	Stroke					
	Main		Raw		IV	
Variable	*Choice*		*Choice*		*Choice*	
Distance (10km)	-0.360***	(0.051)	-0.0859	(0.061)	-0.539***	(0.086)
Volume (1,000s)	0.167*	(0.093)	-0.842***	(0.103)	0.124	(0.115)
Occupancy (%)	-0.0130***	(0.004)	-0.00859**	(0.004)	-0.0179***	(0.005)
Specialization - Stroke (%)	0.807***	(0.116)	0.347***	(0.130)	0.701***	(0.146)
Mortality - Stroke (%)	-0.00168	(0.005)	0.149***	(0.011)	0.00457***	(0.002)
Readmission - Stroke (%)	0.00409***	(0.001)	0.0856***	(0.021)	-0.00217**	(0.001)
LOS - Stroke (days)	-0.000824	(0.007)	0.219***	(0.014)	-0.00838	(0.007)
ALC (days)	-0.0622***	(0.020)	-0.243***	(0.022)	-0.120***	(0.025)
HSMR (%)	-0.0694***	(0.015)	-0.110***	(0.017)	0.154***	(0.053)
Patient characteristics	Yes		Yes		Yes	
Hospital F.E.	Yes		Yes		Yes	
Observations	214,758		214,752		156,045	
Pseudo R-squared	0.443		0.558		0.551	
ll	-27,359.664		-21,727.979		-17,445.086	

Notes: * p <0.1 ** p <0.05 *** p <0.01. Standard errors in parentheses. Hospital fixed effects and patient interactions included. Choice set 10 closest hospitals within 99th percentile of distance. Mortality, readmission, LOS and specialization are condition specific variables. *Main* is our base specification. *Raw* uses group-adjusted hospital mortality and readmission rates. *IV* uses the methodology proposed by Gowrisankaran and Town (1999) to correct for selection in the hospital quality measures (mortality and readmission rates).