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Utilization and Payment Effects of Medicare Referrals to Long-Term Care Hospitals (LTCHs)

Final Report

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EXECUTIVE SUMMARY

Purpose

Long-term acute care hospitals (LTCHs) provide care for complex patients who are transferred from general acute care hospitals after having been identified as likely to need several weeks of continued acute care. Only 1%–2% of all Medicare discharges from general acute care hospitals are admitted to LTCHs for further care. For certain complex conditions, however, such as patients who need to be weaned from prolonged mechanical ventilation or those recovering from complex infections, transfers to LTCHs have become a more standard practice. LTCH use is also more common in some parts of the country than in others. The Centers for Medicare & Medicaid Services (CMS) is interested in understanding how these care decisions affect resource use. Specifically, CMS would like to understand any differences in Medicare payments, facility costs, and Medicare margins between patients referred to LTCHs and patients with similar conditions and levels of acuity who do not use LTCHs but remain for longer periods in general acute care hospitals.

Comparing LTCH patients to non-LTCH patients is difficult because those who use LTCHs have already been identified as needing several weeks of continued acute care, and they are therefore more severely ill than other patients admitted for the same conditions. As a result, we expect LTCH use to be associated with higher costs and higher Medicare payments. Our study used statistical matching based on clinical data from Medicare claims to control for the selection of sicker patients into LTCHs. We then estimated the impact of referral to LTCHs using the difference between LTCH users and clinically similar non-LTCH users in Medicare payments, costs, margins, and lengths of stay.

