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Comparing the Clinical Quality and Cost of Secondary Care in Academic Health Centers and in Community Hospitals

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FOREWORD

Pioneer Institute commissioned this study to highlight the need for policymakers, insurers, employers, health care providers, and patients in Massachusetts to understand how consumer-driven health care may affect the state's health care system.

Faced with high and rising costs for health insurance, employers in Massachusetts and across America are exploring insurance products that can hold down costs by giving employees a financial incentive to seek lower-cost health care providers. The move toward consumer-driven health care has important implications for Massachusetts.

The Commonwealth is home to a concentration of world-class teaching hospitals, in addition to many excellent community hospitals. These health care institutions provide Massachusetts residents with access to the highest quality health care and support thousands of jobs around the Commonwealth. Moreover, medical research conducted at teaching hospitals helps fuel Massachusetts's biotechnology industry, one of the state's leading economic engines.

This report compares cost and quality of care at teaching and community hospitals in six states. Unlike many similar studies, the authors of this report focus exclusively on the privately insured, under-65 population (those most like to be offered employer-sponsored consumer-driven health plans) and only on secondary care, that is, treatment commonly available at both teaching and community hospitals, like obstetrics, appendectomies and gastro-esophageal procedures.

Massachusetts patients use teaching hospitals at a much higher rate than do patients in other states and they use them for care that is also provided at community hospitals. However, research studies, including this one, have found that the cost of secondary care provided at teaching hospitals is significantly higher than at community hospitals, perhaps in part because of the teaching and research mission of teaching hospitals. At the same time, there is evidence that the quality of secondary care is about the same at less-expensive community hospitals.

In the coming years, market forces will play an increasing role in allocating health care resources in Massachusetts. Pioneer Institute hopes this study will spark a discussion among policymakers, business leaders, health care insurers, providers, and patients about the implications of consumer-driven health care for the Commonwealth's health care system and our economy.

—Stephen J. Adams
President/CEO
Pioneer Institute

EXECUTIVE SUMMARY

This study analyzes data from hospitals in six states, including Massachusetts, to compare the cost and quality of secondary care for under-65, privately insured patients in Academic Health Centers (AHCs) and non-AHC or community hospitals. Six measures of clinical quality of care were chosen from "potentially avoidable adverse hospital outcomes" developed by the Healthcare Utilization Project (HCUP) of the Agency for Healthcare Research and Quality. The authors discuss the research findings in the context of changes in the market for health insurance, including the emergence of "consumer-driven" health insurance products. The study population is the most likely group to be enrolled in the emerging insurance products that encourage consumers to make health care choices on the basis of cost and quality information. The cost and quality measures used in the study are already available to many privately insured consumers through web-based information tools provided both independently and in conjunction with the new insurance products.

Inpatient cost per case is 19 percent higher at Academic Health Centers (AHCs) than at community hospitals.

Major Findings

1) Inpatient costs per case at AHCs were significantly higher than at non-AHC hospitals, even after controlling for patient case mix, severity, and other controllable characteristics. The study found AHC inpatient cost per case to be 19 percent higher than at non-AHC hospitals.

2) The most commonly occurring poor clinical outcomes are infrequent events for secondary care; that is, potentially avoidable morbidity (i.e., nonfatal inpatient complications) and mortality (i.e., patient death) outcomes are low for patients in this sample regardless of whether care is delivered in AHCs or non-AHC hospitals.

3) Measured in terms of seven possible adverse outcomes for this patient population, quality at the AHCs was better than at non-AHC hospitals in two out of the seven and no better in five out of the seven adverse outcomes. For three of these five outcomes, including mortality, the non-AHC hospitals had a higher measurable quality of care.

4) Length of stay at AHCs and non-AHC hospitals was virtually the same.

The authors conclude that, on average, patients choosing a lower-cost community hospital for secondary care would receive care of similar quality to that provided in AHCs.

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If large numbers of patients do respond to financial incentives to choose lower cost community hospitals, the AHCs stand to lose a significant share of the under-65 privately insured secondary care market. For the non-AHC hospitals, such a shift would mean a financial windfall if they were able to manage the increased demand. To the extent that community hospitals increased their privately insured patient mix, they would likely improve their financial position, while for AHCs, finances would deteriorate. Payment as a percentage of cost is generally higher for privately insured patients than for Medicare and Medicaid patients. A shift in secondary care patients from AHCs to community hospitals would decrease the funds available to support those non-clinical activities that are considered part of the mission of the teaching hospital.

Comparing the Clinical Quality and Cost of Secondary Care in Academic Health Centers to Community Hospitals

By **Nancy M. Kane, DBA; Jack Needleman, Ph.D.;** and **Liza Rudell, M.S.**

Introduction

Since 1999, growth in private health insurance premiums nationally has outstripped the rate of growth in inflation, workers' earnings, and the Gross Domestic Product. From 2001 through 2003, both increased use and higher costs of inpatient hospital care were key drivers of private health care cost increases.[1] The consumer backlash against managed care has left many employers scrambling to come up with new solutions to contain double-digit increases in premium costs. One strategy is the use of "consumer-driven" health insurance plans (CDHPs), designed to sensitize consumers to the costs of their health care choices.[2] These emerging insurance products are marketed primarily to the privately insured under-65 population and use financial incentives, tied to cost and quality information, to encourage consumers to seek lower cost care. Some such plans, for example, provide for lower cost-sharing if patients choose preferred (lower-cost) providers or pharmaceuticals and higher cost-sharing if the patient chooses a nonpreferred (higher-cost) option.

