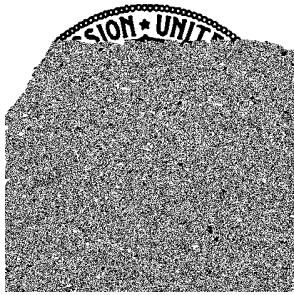


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A Retrospective Analysis of the Clinical Quality Effects of the Acquisition of Highland Park Hospital by Evanston Northwestern Healthcare^{*}

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Abstract: In 2004, the Federal Trade Commission brought legal action retrospectively challenging the 2000 acquisition of Highland Park Hospital by Evanston Northwestern Healthcare in Evanston, Illinois. A major issue in the case was whether the merger had resulted in improved clinical quality at Highland Park. In this paper, we report the findings of our analysis of that issue. We examined numerous quantitative measures of clinical quality and found little evidence that the merger improved quality. We also describe the conceptual framework in which we

II. Data, Quality Measures, and Empirical Methodology:

A. Data.

Our data source is the Illinois Department of Public Health (IDPH) Universal Dataset. This data set contains all inpatient discharges from nonfederal acute care hospitals in Illinois from 1998-2003. It contains information on the demographic characteristics of each patient, as well as ICD-9-CM (International Classification of Diseases, 9th Revision, Clinical Modification) diagnosis and procedure codes that describe the clinical condition of each patient and what procedures were performed. In preparation for trial, we also analyzed specialty-specific patient outcomes data from the National Registry of Myocardial Infarction, the Society for Thoracic Surgeons, and the National Perinatal Information Center, as well as patient satisfaction and experience data from the vendor Press Ganey. Hospitals voluntarily submit their data to these organizations and programs, and then receive benchmarking reports describing their performance in comparison with other facilities. The merging parties were required to provide these reports for review and analysis, and they were used in the first author's testimony, but they belong to the merging parties and therefore are not available to report here.

B. Quality Measures.

The primary quality measures analyzed in this paper come from Version 2.1 of the Inpatient Quality Indicators (IQIs) and the Patient Safety Indicators (PSIs) developed by the Agency for Healthcare Research and Quality (AHRQ). These indicators of health care quality make use of hospital inpatient administrative data such as the IDPH data, and focus principally on short-term patient outcomes. The IQIs reflect quality of care inside hospitals, including inpatient mortality for medical conditions and surgical procedures, and the PSIs focus on potentially avoidable

complications and iatrogenic events. To implement these measures, we ran the data obtained from the IDPH through a commercial “grouper” software program that used each patient’s demographic information, diagnosis codes, and procedure codes to assign that patient to an “All Patient Refined Diagnosis Related Group” (APR-DRG) and to a Risk of Mortality (ROM) subclass. We then fed these APR-DRGs and ROMs, along with other elements from the IDPH dataset, into AHRQ’s publicly-available Quality Indicator software for SAS to generate risk-adjusted outcomes measures. IQI risk-adjustment incorporates age, gender, age-gender interactions, circumstances of admission (i.e., transfer from another hospital), and APR-DRGs with ROM subclasses. PSI risk-adjustment incorporates age, gender, age-gender interactions, circumstances of admission, base DRGs (i.e., aggregated across comorbidity/complication levels), and AHRQ-defined comorbidities.³

The other quality measures that we used were developed by the Joint Commission on Accreditation of Healthcare Organizations, now known as The Joint Commission (TJC). TJC is the largest accrediting organization for acute care hospitals in the US; its accreditation review process includes a broad array of Core Measures that hospitals are required to collect and report. TJC maintains measures of risk-adjusted mortality for heart attack patients, neonatal mortality, and obstetric trauma. We purchased these measures, which are now publicly available on Medicare’s HospitalCompare website but were not at the time, from a leading vendor (Iameter).

All of the analyses described in this paper involve patient outcomes. This is an appropriate focus, as outcomes are of ultimate interest to patients, their families, and policy-makers. However, data limitations make it difficult to judge a hospital solely on its outcomes. This is partly because hospitals often have a relatively small number of patients of a given type, which makes outcomes a noisy measure of quality; and partly because there are many outcomes that cannot be

measured at all with available data, such as post-hospitalization mortality, quality of life, and functional status. For this reason, hospital quality researchers also use “structural” quality measures, which focus on whether organizations have the human resources and technical infrastructure to provide high-quality care, and “process” measures, which focus on the specific diagnostic and therapeutic services that organizations provide. At trial, the first author discussed several of these measures, but we do not discuss them here as they mostly relied on proprietary data obtained from the merging parties. For this reason, the results reported below are confined to outcomes measures from AHRQ and TJC, which represented the core of our analysis.