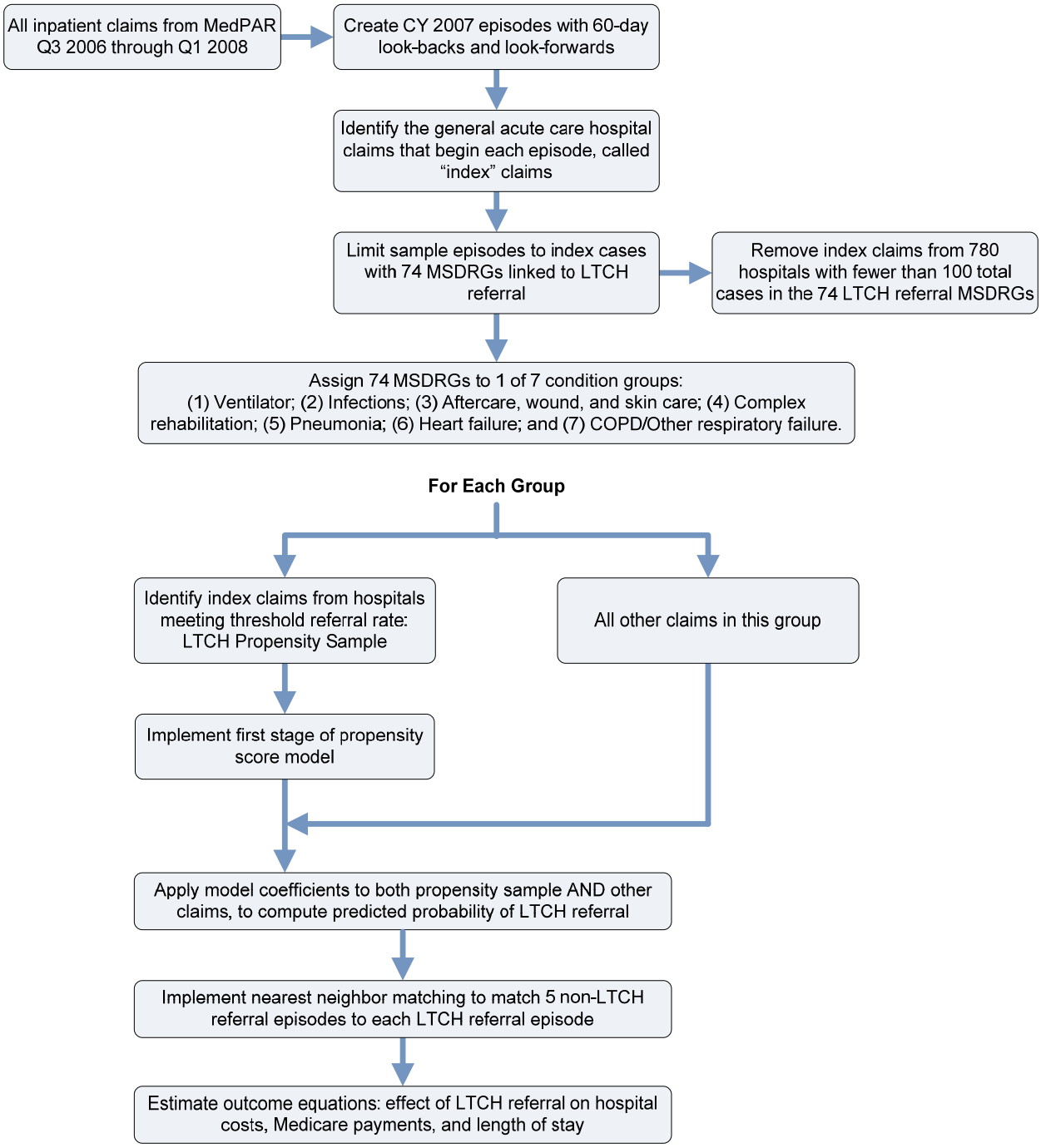
Methodology

We began by identifying a set of conditions in general acute care hospitals paid under the inpatient prospective payment system (IPPS) in which LTCH referral is more common. Conditions were defined using Medicare severity diagnosis-related groups (MS-DRGs). We then constructed inpatient episodes of care anchored on an index general acute care hospital admission for all of these conditions. To create matched groups of patients referred to LTCHs and patients not referred to LTCHs, we implemented a propensity score matching (also called pseudo-randomization) technique that is commonly used for the evaluation of non-experimental interventions.

All facility claims were matched by provider number and discharge date to Medicare cost reports. Hospital-specific cost-to-charge ratios were computed for each of the types of service charges that are summarized in the Medicare Provider Analysis and Review File (MedPAR) claims files. These ratios were used to convert charges on these claims to estimated costs.

Figure ES.1 provides an overview of our technical approach and is followed by a description of the specific steps used in the modeling.

Figure ES.1
Technical approach for episode analysis



NOTE: MedPAR = Medicare Provider Analysis and Review File; MS-DRG = Medicare severity diagnosis-related groups; LTCH = long-term acute care hospitals; COPD = chronic obstructive pulmonary disease.

1. We used the 2008 3M grouper software that assigns an MS-DRG to each claim to group claims from the 2006 MedPAR file, and identified 74 MS-DRGs with higher than average rates of LTCH referral. These 74 MS-DRGs were then aggregated into seven condition groups: ventilator; infection; aftercare, wound, and skin care; complex rehabilitation; pneumonia; heart failure; and chronic obstructive pulmonary disease (COPD)/other respiratory failure.

2. We constructed episodes of care using all 2007 MedPAR inpatient claims, searching within 60 days of admission and discharge dates to a general acute care hospital to find claims from other admissions—including those to LTCHs, skilled nursing facilities (SNFs), and inpatient rehabilitation facilities (IRFs)—for the same Medicare beneficiary. The index hospitalization was identified as the general acute care hospital discharge that was preceded by at least 60 days with no other inpatient acute or skilled nursing days. We ran the 2008 3M grouper against these claims and then limited our episode sample to patients for whom the index discharge was assigned to one of the 74 study MS-DRGs.

3. We estimated random-effects logistic regressions to predict LTCH referral. The dependent variable in each model was an indicator equal to one if the index claim was discharged to an LTCH. The explanatory variables included demographics and patient characteristics from the index claim such as age and sex, number of critical care days, reasons for admission, procedures performed, and organ failures and key comorbidities. We constructed a separate model for each of seven groups of conditions. For each group, the propensity estimation sample was limited to hospitals that had a history of referrals to LTCHs.

4. For each observation in the propensity estimation sample, we calculated the individual's propensity score, which is the predicted probability of LTCH referral. We also made an out-of-sample prediction of the probability of LTCH referral for each observation in the sample of hospitals with low or no referral to LTCHs, by applying the coefficients from the propensity score models to the covariate values of the out-of-sample observations. We drew our control group from the set of patients who were not referred to LTCHs in both the propensity-sample hospitals and the out-of-sample hospitals.

5. We then matched up to five non-LTCH users to each LTCH user using the "nearest neighbor" approach, which identified controls with predicted probabilities that were closest in value to the propensity scores of the cases. Matching was implemented with replacement, meaning that an observation could serve as a control for more than one case. Non-LTCH users without a match were then dropped from the comparison samples. The key underlying assumption here is that observations with similar referral probabilities will have similar clinical characteristics, including similar acuity. By using non-LTCH controls from hospitals with low LTCH referral patterns (many of which are hospitals located in parts of the country with few LTCHs), we attempted to minimize the possibility that our non-LTCH controls were similar to our LTCH cases in observed characteristics but different from them in some important but unobserved characteristics.