Clinical costs are widely recognized to be higher at major teaching hospitals (known as Academic Health Centers or AHCs) than at community hospitals.[3] These higher costs are driven largely by the broader mission of AHCs, which includes medical education, research, provision of highly specialized care, and serving as a safety net for poor and uninsured patients.[4] An analysis by The Lewin Group estimated that mission-related costs for fiscal year 1998 accounted for 28 percent of total costs per case at AHCs. The Lewin study accounts for these costs as follows: standby capacity for high technology or intensive services (45 percent), indirect medical education (42 percent), and unfunded research (13 percent).[5]

Clinical costs are widely recognized to be higher at major teaching hospitals (known as Academic Health Centers or AHCs) than at community hospitals.

Most of the care that AHCs provide is also provided in community hospitals.[6] In the 10-state analysis by Kane and Siegrist, 91 percent of inpatient care provided by AHCs was secondary care, including normal deliveries, cesarean sections, gastrointestinal and orthopedic surgery, community-acquired pneumonia, and acute myocardial infarction. Only 9 percent of care was tertiary, identified as the 23 Diagnosis-Related Groups (DRGs)[7]

[1] Bradley C. Strunk, Paul B. Ginsburg, and Jon R. Gabel, "Tracking Health Care Costs: Growth Accelerates Again In 2001," *Health Affairs*—Web Exclusive (2002) W301-302; Stephen Heffler, Sheila Smith, Sean Keehan, M. Kent Clemens, Greg Won, and Mark Zezza, "Health Spending Projections for 2002-2012" *Health Affairs* – Web Exclusive (2002) W3-54–W3-65. The Index of Health Affairs Web Exclusive articles can be found at http://healthaffairs.org/WebExclusives.

[2] J.B. Christianson, S.T. Parente, and R. Taylor, "Defined-contribution health insurance products: development and prospects," *Health Affairs* (2002) 21: 49-64.

[3] This research distinguishes between hospitals on the basis of membership in the Council of Teaching Hospitals (COTH). COTH members are referred to as AHCs or teaching hospitals; non-members are referred to as community hospitals. It should be noted that some "community" hospitals have lesser teaching status, but are here considered nonteaching.

[4] Task Force on Academic Hospitals, "Envisioning the Future of Academic Health Centers," Final Report of the Commonwealth Fund Task Force on Academic Health Centers, February 2003, p. 3. Available online at http://www.cmwf.org/programs/taskforc/ahc_envisioningfuture_600.pdf.

[5] Task Force on AHCs, figure 3, p. 8.

[6] R. Levin, E. Moy, P.F. Griner, "Trends in Specialized Surgical Procedures at Teaching and Nonteaching Hospitals," *Health Affairs* (2000) 19(1): 230-238.

[7] Diagnosis-Related Groups are groups of inpatient discharges that are similar in terms of diagnosis and major procedures, as well as expected treatment cost and length of stay. Medicare uses 506 DRGs as the basis for inpatient payment.

that are performed predominantly in an AHC, including burn care, organ transplants, major cardiac surgical procedures, and craniotomies.[8]

In 2003, for the first time, employers have added separate cost-sharing for hospital admissions in an attempt to focus consumer attention on hospital costs.[9] While only 22 percent of large employers (200+ workers) surveyed in 2003 were very (2 percent) or somewhat (20 percent) likely to introduce tiered networks for doctor visits and hospital stays in 2004, among them are the large employers that generally lead the others in adopting innovative plan designs.[10] Many more employers are dissatisfied with the current health care system and are looking for new approaches to contain rising premiums.

In Massachusetts, insurers are just beginning to introduce consumer-driven health plans (CDHPs). A 2002 tiered product offered by Tufts Health Plan attracted few enrollees in its first six months. The Group Insurance Commission, which manages benefits for Massachusetts state employees, retirees, and their families, negotiated with three major carriers to offer tiered network products in July 2004. The plans use financial incentives to steer health care consumers toward providers of higher quality and lower cost.[11] The state's largest insurers are providing access to websites that use largely administrative data sets like those used in this study to help members search for the best medical care with the fewest complications or deaths. While some hospitals object, health plans are responding to employer pressures to justify the high cost of health care and to force quality improvement on poor performers.[12] All of these products reflect an increasing awareness by purchasers and payers that there is wide price variation among providers for the same or similar patient care.

The possibility that relative costs will become a more significant factor in the health care choices of consumers raises a number of important issues.