C. Empirical Methodology.

Our empirical methodology involves a series of difference-in-differences analyses of risk-adjusted mortality and complication rates for a number of clinical conditions. We evaluate whether the changes in these rates at the merged hospitals were different than the average change at a set of control hospitals. Changes in the control group rates serve as a counterfactual proxy for what the changes would have been at the merging hospitals absent the merger.

The virtue of difference-in-differences analysis is that confounding factors that do not vary over time (i.e., hospital fixed effects) are “differenced out.” If the case mix of each hospital’s patients did not change from year to year, then any differences in patient severity of illness would also be differenced out, and there would be no problem using raw mortality and complication rates in the analysis. But patient mix can change over time, particularly following a merger that may alter referral practices in the community, leading to differential changes in hospitals’ case mixes. For this reason, we prefer to evaluate risk-adjusted mortality and complication rates, which are interpreted as the rate that a hospital would have had if its patients were of average se-

verity. Even with the risk-adjustment, we recognize that some confounding is likely to persist

1998-1999, and the post-merger period as 2001-2003. Our primary concern is with changes in clinical quality at HPH, as it is at HPH that Respondent's Counsel claimed the merger improved quality. However, it is also possible that the merger could have had effects on clinical quality at Evanston Hospital and/or Glenbrook Hospital, as resources may have been diverted from Evanston or Glenbrook to Highland Park in such a way that Highland Park's gain was Evanston's or Glenbrook's loss. This effect is most likely to be present for cardiac services because ENH started a new cardiac surgery and interventional cardiology program at HPH, and the resources for that program were drawn largely from Evanston and Glenbrook. To simplify the presentation, we report only analyses on HPH and Evanston Hospital, but these results are not materially affected by adding Glenbrook Hospital.

We define our difference-in-differences estimator $\hat{\phi} = \hat{\phi}_{\text{enh}} - \hat{\phi}_{\text{control}}$. Under the assumption of i.i.d. random sampling from a binomial distribution, the standard error of $\hat{\phi}$ is the denominator of the expression below. Therefore the following is (approximately) distributed standard normal under the null hypothesis that quality at ENH did not change relative to the control group:

$$\frac{\hat{\phi}}{\sqrt{\dots}}$$

merger absolute (percentage point) differences at the treatment hospitals, and then calculate the difference between those differences and the absolute differences at the control hospitals. We report both risk-adjusted and raw rate results, which are similar in most cases.

A. Cardiac Surgery and Interventional Cardiology.

After the merger, ENH established cardiac surgery and interventional cardiology programs at HPH, so that coronary artery bypass graft (CABG) surgery and percutaneous coronary intervention (PCI) procedures began to be performed there. Since there was no such program at HPH before the merger, no pre- vs. post-merger comparison is possible. But it is possible that the establishment of the program at HPH had an adverse impact on Evanston Hospital, as resources may have been diverted to support the new program at HPH.⁶

heart attack), inpatient congestive heart failure (CHF), pneumonia, and stroke.⁷ Respondent's Counsel claimed that the merger allowed HPH to realize the advantages of a teaching hospital.⁸ Based on publicly available data, the first author argued that neither EH nor HPH met the definition of a teaching hospital, as defined in most prior studies (i.e., membership in the Council of Teaching Hospitals or at least 0.10-0.27 residents per bed). Nevertheless, we tested the claim by analyzing the AHRQ Inpatient Quality Indicators for those four conditions as well as the corresponding TJC indicator for AMI. Results are reported in Table 2.

According to the IQI measure, risk-adjusted AMI mortality at the control hospitals decreased by 1.88%, and increased at HPH by 0.34%, for a difference-in-differences of 2.22%. This finding suggests a decrease in quality at HPH, but is not statistically significant. However, for this measure there is an unusually large divergence between the risk-adjusted result and the raw difference-in-differences of -3.21% (also not statistically significant). Both the risk-adjusted and raw rates show a large and statistically significant decrease in quality at EH, difference-in-differences of 4.46% and 3.33%, respectively.