6. Using the matched sample, we estimated multivariate linear regressions for each condition group, for each of the dependent outcome variables: Medicare payments, costs, and margins (expressed as Medicare payment-to-cost ratios); and acute episode days. The explanatory variables of interest were indicator variables for LTCH referral. In some models, we interacted the LTCH referral variable with additional indicator variables denoting lower and higher referral probability, to assess possible heterogeneity in the LTCH referral effects. The coefficients on the LTCH referral indicator variables and their interaction terms identify the study questions of interest.

7. Additional patient-level control variables that were added to the outcome equations included indicators for other transfers (specifically, to other general acute care hospitals or other post-acute care facilities), and a set of mortality indicators to capture the effects of mortality within 2, 3, or 4 weeks of admission. Additional non-patient control variables included organizational characteristics of the index general acute care hospital such as teaching status, size, case-mix, and other market characteristics of the index hospital. Finally, in some models in which key clinical variables were not balanced between the LTCH users and non-users in the final matched analysis sample, we included these clinical measures in the outcome equation as well.

The two-step process using both propensity score matching and multivariate outcomes regressions is designed to control for the underlying differences between the LTCH and non-LTCH populations and improve the potential for unbiased estimates of the outcome differences. There are numerous patient characteristics influencing the transfer decision, however, that cannot be captured in claims data. The success of the propensity score approach rests on an assumption that the observed characteristics—the claims-based variables used in the initial referral model—are correlated with these other unobserved characteristics. The accuracy of this assumption can rarely be tested directly but can sometimes be assessed indirectly. One approach we took was to examine characteristics of the index admission alone, to identify differences between LTCH users and non-users in costs for the initial general acute care hospitalization.

Model Results

In analyzing utilization and financial outcomes for the full inpatient episodes of care, we found that:

- Patients transferred to LTCHs have longer stays, higher total payments, and higher provider costs than clinically similar patients who complete their acute care during the index general acute care hospital admission. We found this for all seven condition groups. Both payments and costs are estimated to be significantly higher for LTCH users. The magnitude of the differences varies by condition and varies between low and high referral probability patients. Significant positive differences were found, however, for every patient subgroup.

- Patients in the ventilator condition group show the smallest proportional differences in Medicare stays, payments, and costs between LTCH users and non-users. The largest differences for Medicare payments were found in pneumonia group; the

largest differences for costs were in the complex rehabilitation group; and the largest differences in episode length of stay were in the heart failure group.

- In five of the seven condition groups, Medicare payment-to-cost ratios averaged across the full episode were higher for LTCH users than non-users. This was particularly true for episodes where the index admissions had high LTCH referral probability scores ("most likely referrals"). The ventilator group and the complex rehabilitation group were the noticeable exceptions to this pattern; in these two groups, incremental episode costs associated with LTCH referral were greater than incremental episode payments associated with LTCH referrals.

Simulations

The payment and cost models in our analysis were estimated in log-linear form. For the most part we express our results in the form of proportional effects—that is, the percent difference in the outcome variable that can be expected from a one-unit change in the independent variable of interest (in this case, LTCH transfer). For ease of interpretation, we also constructed simulations to illustrate the absolute level of the estimated LTCH referral effects, restricting the simulation sample to the group of patients with the highest referral likelihood within each condition group. We predicted expected episode payments, episode costs, and episode lengths of stay for each observation in the highest quartile of LTCH referral probability for each condition group, under two scenarios: the first models all patients as if they were LTCH users; the second models all patients as if they were not LTCH users.

There are two typical approaches to construct simulations from regression models. One is to identify covariate characteristics of a typical or "reference" episode and to compute the expected difference in outcome for that reference episode with and without LTCH referral. The other approach uses the sample covariate values as they are and computes the expected difference in outcomes averaged over the sample. We chose the second approach; thus all other covariate values for the observations in our simulation samples were left unchanged. The results are presented in ***Table ES.1***.

- **Episode days**— LTCH referrals are associated with much longer hospital stays. In ***Panel A***, increases in total hospital utilization (including general acute and specialty hospitals) range from 17.8 days in the COPD group to 29.5 days in the complex rehabilitation group. The lowest proportional effect is for ventilator patients (a 48% increase) and the highest is for pneumonia patients (a 128% increase). As discussed later in this report, the increase in total hospital days cannot be attributed to substitution of LTCH care for stays in a skilled nursing facility.