Since the plans are new to the marketplace, their effectiveness in reducing health care costs is not known. Existing CDHP vendors are claiming employer premium savings of 7 to 10 percent on employees enrolled in CDHP products.[13] Supporters claim that greater financial responsibility will influence consumers to use medical resources more appropriately, while detractors express concern about the ability of consumers to use health care cost and quality information, the validity and utility of the information given to them, and the higher vulnerability to increased cost-sharing of chronically ill and low-income people who might be discouraged from seeking appropriate care.[14] Despite these concerns, benefits consultants and industry experts expect CDHPs to enroll anywhere from 15 to 50 percent of the employer-based health insurance market over the next three years.[15]

Most privately insured health care consumers have the option of seeking care in one hospital type or another and have—at least up until now—been insulated from the financial effects of their decisions through their insurance plans. The possibility that relative costs will become a more significant factor in the health care choices of consumers raises a number of important issues: Will financial incentives lead privately insured

[8] Nancy M. Kane and Richard B. Siegrist, "Exploring the Relationship Between Inpatient Hospital Costs and Quality of Care," *The American Journal of Managed Care*, June 2003, Vol. 9 (Special Issue 1): SP43–SP49. The other nine states (with percent discharges from AHCs) were New York (39.5), Virginia (17.3), Florida (8.5), Texas (14.8), Illinois (25.4), Iowa (6.7), California (12.2), Washington (7.9), and Colorado (5.2).

[9] The Kaiser Family Foundation and Health Research and Educational Trust, "Employer Health Benefits, 2003 Summary of Findings,"on http://www.kff.org.

[10] Ibid., p. 6, see exhibit 8.

[11] Liz Kowalczyk, "Massachusetts Adopts Healthcare Rating System," *Boston Globe*, March 11, 2004, E2.

[12] Kowalczyk, "On Line Rankings Rankle Hospitals; Insurers Offering Data to Consumers," *Boston Globe*, March 8, 2004, A1.

[13] S. Marshall, "Workers Take Control; New health plan lets employees decide how to spend monies; local firms are slow to adopt it," *Crain's New York Business*, March 24, 2000: 11; D. Levick, "New Breed of Health Insurance Emerging," *Hartford Courant*, July 6, 2003, A1.

[14] Jill M. Yegian, "Tiered Hospital Networks: Reflections from the California HealthCare Foundation/Health Affairs Roundtable," *Health Affairs* Web Exclusive, March 2003: W3-147–W3-153.

[15] J.R. Gabel, A.T. LoSasso, T. Rice, "Consumer-Drive Health Plans: Are They More Than Talk Now?" *Health Affairs* Web Exclusive, November 2002: W405.

patients away from AHCs to less expensive community hospitals? If so, will they be sacrificing clinical quality of care?

This second question is the focus of our research. We compare cost and quality of care at AHCs with community hospitals in six states to address the following research question: Is the high cost of AHCs for secondary care justified by higher clinical quality?

Literature Review

Several previous research studies have compared clinical outcomes in AHCs with those in community hospitals. One publication summarizes 20 studies published in peer-reviewed academic journals from 1985 to 2001 that assess quality of care by hospital teaching status.[16] Highlighting the wide range of methodological differences in study approaches, including data source (administrative vs. medical records), quality definition (mortality vs. morbidity, and given the latter, nature of morbidity),[17] teaching status definition, method of risk adjustment, and study populations, the authors convey the difficulty in drawing sweeping conclusions regarding relative quality of care provided in the two settings. The authors report that the literature generally reveals a higher quality of care offered by teaching hospitals relative to nonteaching hospitals, but this conclusion is based heavily on mortality rates and outcomes for Medicare patients, who are older and generally more frail than other groups, and may not be generalizable to younger patient groups. Other findings in the Ayanian survey that involved all patients (not just Medicare) found more frequent adverse events in teaching hospitals, and poorer surgical outcomes for some procedures, but the same or better mortality in teaching hospitals, depending on what patient conditions were reviewed.

We compare cost and quality of care at AHCs with community hospitals in six states to address the question: Is the high cost of AHCs for secondary care justified by higher clinical quality?

One study not included in the Ayanian review focuses on morbidity measures from the VA National Surgical Quality Improvement Program (NSQIP) to assess seven surgical specialties and eight specific operations.[18] The study included data from 128 Veterans Administration surgical centers nationwide, covering the period 1997 to 1999. Adjusted morbidity rates, as measured by wound infection, respiratory complications, urinary tract infection, central nervous system complications, cardiac complications, and other complications, were found to be significantly higher in teaching hospitals relative to nonteaching hospitals for four out of seven specialties and four out of eight operations.[19]

A recent analysis compared maternal outcomes for low-risk pregnancies in community hospitals and teaching hospitals in Massachusetts. It concluded that maternal outcomes (adjusted for case mix, demographic characteristics, and volume) were comparable between community and teaching hospitals. Charges at teaching hospitals, however, were nearly twice as high as at community hospitals for vaginal deliveries.[20]

Clearly, conclusions regarding quality differences between teaching and community hospitals depend on what patient populations and what conditions are reviewed, among other things.

[16] J. Ayanian and J.S. Weissman, "Teaching Hospitals and Quality of Care: A Review of the Literature," *The Millbank Quarterly* (2002), 80 (3): 569-593.

[17] Mortality means patient death; some studies only look at patient deaths in the hospital, while others include patient deaths within some time period after discharge. Morbidity reflects nonfatal inpatient complications that adversely affect the patient's clinical outcome.

[18] S.F. Khuri et al., "Comparison of Surgical Outcomes Between Teaching and Nonteaching Hospitals in the Department of Veterans Affairs," *Annals of Surgery* (2001) 234 (3): 370-383.

[19] Specialties: gen. surg, ortho, urology, and vascular. Operations: vascular reconstruction, partial colectomy, open cholecystectomy, and laparoscopic cholecystectomy.