According to the TJC measure, risk-adjusted AMI mortality decreased by 1.52% at the control hospitals (compared to 1.88% according to the IQI measure), and decreased by 5.01% at HPH (compared to an increase of 0.34% according to the IQI measure), for a non-significant difference-in-differences of -3.48%. Similarly, the difference-in-differences at Evanston is -0.59%, as compared to an increase of 4.46% for the IQI measure. These differences may be partially explained by differences in risk-adjustment, and also by the exclusion of patients who were transferred in from other hospitals (as well as out-transfers) from the TJC measure; by contrast, the AHRQ measure only excludes out-transfers, because it is not known whether they survived the acute hospital stay. However, the discrepancy is large enough to cause us to suspect that there

may have been a coding error in the commercial software that we used to group the APR-DRGs, in the AHRQ IQI software, or in the software used by Iameter to calculate the TJC measures.

CHF mortality improved non-significantly at both HPH (risk-adjusted difference-in-differences of -1.60%) and EH (-0.19%) after the merger. Risk-adjusted and raw pneumonia mortality and stroke mortality deteriorated non-significantly at HPH (risk-adjusted difference-in-differences of 0.30% for pneumonia and 2.42% for stroke). There was a large and statistically significant deterioration in risk adjusted pneumonia (3.14%) and stroke (4.94%) mortality at Evanston Hospital.

C. Nursing-Sensitive Indicators.

Another claim made by Respondent's Counsel was that the merger improved nursing care at HPH.⁹ We evaluate this claim by examining Patient Safety Indicators that are known to be sensitive to the quality of care.

IV. Interpretation of Results:

As can be seen in the tables, the standard errors on the Highland Park Hospital differences-in-differences estimates are generally quite large, so in many instances where the point estimate indicates a relative deterioration, substantial improvement cannot be ruled out. However, although we did not attempt a formal statistical test of whether quality improved “overall” across all the quality measures, our results taken together suggest that an overall improvement at HPH is unlikely, and that a large overall improvement is very unlikely.¹³ This conclusion is reinforced by the fact that, as discussed below, the relevant literature does not support a prior belief that hospital mergers are likely to improve quality.

Our results must be interpreted with caution. The statistical significance of some findings may be overstated because we did not account for heterogeneity among control hospitals. We also cannot exclude the possibility of endogeneity; a decision to merge may reflect hospital managers’ inside knowledge of emerging trends in quality, such that the experience of control hospitals may not represent what would have happened at the merging hospitals absent the merger.

V. Conceptual Framework:

A. Priors.

Since the ENH/HPH case was retrospective, our primary evidence came from our difference-

rate of potentially overused procedures by 1.2% among managed care patients. Finally, Gowrisankaran & Town (2003) found that competition improved quality for HMO patients, and reduced quality for Medicare patients, with the net effect being close to zero.

In addition to these empirical results, we can also take some guidance from economic theory. As discussed in Gaynor (2006), the effect of reduced competition on quality (holding the cost of producing quality constant) is theoretically ambiguous when profit-maximizing firms choose both price and quality.¹⁴ But when prices are fixed rather than chosen by the firm, optimal quality unambiguously decreases following a compe

hospital is sufficiently ineffective, the acquiring system can achieve large gains by substituting better management. See Section VI below for a discussion of how claims of clinical superiority can be evaluated. If a merger is found likely to improve clinical quality by means of exporting superior practices, this benefit would likely require geographic proximity and therefore be merger-specific, because the process of improving the inferior hospital likely requires the physical presence of personnel from the superior one.

ii. Economies of Scale.

Another way that a merger can improve clinical quality is through economies of scale in the provision of quality (which is distinct from economies of scale in producing output). There are some quality-improving pieces of equipment with high fixed costs and low marginal costs that are not worthwhile for an independent hospital or a small hospital system, but are worthwhile for a sufficiently large system.¹⁷ A merger may put the merged entity above this threshold, resulting in additional investment in quality, or the larger of the merging entities may (with little incremental cost) be able to extend to the smaller entity the benefits of investments that have already been made. Such scale economies can be a source of improved clinical quality, but may yield

yield large quality benefits due to increased data portability across sites of care and decreased incidence of medication-related errors.¹⁸

Another potential source of scale economies is surgical procedures that exhibit a volume-outcome relationship in which more repetition of

iii. Financial Resources.

Another possible means by which a merger can improve clinical quality is via quality-improving investments that one party to the transaction (usually the acquired hospital) was previously unable to make due to lack of financial resources. The standard theory of corporate finance suggests that firms will make those investments, and only those investments, for which the present value of the net benefits, discounted at the appropriate rate, exceeds the investment cost, regardless of the ownership of the firm. This conclusion might fail to hold if for some reason the acquiring system has a lower cost of capital than the acquired hospital. In that case, the acquired hospital would have made those investments that were worthwhile given its original cost of capital, and the acquiring system would make additional investments that would not have been worthwhile at that cost of capital, but are worthwhile given its new, lower cost. But these incremental investments are expected to be the marginal (i.e., least valuable) investments.