- **Medicare payments**—The simulation results provide substantial evidence that LTCH referrals lead to large increases in Medicare outlays. In ***Panel B***, the smallest increase in Medicare episode payments is $24,143 in the COPD/other respiratory group, and the largest increase is $39,547 in the complex rehabilitation group.

- **Medicare costs**—We found that the episode costs are also substantially higher for LTCH users (***Panel C***). In all but the ventilator condition group, the proportional increase in costs is much greater than the proportional increase in hospital days, indicating that longer stays drive some but not all of the cost differences. Also, simulated episode costs are higher than the simulated episode payments, in all condition groups except the ventilator group.

- **Medicare margins**—In ***Panel D***, we present the aggregate average Medicare margins for the full episode of care implied by the simulated episode payments and costs. These margins are an average across different sites of care and therefore are not representative of the profitability of any one care setting. In the ventilator group, margins are 1.3 percentage points lower for the LTCH referral episodes; but in all other condition groups, the margins for the full episode of care are higher if all the patients were referred to LTCH than if all patients were not referred. There is substantial variation across the condition groups in the margin difference. For the complex rehabilitation group, simulations show LTCH users to have margins that are 5.0 percentage points higher; but for the pneumonia group the LTCH users have margins that are 56.8 percentage points higher. Higher margins for the full episode of care for LTCH users indicate that LTCH PPS margins are higher than other IPPS margins, suggesting a payment parity problem between general acute care hospitals and LTCHs for at least some MS-DRGs. With the exception of the ventilator group, all of the aggregate simulated margins for the episodes of care are negative.

Table ES.1
Simulation of the impact of long-term care hospital use on episode payments, costs, margins, and days: Matched sample of patients with the highest likelihood of long-term care hospital referral

Panel A: Number of acute episode days simulation

Condition group	N	If all cases referred to LTCH	If no cases referred to LTCH	Difference	Percent difference
Ventilator group	6,546	68.0	45.8	22.2	48%
Infection group	6,851	51.8	27.1	24.7	91%
Aftercare, wound, and skin care group	4,015	55.8	30.4	25.4	84%
Complex rehabilitation group	805	54.6	25.1	29.5	118%
Pneumonia group	1,306	41.5	18.2	23.3	128%
Heart failure group	915	43.2	20.1	23.1	115%
COPD/other respiratory group	1,706	37.2	19.4	17.8	92%

Panel B: Medicare episode payment simulation

Condition group	N	If all cases referred to LTCH	If no cases referred to LTCH	Difference	Percent difference
Ventilator group	6,546	$135,351	$99,316	$36,035	36%
Infection group	6,851	59,918	28,350	31,568	111%
Aftercare, wound, and skin care group	4,015	59,357	26,878	32,479	121%
Complex rehabilitation group	805	60,682	21,135	39,547	187%
Pneumonia group	1,306	41,435	11,030	30,405	276%
Heart failure group	915	38,881	12,415	26,466	213%
COPD/other respiratory group	1,706	37,652	13,509	24,143	179%

Panel C: Medicare episode cost simulation

Condition group	N	If all cases referred to LTCH	If no cases referred to LTCH	Difference	Percent difference
Ventilator group	6,546	$119,163	$86,135	$33,028	38%
Infection group	6,851	61,495	31,187	30,308	97%
Aftercare, wound, and skin care group	4,015	65,301	32,238	33,063	103%
Complex rehabilitation group	805	68,670	24,977	43,693	175%
Pneumonia group	1,306	45,624	18,414	27,210	148%
Heart failure group	915	51,707	20,909	30,798	147%
COPD/other respiratory group	1,706	45,274	21,774	23,500	108%

Panel D: Aggregate average Medicare margins simulation

Condition group	N	If all cases referred to LTCH	If no cases referred to LTCH	Point Difference
Ventilator group	6,546	12.0%	13.3%	-1.3
Infection group	6,851	-2.6%	-10.0%	7.4
Aftercare, wound, and skin care group	4,015	-10.0%	-19.9%	9.9
Complex rehabilitation group	805	-13.2%	-18.2%	5.0
Pneumonia group	1,306	-10.1%	-66.9%	56.8
Heart failure group	915	-33.0%	-68.4%	35.4
COPD/other respiratory group	1,706	-20.2%	-61.2%	40.9