[20] Massachusetts Division of Health Care Finance and Policy, "Maternal Outcomes at Massachusetts Hospitals," Analysis in Brief, Number 5, July 2003.

Research Methods

Sample Selection

Hospital Sample: Our sample consisted of all AHC and non-AHC community acute general hospitals in six states, chosen because they had good, detailed patient discharge abstract data for 2000, a high presence of AHCs, and substantial regional variation. The original sample consisted of 1,242 hospitals: Massachusetts (76 hospitals), Virginia (87), Illinois (197), Florida (218), New York (241), and California (423); 35 hospitals in this sample were dropped due to data deficiencies so that the final sample was 1,207.

Patient Sample: Patients were selected by their insurance, age, and medical characteristics. Only privately insured patients under age 65 receiving secondary care were included in the study, as this is the population most likely to be offered consumer-driven insurance plans. Patients classified in 23 DRGs defined as tertiary—which are treated predominantly in a teaching hospital setting—were excluded. In addition, patients in DRGs representing psychiatric and substance abuse were omitted, as the clinical outcome measures did not apply to them. We then chose patients in the DRGs representing the top 50 percent of the cumulative cost of secondary care for our sample. (Table 4 in the technical appendix provides a list of those DRGs, their frequency and distribution across teaching and community hospitals in our six-state sample.)

Variable Definitions and Adjustments

Cost and Quality Measures: The inpatient cost of care for each patient was estimated by multiplying the charge for each revenue center reported in the patients' discharge abstract by the ratio of costs to charges for that revenue center as reported by the patient's hospital on its Medicare Fiscal Year 16 (1999-2000) Cost Report.[21]

Measures of clinical quality of care were chosen from "potentially avoidable adverse hospital outcomes" developed by the Healthcare Utilization Project (HCUP) of the Agency for Healthcare Research and Quality. These were created to provide a quality assessment tool that can be used with hospital administrative data, by hospitals, states, and communities to assess the quality of inpatient care. We chose six of ten measures of inpatient complication rates of various types. The four avoidable complications not used in this analysis required data elements that were not reliably available in our UHDDS data set and were less commonly occurring than the six chosen for analysis. The six chosen for this analysis occur frequently enough in the under-65 population to make statistical analysis possible:

- Wound infection
- Pneumonia after major surgery/invasive vascular procedure
- Mechanical complications due to device, implant, or graft
- Pulmonary compromise after surgery
- Urinary tract infection after major surgery
- Other adverse effects.[22]

Severity Adjustments: To control for the influence of case mix and patient severity on the likelihood of experiencing the complication, we constructed categorical variables for each patient DRG included in the analysis and categorical variables for the four severity levels defined in the Refined DRG system.

Severity adjustment is a within-DRG adjustment for the severity of the particular cases treated; these are calculated using an algorithm from Yale called the Resource-Adjusted DRG. The algorithm recognizes differences in the severity of the cases using patient discharge abstract data (age, gender, secondary diagnoses, procedures, and discharge disposition) to assign the case to one of four severity levels (0,1,2,3) for surgical patients, and three severity levels for medical patients. For instance, a patient with Congestive Heart Failure (CHF) and no complications would be in a lower severity group than one with CHF and renal failure, although both would be classified into the same DRG. This adjustment is particularly useful for comparing mortality and morbidity rates across hospitals, as it uses actual patient characteristics, rather than cost weights, to adjust for these quality indicators.

Other Patient Variables: Age was included in the analysis, defined as a series of categorical variables with age 18-44 as

[21] M. Shwartz, D. Young, R. Siegrist, "Ratio of Costs to Charges: How Good a Basis for Estimating Costs?" *Inquiry* (Winter 1995/1996). Charges represent the price the hospital lists for each service it provides; it is based on several considerations, including payer mix and comparable market prices for each service. Costs represent the resources used by the hospital to produce the service. Cost and price are not necessarily highly correlated.

[22] This category included post-procedure hemorrhage diagnoses and procedures, miscellaneous complications such a postsurgical cataract fragments, nonhealing surgical wounds, air embolism, transfusion reactions, and persistent postoperative fistula, as well as iatrogenic complications.

the reference group. Gender was included with female as the reference group. Sensitivity analysis was done on source of admission (1 if transferred from another acute hospital, 0 for all other sources of admission). These data were derived from the discharge abstract.

Other Hospital Variables: Membership in the Council of Teaching Hospitals (COTH), as reported in the American Hospital Association (AHA) Annual Survey, was used to identify Academic Health Centers. All other hospitals, including some with lesser teaching status, were considered community hospitals. Hospital location in rural or metropolitan areas was also taken from the AHA Annual Survey. We included categorical variables for state, with Massachusetts as the reference group. To account for the potential impact of payer mix on the quality of care received by privately insured patients, we estimated from the discharge abstracts for each hospital the percentage of patients who were Medicare, Medicaid, and self-pay.[23]

Statistical Analysis

Dependent Variables: Nine outcome measures were assessed: the six morbidity outcomes described above, mortality, length of stay (LOS), and total inpatient cost. We used the log of cost and length of stay in our analysis to account for skewed distributions of these variables.

Independent Variables: Hospital variables included in the analysis were COTH membership, state, rural location, and the payer mix variables. Patient level variables included in the analysis were age, gender, and categorical variables for DRG and the patient's severity level.