Any clinical quality benefit resulting from increased financial resources will not be merger-specific if there is an alternative acquirer that does not represent a competitive concern, is willing to pay a price that the acquired hospital would accept if the merger under investigation were blocked, and is willing to make similar investments. These conditions will be met if the investments are worthwhile on their own merit, but not if the willingness to make the investments, or even the willingness to undertake the merger, is dependent on the

C. Health Effects of Higher Prices for Health Insurance.

Even if our analysis had found a merger-specific quality increase at the merging hospitals, the indirect effect of a price-increasing merger on health must still be considered. Higher hospital prices cause health insurance premiums to increase, which causes some people to lose or forego insurance. Town et al (2006) estimated that in 2003 there were 695,000 fewer insured people in the U.S. than there would have been had there been no hospital merger activity in the 1990s. There is a substantial literature showing that lack of insurance harms health, and may be responsible for 18,000-22,000 premature deaths each year in the US,²⁴ although this estimate has recently been challenged by Kronick (2010). This harm would not be realized at the merging hospitals, as the people who lose their insurance would not necessarily have used the merging hospitals (or any hospital). The magnitude of this effect is difficult to quantify, as it would require estimating the insurance premium increase resulting from the hospital price increase, the number of people who would lose their insurance as a result of that premium increase, and the health harm accruing to the people who lost their insurance. But the effect is present, and it means that any measured health benefit at the merging hospitals represents an upper bound on the total beneficial effect of the merger on health. Because of the absence of demonstrable quality improvement in the ENH/HPH case, it was not necessary for us to address this question.

VI. Applicability to Prospective Merger Analysis:

This paper has focused on retrospective evaluation of the Evanston Northwestern Healthcare/Highland Park Hospital case. But the great majority of merger cases are prospective in nature, where the objective is to predict the effects of the merger, rather than to measure them after the fact. A recent example is the proposed acquisition of Prince William Hospital in Manassas,

merger quality trends may also be of some value, but can be misleading because trends may not persist, particularly if one hospital started with a much lower level of clinical performance.

Large pre-merger differences in quality levels are neither necessary nor sufficient for a merger to result in a quality increase. It is possible that a superior acquiring hospital will fail to improve an inferior one, and it is also possible that one hospital can improve another even if it is

Specifically, we use a straightforward difference-in-differences methodology to determine whether the merger resulted in improved performance on a variety of clinical outcomes measures (risk-adjusted inpatient death and complications). We find little evidence that the merger caused quality to improve at Highland Park.

On the basis of these findings, the Administrative Law Judge found “no evidence of improvement in overall quality of care relative to other hospitals.”²⁷ We believe that our basic framework for analyzing the clinical quality effect of mergers will be applicable to future cases, including prospective ones. There are plausible mechanisms through which a merger can cause a substantial quality improvement, which means that case-specific quality analysis is important. While we take no position on how price and quality should be traded off against each other when they are in conflict, our methodological approach will characterize the magnitude of any quality effect, which can then be weighed against the predicted (or observed) price effect in the manner deemed appropriate by the decision maker.

¹ Dr. Haas-Wilson estimated that ENH’s inpatient price increased 11.1 to 17.9 percentage points more than the price at various control groups after the merger. See *In re Evanston Northwestern Healthcare Corp.*, Dkt. No. 9315, slip op. at 35 (Aug. 6, 2007) (opinion of the Commission) available at <http://www.ftc.gov/os/adjpro/d9315/070806opinion.pdf>. Respondent’s expert Dr. Jonathan Baker estimated that ENH’s inpatient price increased 9 to 10 percentage points more than at his control group after the merger. *Id.* at 38.

² Pretrial Brief of Respondent at 31, *In re Evanston Northwestern Healthcare Corp.*, Dkt. No. 9315 (Oct. 20, 2005) (initial decision), available at <http://www.ftc.gov/os/adjpro/d9315/050127respptrialbrief.pdf>; Post-Trial Brief of Respondent at 74, *In re Evanston Northwestern Healthcare Corp.*, Dkt. No. 9315 (Oct. 20, 2005) (initial decision) available at <http://www.ftc.gov/os/adjpro/d9315/050527respptrialbrief.pdf>; and Respondents’ Corrected Appeal Brief at 68, *In re Evanston Northwestern Healthcare Corp.*, Dkt. No. 9315 (Aug. 6, 2007) (opinion of the Commission), available at <http://www.ftc.gov/os/adjpro/d9315/060112enhappealbriefcorrected.pdf>.