NOTES: LTCH = long-term care hospital; COPD = chronic obstructive coronary disease. Highest likelihood of LTCH referral defined as those cases in the top quartile of the propensity score.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Potential Limitations

One possibly significant limitation of the study is the absence of data on SNF payments and costs. If LTCH stays are substituting, even in part, for high-level SNF care, then our models will overstate the episode cost and payment differentials attributable to LTCH use. To explore the effects of this limitation, we included SNF days in the definition of the episode in some of the analyses. Based on days of care, we found little evidence of a substitution effect between SNFs and LTCHs. Overall, 41.2% of LTCH cases and 42.7% of matched non-LTCH controls had a SNF stay within the episode. In our simulation results, SNF stays were the same or *longer* for LTCH users compared to non-users in five out of the seven condition groups. In the conditions groups for ventilator care and aftercare, wound, and skin care, the non-LTCH users averaged only about 1.5 more days in SNFs than did LTCH users.

We have conducted extensive sensitivity tests to assess the impact of the decisions made in the analysis design regarding estimation samples, variable specifications, and statistical techniques. Overall, the pattern of the results is robust to the sensitivity analyses. Matching, by itself, substantially reduces differences in each of our outcome variables between LTCH users and non-LTCH users. Using multivariate regression to introduce additional control variables in the outcome comparisons on matched groups further reduces the differences. LTCH referral effects as identified by the coefficients on the LTCH indicators for high referral likelihood patients are statistically significant yet, with the exception of the ventilator group, still have wide confidence intervals. Bootstrapped standard errors on the simulation results were not computed, but we note that the magnitude of the coefficients is always large and positive, even though not always precisely estimated.

We recognize the limitations of analyses based on the limited clinical information available from claims data. Consequently, we are still concerned that due to uncontrolled selection effects, at least some of the higher resource use observed in LTCH users may still be attributable to higher patient acuity rather than care settings or transfer decisions.

As a further check on our findings, we compared outcomes for matched episodes located in New York, Oregon, and Virginia (states with few or no LTCHs) to outcomes of episodes in Oklahoma and Texas (states with high LTCH use). Large differences in resource use were still evident.

Examining differences in the index general acute care hospitalizations for the matched sample is one way to check for remaining selection bias. If LTCHs are substituting for extended general acute care hospitalization, then other things being equal, index hospitalization costs should be lower for cases that are transferred to LTCHs than for those that remain in the index general acute care hospital for the duration of their acute stay. Among patients in the higher referral probability categories, we found that index hospitalization costs for LTCH users were significantly lower in the ventilator group (as expected); and they were similar or *lower* in the infection and wound-care groups; and actually higher in the complex rehabilitation and heart failure groups.

If, even after statistical matching, costs for the index general acute hospital stays for LTCH users are higher than costs for non-LTCH users, we should suspect that the LTCH users

are still systematically sicker. The magnitude of our findings across all condition groups, and their robustness to many specification changes, suggest that the differences we see between LTCH users and matched non-users are too large to be attributed solely to selection bias. This study makes a significant contribution to our understanding of the role of LTCHs in long-term critical and acute care, even as it points to the need for further exploration.

Unmeasured selection factors can affect the likelihood of LTCH use from both sides of the transfer decision—those influencing the decisions of the index hospital to look for an LTCH transfer and those influencing the decisions of the LTCH hospital to accept the patient. We conducted extensive modeling to identify transfer predictors from the index hospital's perspective. These were either included in outcome models as covariates or included as a basis for matching. We may not have been as successful at capturing factors that identify the best LTCH admission from the perspective of the LTCHs. LTCHs are looking for specific types of patients that fit their clinical expertise, but must also function within regulatory restrictions that promote long-staying patients (greater than 25 days) and penalize shorter-than-expected stays. We acknowledge that our model may not control for this adequately.

SECTION 1
INTRODUCTION

1.1 Background

Long-term acute care hospitals (LTCHs) provide care for complex patients who are transferred from general acute care hospitals after having been identified as likely to need several weeks of continued acute care. Only 1%–2% of all Medicare discharges from general acute care hospitals are admitted to LTCHs for further care. For certain complex conditions, however, such as patients who need to be weaned from prolonged mechanical ventilation or those recovering from complex infections, transfers to LTCHs have become a more standard practice. LTCH use is also more common in some parts of the country than in others. The Centers for Medicare & Medicaid Services (CMS) is interested in understanding how these care decisions affect resource use.