Regression Models: We ran patient-level ordinary least-squares (OLS) regression to analyze the continuous variables, LOS (logged) and total cost (logged), and patient-level logistic regression to analyze the dichotomous morbidity and mortality measures, with all patient and hospital characteristic variables included in each regression. Standard errors were adjusted for clustering of patients within hospitals. T-statistics were calculated for the OLS regressions and z-statistics for the logit regression.

We report, for each dependent measure, the number of patients in the analysis sample, the coefficient from the OLS regressions for cost and length of stay, the odds ratios for mortality and other outcomes, and the 95% confidence interval and p-values on the coefficient or odds ratio.

As a test on the robustness of the model we use in our analysis, we also conducted a hospital-level analysis using a two-step method used in prior research on hospital quality.[24] The results were virtually identical to those obtained from the patient-level regression and are not reported here.

In response to a reviewer's comments, we did a sensitivity analysis on admission source (transfers from other hospitals) as a possible explanatory factor for the outcome measures. Transfers were more likely into AHCs than community hospitals. We found no consistent pattern in increased or decreased risk of adverse outcomes among transferred patients. Sensitivity analysis indicated that our findings with respect to teaching status would be unchanged by excluding transfer patients or including transfer patients as a variable in the analysis (results not shown).

The well-recognized limitations of comparing hospital quality using administrative data sets apply to this study as well. These include the limited level of detail available at the patient level for measuring poor outcomes or for adjusting for risk of adverse outcomes, the absence of data on adverse but relevant events occurring beyond the inpatient stay such as 30-day mortality, and differences in data gathering practices across hospitals.[25] However, administrative data is currently the only comprehensive source of outcome measures for inpatient care, permitting standardized, if not perfect, comparisons among all hospitals within a patient's service area. Many proprietary and public information web sites already rely on administrative data sets, often coupled with patient survey and other nonclinical sources of information, to inform consumers about cost and quality of hospital care.

[23] Payer mix adjustments are used as a proxy to adjust for the socioeconomic characteristics of the patient population; high proportions of elderly (Medicare) or low-income (Medicaid, self-pay) patients might indicate patients who are more clinically vulnerable in ways that are not captured by the case mix and severity adjustments (e.g., arrive in more advanced state of illness, experience mental instability or confusion more easily, be less active advocates on their own behalf, lack family advocacy support, etc).

[24] J. Needleman et al., "Nurse-Staffing Levels and the Quality of Care in Hospitals," Special Article, *NEJM* (2002) 346 (22): 1715- 1722.

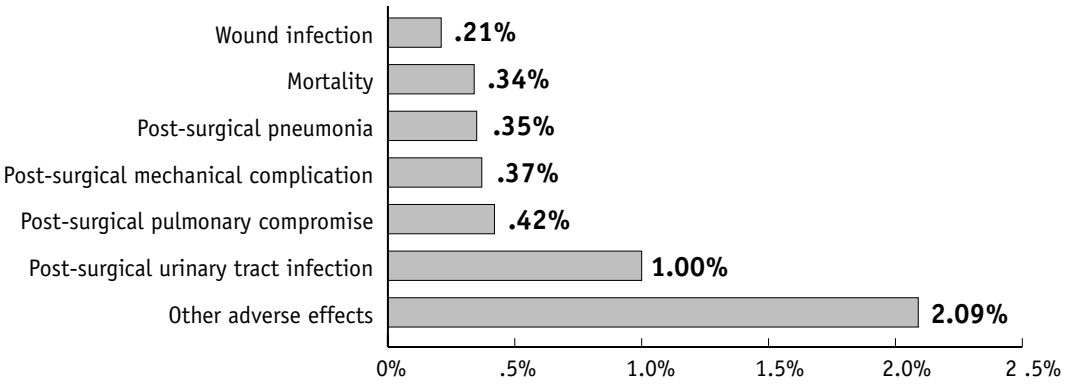
[25] A.E. Powell, H.T.O. Davies, R.G. Thomson, "Using Routine Comparative Data to Assess the Quality of Health Care: Understanding and Avoiding Common Pitfalls," *Quality and Safety in Health Care* (2003) 12: 122-128.

Study Findings

1) Inpatient costs per case at AHCs were significantly higher than at non-AHC hospitals, even after controlling for patient case mix, severity, and other controllable characteristics. The study found AHC inpatient cost per case to be 19 percent higher than at non-AHC hospitals.

2) The most commonly occurring poor clinical outcomes are infrequent events for secondary care; that is, potentially avoidable morbidity and mortality outcomes are low for patients in this sample regardless of whether care is delivered in AHCs or non-AHC hospitals.

Percentage of Patients Experiencing Adverse Outcomes (average of AHCs and non-AHCs)



Measured in terms of seven possible adverse outcomes for this patient population, quality at the AHCs was better than at non-AHC hospitals in two out of the seven and no better in five out of the seven adverse outcomes. For three of these five outcomes, the non-AHC hospitals had a higher measurable quality of care.

3) Measured in terms of seven possible adverse outcomes for this patient population, quality at the AHCs was better than at non-AHC hospitals in two out of the seven and no better in five out of the seven adverse outcomes. For three of these five outcomes, the non-AHC hospitals had a higher measurable quality of care.