³ Additional information regarding risk-adjustment is available at the AHRQ Quality Indicators website, <http://qualityindicators.ahrq.gov>.

⁴ See Lorence et al (2003) and Santos et al (2008).

⁵ The other three control groups were all non-federal general acute care hospitals in the Chicago PMSA that: (i) were not involved in a merger between 1996 and 2002; (ii) had residency programs at the time of the merger; and (iii) had more than 0.25 residents and interns per staffed bed between 1998 and 2002.

⁶ It is also possible that the existence of the programs at HPH improved access to those services, and thereby improved cardiac health in the broader community. We investigated this question and found no such evidence, and so we do not report those results here.

⁷ See Ayanian and Weissman (2002) for an excellent summary of this literature, including description of various definitions of teaching hospitals that have been used in 20 published studies.

⁸ Post-Trial Brief of Respondent, *supra* at 93; and Respondent’s Corrected Appeal Brief, *supra* at 4.

⁹ Post-Trial Brief of Respondent, *supra* at 83; and Respondent's Corrected Appeal Brief, *supra* at 12.

¹⁰ See http://www.qualityforum.org/Projects/n-r/Nursing-Sensitive_Care_Initial_Measures/Nursing_Sensitive_Care_Initial_Measures.aspx

¹¹ Post-Trial Brief of Respondent, *supra* at 75; and Respondent's Corrected Appeal Brief, *supra* at 12.

¹² With respect to obstetric trauma, the TJC indicator includes both types of vaginal deliveries (with and without instrumentation) whereas the AHRQ indicator stratifies them to create two separate indicators. In addition, in the version of the AHRQ Quality Indicators software that we used in this analysis (Version 2.1), the numerator definition was somewhat different than that in the TJC indicator, capturing high vaginal and cervical trauma but excluding third degree perineal lacerations.

¹³ Several results suggest deterioration at Evanston Hospital as well, with the notable exception of some nursing-sensitive indicators. The larger sample sizes at Evanston Hospital mean that the tests have more power, and so more results achieve statistical significance. However, it is not clear that this deterioration was a result of the merger with HPH. It is possible that the merger harmed EH through diversion of resources or lack of focus, but it is also possible that the deterioration had some other cause.

¹⁴ Many hospitals, including ENH, are not-for-profit (NFP). There is limited evidence that NFP hospitals tend to have somewhat higher clinical quality (see Devereaux *et al.*, 2002; Eggleston *et al.*, 2008; Picone *et al.*, 2002; Shen, 2002; and Farsi, 2004), but we are aware of no direct evidence on differences between NFP and FP hospitals in their quality response to mergers. It is possible that NFP hospitals reinvest a larger fraction of the gains from competition-reducing mergers, although we are aware of no direct evidence on this question either. The quality effect of any such additional spending will depend on the pre-merger condition of the acquired hospital and on the specific investments chosen by managers of the merged entity. If the merging hospitals had adequate resources already, then the additional expenditures will likely only generate

²⁶ See Vogt & Town (2006), Vita & Sacher (2001), Haas-Wilson & Garmon (this issue), Thompson (this issue), and Tenn (this issue).

²⁷ See *In re Evanston Northwestern Healthcare Corp.*, Dkt. No. 9315, slip op. at 173 (Oct. 20, 2005) (initial decision), available at <http://www.ftc.gov/os/adjpro/d9315/051020initialdecision.pdf>

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4.15% 4.00%

2.02%	2.31%	1.63%	1.59%	-0.33%	1.89%	1.59%	-0.59%***
(0.04%)	(0.03%)	(0.21%)	(0.17%)	(0.27%)	(0.13%)	(0.11%)	(0.18%)
2.22%	2.39%	1.89%	1.31%	-0.76%***	1.83%	1.45%	-0.56%***
(0.04%)	(0.03%)	(0.23%)	(0.15%)	(0.28%)	(0.13%)	(0.10%)	(0.17%)
12.21%	11.03%	9.82%	9.23%	0.59%	11.40%	7.53%	-2.70%*
(0.27%)	(0.19%)	(1.99%)	(1.28%)	(2.39%)			