This study uses data from the Medicare inpatient claims files to estimate differences in provider costs, Medicare payments, and length of Medicare stays among very complex patients, between those that use LTCHs and those that do not. The claims analyses are part of a larger study in which Kennell and Associates, and its subcontractor RTI International, examine patient and facility criteria needed to assure medical necessity and appropriateness of care for Medicare LTCH patients.

The chief difficulty in comparing economic or clinical outcomes between LTCH users and non-LTCH users is that patients transferred to LTCHs are generally much more severely ill than the typical hospital patient, and we would expect more severely ill patients to be more costly to the hospital and to the Medicare program. The key challenge in our analysis, therefore, was to construct an appropriate control group of non-LTCH users that were clinically similar to the patients referred to LTCH, such that comparing their costs and payments could provide a valid estimation of the effect of LTCH use on payments, costs, and margins.

1.2 Literature Review

1.2.1 Reports by the Medicare Payment Advisory Commission

In 2003, the Medicare Payment Advisory Commission (MedPAC) issued a report (MedPAC, 2003) that documented substantial changes in the LTCH industry over time, raising several issues of concern to the Medicare program. These changes included the rapid growth in the number of LTCH facilities and total Medicare LTCH spending; high concentrations of LTCHs in certain regions, with very uneven geographic distribution in others; higher total payments for LTCH users; and lack of evidence for improved clinical outcomes for LTCH users.

In particular, the 2003 MedPAC report compared payments across PAC settings, examining episodes of care for the top 11 conditions that generate LTCH transfers. The study design controlled for patient severity differences only using All Patient Refined Diagnosis-related Group (APR-DRG) assignments, grouping each of the 11 DRGs into one of four possible levels of severity. MedPAC concluded that for these conditions, LTCHs appeared to be an expensive substitute for skilled nursing facility (SNF) care, did not reduce stays in initial acute

admissions, and did not appear to reduce mortality. Yet the report cautioned that some of these findings could be due to unmeasured differences in case mix.

A subsequent MedPAC report in 2004 included results from reanalyzed claims data from the first half of 2001, using study designs that provided better control for selection of sicker patients into LTCH settings (MedPAC, 2004). The 2004 report described MedPAC's model to identify factors that predict LTCH use. The strongest predictor of LTCH use was having had a tracheostomy procedure in the acute setting, but other significant predicting conditions included DRGs for respiratory system diagnosis with ventilator support, acute and subacute endocarditis, amputation, skin graft and wound debridement, and osteomyelitis. Having an APR-DRG severity level of 3 or 4 in the acute admission was also independently associated with greater likelihood of subsequent LTCH use. Geographic proximity to an LTCH raised the probability of an LTCH admission by four times. In geographic areas without LTCHs, MedPAC's findings indicated that the use of freestanding SNFs was higher, particularly for tracheostomy patients and those with the highest probability of LTCH referral.

MedPAC identified two subsets of cases representing the most complex patients: those scoring above the 95th percentile in a model of the probability of LTCH use and those with a tracheostomy and long-term ventilator support. Restricting analysis to these two groups allowed MedPAC to compare episode outcomes across PAC settings for only the most medically complex cases. Their study also applied "instrumental variables" regression approaches, which used distance from the patient to the nearest LTCH as an instrument to provide statistical control for adverse selection into LTCHs that is not captured using APR-DRGs.

Among tracheostomy patients only, episode payments were found to be *lower* for episodes using LTCH than for others, and the difference was statistically significant. Among patients within the top 5% probability of using LTCH care, LTCH users and non-users had statistically similar episode payments. The report found *fewer* acute readmissions among those discharged into LTCHs compared with those discharged into other post-acute settings. Furthermore, it found a reduction in acute hospital length of stay associated with LTCH use—7 fewer days in the full sample and 9 fewer days in the most clinically complex group. Shorter acute stays for LTCH users suggest that LTCH care is not simply an alternative site for PAC but a substitute for latter parts of acute stays, specifically the days in step-down or intermediate care units that provide nursing levels most similar to the care in LTCHs.

Findings from the empirical analyses in the 2004 MedPAC report present a very different picture from descriptive findings in the 2003 report, which showed higher payments and poorer outcomes for patients using LTCHs. The 2004 report found that, for the most complex patients, LTCH use was associated with similar or improved outcomes at similar or lower Medicare payments, compared with other (or no) PAC use. These results held only for the most complex LTCH admission, not for other LTCH admissions. The difference between the 2003 and 2004 conclusions underscores the importance of identifying clinically appropriate comparison groups for the chronically critically ill patients seen in LTCHs.