Comparison of AHCs and non-AHCs in the likelihood of seven adverse outcomes

	Less likely in AHCs	Less likely in non-AHCs	No difference
Wound Infection		✓	
Mortality		✓	
Post-surgical Pneumonia	✓		
Post-surgical Mechanical Complication			✓
Post-surgical Pulmonary Compromise	✓		
Post-surgical Urinary Tract Infection		✓	
Other Adverse Effects			✓

4) Length of stay at AHCs and non-AHC hospitals was virtually the same.

For details, please see table 3 in the technical appendix.

Implications for AHCs and Community Hospitals

The study design considers all publicly available, measurable characteristics of patients or hospitals that can be derived from administrative data sets and are known to account for variations in quality or cost outcomes, including disease severity, case mix, patient age and gender, hospital payer mix and location, and transfer status of patients. The sample population of privately insured, under-65 patients receiving care for secondary conditions should reduce the possibility that patient characteristics not considered explain the differences in observed outcomes. The poor outcomes measured in this study are such rare events that detecting statistically meaningful differences requires a very large sample size. Manually sampling over a million records is not feasible. Perhaps in the future when more medical records are electronic, more detailed clinical data could be used to understand the outcomes observed in this paper. At this point, however, the data used in this study are already being used in the marketplace by consumers, employers, and purchasers to make choices. What that data say about outcomes needs to be understood by policymakers and providers alike. The implications of our findings are discussed below.

While not all consumers have access to a community hospital for secondary care—for instance, residents within Boston city limits seeking maternity care only have choices among AHCs—many who seek secondary care in an AHC could choose a closer community hospital. To use Boston AHCs again as an example, there are two deliveries in Boston AHCs by women living outside the city limits for every one delivery by a woman living within city limits.[26] Most of these non-city residents could have gone to a local community hospital for their delivery. For our sample, we found that on average, patients choosing a lower-cost community hospital for secondary care would receive care of similar quality to that provided in AHCs.

If large numbers of patients do respond to financial incentives and such quality of care data as have been presented here, the AHCs stand to lose a significant share of the under-65 privately insured secondary care market to non-AHC hospitals.

If large numbers of patients do respond to financial incentives and such quality of care data as have been presented here, the AHCs stand to lose a significant share of the under-65 privately insured secondary care market to non-AHC hospitals. For the community hospitals, such a shift would mean a financial boost if they were able to manage the increased demand. While in the aggregate, the bed capacity of community hospitals in our sample states appeared adequate to absorb all of the secondary care provided in AHCs,[27] it is not likely that each local market area would have adequate community hospital bed capacity. In Massachusetts, where the total number of beds decreased 27 percent between 1990 and 2001, the bed loss was proportionately greater in community hospitals.[28] Skilled labor shortages also would impact community hospital capacity.

To the extent that community hospitals increased their privately insured patient mix, they would likely also improve their financial position, while AHCs' finances would deteriorate. Payment as a percentage of cost is generally higher for privately insured patients when compared to Medicare and Medicaid patients. In 2000, the national ratio of average payment to average cost for privately insured patients was 113 percent, while the Medicare ratio was 100 percent (payment equaled cost) and the Medicaid ratio was 96 percent (payment was below average cost).[29]

[26] Massachusetts Division of Health Policy and Finance, p. 4.

[27] Kane and Siegrist, p. 22.

[28] Massachusetts Division of Health Policy and Finance, "Health Care Delivery System," *Chapter 3 in Massachusetts Health Care Trends, 1990–1999,* p. 35.

[29] Medicare Payment Assessment Commission, "Report to the Congress: Medicare Payment Policy," Washington, DC, March 2002, Table B-11, p. 145. Available online at http://www.medpac.gov.

Subsidies from patient care, including the positive margins on privately insured patients, are used by AHCs to fund non-clinical activities, such as teaching and unfunded research. A shift in secondary care patients from AHCs to community hospitals would decrease the funds available to support those activities that are considered part of the mission of AHCs.

Consumer-driven health care could force greater accountability and a healthy dose of public scrutiny on AHCs and community hospitals alike.

The potentially serious financial effects on AHCs of a shift of patient volume to lower cost hospitals have prompted some to consider alternative means for financing medical education and research. The Task Force on AHCs has recently called for separate, public funding and greater AHC accountability for their teaching, research, and other unfunded missions. The Task Force has proposed "open, flexible, administratively simple, predictable, and accountable" mechanisms to support mission-related activities of AHCs, mechanisms that do not rely on clinical income to subsidize teaching, research, and care for the uninsured.[30] Some kind of alternative funding scheme is likely to become widely supported by AHCs themselves if consumer-driven health insurance products lead privately insured secondary care patients toward non-AHC sites of care.

On the other hand, consumer-driven health plans could encourage positive change within teaching hospitals. The intensity of care in AHCs, coupled with the complexity of the organizations and the inexperience of residents, requires sustained attention to communication, coordination, and management infrastructure in order to maintain or improve clinical quality of care. Greater public awareness of clinical quality measures, along with financial incentives for patients to choose lower-cost community hospitals, may exert pressure on AHCs to focus greater resources and managerial attention on quality improvement processes. Consumer-driven health care could force greater accountability and a healthy dose of public scrutiny on AHCs and community hospitals alike. Some public policy action may be required to insure that the dose is not lethal to valuable institutions.

[30] Task Force on AHCs, pp. 45-48.

TECHNICAL APPENDIX

Descriptive Statistics

Selected descriptive statistics of patient and hospital characteristics are summarized in table 1. Twenty percent of the total sample population were patient discharges from AHCs.[31] The total sample size was 1.9 million; 7.4 percent or 137,125 patients in the study were treated in Massachusetts. The Diagnosis-Related Groups "Vaginal Delivery," "Cesarean," and "Uterine/ Adnexa Procedures" constituted a significant portion of the entire 39 DRG group sample, 29 percent, 10 percent, and 8 percent respectively, and females were 75 percent of our sample.

Table 1. Descriptive Statistics for Characteristics of AHCs and Community Hospitals

Patient Characteristics	Total	%	AHCs	Row %	Column %	Non-AHCs	Row %	Column %
All Patients	1,852,740		377,977	20.40		1,474,763	79.60	
<0 years	3,992	0.22	2,281	0.60	57.1	1,711	0.12	42.9
1-17 years	59,825	3.23	14,272	3.78	23.9	45,553	3.09	76.1
18-44 years	1,147,127	61.92	234,667	62.08	20.5	912,460	61.87	79.5
45-54 years	325,946	17.59	65,098	17.22	20.0	260,848	17.69	80.0
55-64 years	315,850	17.05	61,659	16.31	19.5	254,191	17.24	80.5
Female	1,389,016	74.97	277,950	73.54	20.0	1,111,066	75.34	80.0
Male	463,724	25.03	100,027	26.46	21.6	363,697	24.66	78.4
Severity Level 0	1,290,310	69.64	256,816	67.94	19.9	1,033,494	70.08	80.1
Severity level 1	419,688	22.65	87,971	23.27	21.0	331,717	22.49	79.0
Severity Level 2	119,952	6.47	27,577	7.30	23.0	92,375	6.26	77.0
Severity Level 3	19,336	1.04	5,271	1.39	27.3	14,065	0.95	72.7
Hospital Characteristics	**Total**	**%**	**AHCs**	**Row %**	**Column %**	**Non-AHCs**	**Row %**	**Column %**
Metro	1,718,801	94.16	372,557	99.06	21.7	1,346,244	92.89	78.3
Rural	106,563	5.84	3,552	0.94	3.3	103,011	7.11	96.7
Hospital Characteristics	**Mean (total hospitals)**	**SD**	**Mean (AHCs)**	**SD**		**Mean (Non-AHCs)**	**SD**	
% Medicaid Discharges	12.12	10.26	15.09	11.18		11.36	9.87	
% Medicare Discharges	38.84	11.91	32.55	8.49		40.45	12.13	
% Self Pay Discharges	3.21	3.11	3.09	3.69		3.24	2.95	
% Private Discharges	41.96	13.42	44.25	11.66		41.37	13.78	
% Other Pay Discharges	3.87	5.71	5.02	6.65		3.57	5.41	
State Distributions	**Total**	**%**	**AHCs**	**Row %**	**Column %**	**Non-AHCs**	**Row %**	**Column %**
CA	600,661	32.42	53,327	14.11	8.9	547,334	37.11	91.1
FL	310,171	16.74	17,105	4.53	5.5	293,066	19.87	94.5
IL	274,008	14.79	72,748	19.25	26.5	201,260	13.65	73.5
MA	137,125	7.40	60,547	16.02	44.2	76,578	5.19	55.8
NY	369,966	19.97	147,650	39.06	39.9	222,316	15.07	60.1
VA	160,809	8.68	26,600	7.04	16.5	134,209	9.10	83.5

[31] The proportion in our sample by state ranged from 5.5 percent to 44.2 percent: California (8.9), Florida (5.5), Illinois (26.5), Massachusetts (44.2), New York (39.9), Virginia (16.5).

Table 2 summarizes descriptive statistics for dependent variables. The figures illustrate that the potentially avoidable morbidity and mortality outcomes are low for patients in this sample (regardless of whether care is delivered in teaching or nonteaching hospitals). Adverse effects occurred in about 2 percent of this population; urinary tract infection occurred in 1 percent of the at-risk population, and all other outcomes fell below 0.5 percent. Although the at-risk populations for the four post-surgical models were significantly smaller, the numbers remained viable given the large initial sample size. Mean total cost for secondary care in this population was $4,227.21.

Table 2. Descriptive Statistics for Outcomes Measures

	Number of patients experiencing the adverse outcome	Number of patients at risk	% of at-risk patients experiencing the adverse outcome
Wound Infection	3,919	1,852,740	.21%
Mortality	6,260	1,852,740	.34%
Pneumonia After Surgery	1,287	372,076	.35%
Mechanical Complications	1,410	385,808	.37%
Pulmonary Compromise	1,571	370,615	.42%
Urinary Tract Infection	2,242	224,860	1.00%
Other Adverse Effects	38,724	1,852,740	2.09%

	Mean for all patients	Mean for patients experiencing the adverse outcome
Length of Stay (mean, standard deviation)	3.05 days	3.31 days
Total Cost (mean, standard deviation)	$4,227.21	$8,442.41

Regression Results

Results of the regression analysis are presented in table 3. Consistent with prior research, we find costs significantly higher in AHCs than community hospitals, with the coefficient indicating that costs are 18.5 percent higher. Length of stay is longer in AHCs but the difference is small, approximately 3 percent.