1.2.2 Industry Reports

In response to the criticism of the LTCH industry generated by the MedPAC reports, the National Association of Long Term Hospitals (NALTH) sponsored two sets of studies of LTCH patients. The first study set—commonly referred to as the Barlow studies—examined patients admitted to 23 LTCHs over a 1-year period (Scheinhorn et al., 2007a, 2007b). The purposes of this research were to describe the post–intensive care unit (ICU) respiratory ventilator weaning population receiving LTCH care, characterize the LTCH facilities providing weaning services, and determine the outcomes and costs of LTCH use. The Barlow studies found that LTCHs are treating a critically ill population with complex needs and poor outcomes, and they pointed to the need for additional clinical data to better describe the LTCH patient population. However, the Barlow studies did not provide any outcome comparisons between LTCH patients and patients in other settings. Also, the focus on the ventilator weaning population did not allow for generalization to the majority of LTCH patients, who are not ventilator patients.

The second set of studies, sponsored by NALTH and completed by the Lewin Group, used Medicare claims data to examine the clinical and economic impacts of LTCHs (Dobson et al., 2004). The Lewin studies were primarily designed to address MedPAC's concerns that LTCHs may be an expensive alternative to other PAC with little or no clinical benefit. The Lewin studies updated the results of MedPAC's 2003 study with different methodology to control for adverse selection into LTCHs, finding that across the sample of all episodes, LTCH users had lower average payments and better clinical outcomes than non-LTCH patients. The sample size could not support estimates for particular types of episodes. Subsequent MedPAC analysis (MedPAC, 2004) demonstrated clearly that LTCH outcomes for the most complex patients are different from the outcomes for others. This implies that models based on average treatment effects across the sample are not appropriate for this purpose. Lewin's approach to control for selection would require modification to account for the expected variation in the impact of LTCH care across low- and high-complexity patients.

1.2.3 Previous RTI Reports

Our empirical approach in this report is guided by findings from two completed analyses conducted by RTI under contract to CMS (Gage et al., 2005). One study is a detailed review of LTCH prospective payment systems (PPS) rates and diagnosis-related group (DRG) weights; the other is a model of LTCH referral effects on outcomes of care for ventilator cases. Relevant contributions from each of these analyses are described here briefly.

Costs and Payments Under the Long-Term Care Hospital Prospective Payment System

In 2006, RTI reviewed LTCH Medicare costs and payments for the 2 years before and 2 years after implementation of LTCH PPS. Immediately after PPS was implemented (fiscal years [FYs] 2003 and 2004), LTCH margins were found to be much higher than margins in the 2001–2002 period under the prior payment system, which was based on the Tax Equity and Fiscal Responsibility Act of 1982. Margins were also much higher than inpatient prospective payment system (IPPS) Medicare margins for the same DRGs. We found that ventilator and other respiratory-related LTCH DRGs were paid far in excess of expected costs and generated very high PPS margins, whereas LTCH DRGs related to rehabilitation and wound care were paid at rates at or slightly above costs, generating margins that were closer to, although still slightly

higher than, average IPPS margins. We attributed higher overall LTCH margins to the fact that the initial standardized (or base) LTCH PPS rate was substantially overstated.

At the same time, RTI found that the wide variation in margins across LTCH DRGs was evidence of severe bias in the relative weights. In a follow-up study using data from 2005 and 2006 (Gage et al., 2007), we found lower overall LTCH PPS margins but no change in the evidence of bias in the weights. We concluded that the LTCH DRG weights continue to be systematically distorted in favor of case types that use extensive respiratory therapy and other ancillary services and against case types that rely on more intense nursing. Similar though less severe bias in the IPPS weights has been identified in past research, but this bias has been greatly reduced since the introduction of cost-based weights in FY 2007 (Dalton, 2007; Wynn et al., 2007; Wynn and Scott, 2007). Results from this earlier margins study and its update strongly suggest that (1) episode-level margins in the current study will vary by Medicare severity diagnosis related group (MS-DRG), LTCH study condition, or both; (2) episode margins will be higher for LTCH users than for non-users; and (3) the ventilator and other respiratory-related cases will likely have higher margins than other cases.