There is no consistent evidence that adverse outcomes are lower in AHC hospitals. The odds ratios (OR) are significantly lower in AHCs for only two of the seven adverse outcomes studied (post-surgical pulmonary compromise and post-surgical pneumonia). There is no statistical difference in two other outcomes (adverse effects and post-surgical mechanical complications). For three outcomes, adverse event rates controlled for patient and other hospital characteristics are higher in AHCs, including mortality among this low-risk population, wound infection, and post-surgical urinary tract infection.

Table 3. Quality and Cost Outcomes, AHCs compared to Community Hospitals, Patient-level Regressions [32]

	N	Odds ratio on AHCs	95% CI	P>|z|
Mortality	1,825,364	1.27	1.16 - 1.40	0.000
Wound Infection	1,825,364	1.15	1.03 - 1.28	0.011
Other Adverse Effects	1,825,364	.98	.89 - 1.08	0.679
Post-surgical Mechanical Complication	380,055	1.10	.96 - 1.27	0.179
Post-surgical Pulmonary Compromise	365,714	.73	.59 - .90	0.003
Post-surgical Pneumonia	310,500	.74	.59 - .91	0.006
Post-surgical Urinary Tract Infection	38,281	1.22	1.06 - 1.40	0.006
	N	**OLS coefficient on AHCs**	**95% CI**	**P>|t|**
Logged Length of Stay	1,825,364	1.04	1.03 - 1.04	0.000
Logged Total Cost	1,704,019	1.19	1.18 - 1.19	0.000

[32] "Odds ratio" represents the likelihood of experiencing the adverse outcome in an AHC relative to the likelihood of experiencing it in a community hospital (which is set at 1.00). P is the probability that the observed differences in the odds ratios between AHCs and community hospitals are not real differences. Thus, patients treated in AHCs have an odds ratio of experiencing pulmonary compromise after surgery that is only 73 percent of the odds ratio for patients treated in community hospitals, and there is a 99.7 percent chance that the difference in these odds ratios is real.

Table 4. DRGs: Descriptive Statistics by Hospital Status

DRG categorization	Total	%	AHCs	%	Non-AHCs	%
AMI	26,596	1.44	3,142	.83	23,454	1.59
Antepartum	39,058	2.11	9,432	2.50	29,626	2.01
Appendectomy	42,231	2.28	6,922	1.83	35,309	2.39
Arrhythmias	30,363	1.64	5,613	1.49	24,750	1.68
Atherosclerosis	14,949	.81	1,589	.42	13,360	.91
Back & Neck	36,687	1.98	9,852	2.61	26,835	1.82
Bronchitis/Asthma	25,960	1.40	4,198	1.11	21,762	1.48
COPD	21,212	1.14	2,603	.69	18,609	1.26
Cardiac Cath	43,477	2.35	11,008	2.91	32,469	2.20
Cellulitis	24,494	1.32	5,037	1.33	19,457	1.32
Cesarean	190,140	10.26	38,992	10.32	151,148	10.25
Chemotherapy	21,459	1.16	11,612	3.07	9,847	.67
Chest Pain	78,283	4.23	11,913	3.15	66,370	4.50
Gastro-Esoph	76,992	4.16	12,540	3.32	64,452	4.37
GI Hemorrhage	23,409	1.26	3,929	1.04	19,480	1.32
GI Obstruction	14,486	.78	3,197	.85	11,289	.77
Heart Failure	22,203	1.20	3,798	1.00	18,405	1.25
Inflammatory Bowel	9,895	.53	2,644	.70	7,251	.49
Kidney Procedures	9,422	.51	4,496	1.19	4,926	.33
Kidney/Urinary Infections	17,350	.94	3,203	.85	14,147	.96
Lap Chole	41,526	2.24	6,853	1.81	34,673	2.35
Lower Extremity	22,035	1.19	5,104	1.35	16,931	1.15
Major Bowel	31,775	1.72	8,435	2.23	23,340	1.58
Major Chest	12,919	.70	4,984	1.32	7,935	.54
Major Joint	35,441	1.91	8,240	2.18	27,201	1.84
Major Male Pelvic	11,302	.61	4,023	1.06	7,279	.49
Medical Back	16,593	.90	3,344	.88	13,249	.90
OR for Obesity	11,811	.64	3,456	.91	8,355	.57
Other Circulatory	13,848	.75	4,252	1.12	9,596	.65
Other Digestive	15,030	.81	3,520	.93	11,510	.78
Other Vascular	11,483	.62	3,470	.92	8,013	.54
PVD	14,474	.78	3,192	.84	11,282	.77
Pancreas	21,685	1.17	3,768	1.00	17,917	1.21
Pneumonia	37,729	2.04	5,931	1.57	31,798	2.16
Poisoning/Toxic Drug	16,704	.90	2,697	.71	14,007	.95
Seizures	22,631	1.22	5,760	1.52	16,871	1.14
Spinal Fusion	32,360	1.75	8,933	2.36	23,427	1.59
Stroke	21,592	1.17	4,423	1.17	17,169	1.16
Syncope & Collapse	13,970	.75	2,852	.75	11,118	.75
Uterine/Adnexa Proc	141,741	7.65	23,995	6.35	117,746	7.98
Vaginal Delivery	537,425	29.01	105,025	27.79	432,400	29.32

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