Outcome Differences Among Ventilator Support Cases in Long-Term Care Hospitals

A second claims-based study was conducted under the same CMS contract to identify the referral effects attributed to LTCH use among acute care ventilator patients only. The study population was limited to beneficiaries living in the three states with the highest LTCH admission rates in the country at that time (Texas, Louisiana, and Oklahoma). Because the three study states were identified on the basis of their unusually high LTCH bed supply, admission patterns in the study area cannot be considered representative of other parts of the country.

RTI used a propensity-score approach to stratify episodes according to their predicted probability of an LTCH referral based on patient and clinical variables alone. The propensity score algorithm identified six statistically balanced groups of episodes, within which actual LTCH use or nonuse simulated a random assignment.[1] The outcome variables of interest included covered inpatient days, Medicare payments, readmission rates, and mortality; average LTCH referral effects on each of these outcomes were estimated separately for each propensity group. The study estimated significant LTCH referral effects on both cost and clinical outcomes, but also found considerable differences in LTCH referral effects between the least likely and most likely LTCH referral groups.

In the most likely referral groups (almost exclusively long-term ventilator cases with tracheotomies), Medicare payments were the same or lower, mortality was lower, and the

[1] Stratified propensity scores are one of several modeling options for controlling for selection effects in non-experimental data. The first stage in a propensity model is to estimate the likelihood of the treatment variable (in this case, LTCH use) on the basis of patient clinical and demographic factors only; this stage serves to group observations based on treatment likelihood. The groups are formed to simulate random assignment by making sure that, within each individual group, bivariate testing indicates that mean values of observed patient attributes of those who receive the treatment (LTCH users) are not statistically significantly different from mean values of those who do not (non-LTCH users). The second stage of the modeling estimates differences in outcome measures within each propensity group and either computes a sample average treatment effect using a weighted average across the groups or computes local average treatment effects within groups.

chances of being discharged to home within 60 days was higher for those referred to LTCHs than for those remaining in acute care settings for the duration of their episodes.

In the less-likely referral groups (younger, short-term ventilator cases, most likely to have been weaned before transfer), Medicare payments were much higher, hospital stays were longer, and all other outcome measures were the same or slightly worse for those referred to LTCHs than for those remaining in acute care settings.

If the stratified propensity design provided adequate control for selection, these study results suggest strongly that LTCHs could be providing beneficial and cost-effective services for a subset of complex patients, but not for all types of patients admitted to this setting. In the three states used for the \study of outcome differences in ventilator patients, about 30% of the *actual* prolonged mechanical ventilation admissions to LTCHs were classified into the two highest propensity groups where the most benefit was observed; about 20% were classified in the two lowest propensity groups where higher costs and no benefits were observed. This suggests that as much as one-fifth of the ventilator-DRG referrals to LTCHs in the study area in 2004 could be classified as inappropriate.

When similar modeling techniques were applied to groups of other respiratory or medically complex cases, RTI could not identify a sufficiently strong prediction model for LTCH referrals. RTI also identified several limitations to the propensity score modeling that might have overstated the referral effects in the least and most likely referral groups. The most important of these limitations was the likelihood of omitted variables related to patients' instability, causing the model to fail to identify a "too sick to transfer" phenomenon (which would overstate the benefits of LTCH referral among those with the highest propensity scores). RTI concluded that propensity score approaches for this topic needed to be refined to extend the modeling to other types of LTCH cases, and additional statistical approaches should be explored, to further reduce selection bias.

The approach taken in the current Kennell/RTI study addresses several limitations from the earlier RTI study. We include a richer set of clinical prediction variables in the logistic propensity score model, particularly secondary diagnoses and interactions between organ failures. Also, we allow our matched control group to include observations from hospitals that did not refer their patients to LTCHs (which are often located in areas with low LTCH supply). We posited that selection bias is more likely to pose a problem when comparing outcomes between LTCH users and non-LTCH users from index hospitals that have above-average LTCH referral rates. Non-referral in those hospital settings is likely due to clinical characteristics that we cannot observe in the claims file – whether continued hemodynamic instability, specific lab values that indicate worsening of a condition, or simply clinician judgment that this patient has poor prognosis for recovery.

In RTI's earlier outcomes study on ventilator patients, the analysis sample was drawn only from patients in states with high LTCH use. In reviewing the limitations of that study, we felt confident that propensity score methods were capturing the characteristics of patients who were sick enough to be appropriate transfers, but we were not confident that we could identify patients who were too sick to transfer. Our current propensity model includes many LTCH referral predictors and interactions on referral predictors that are designed to identify the "too

sick to transfer" phenomenon. We are also reducing the potential for bias from remaining unmeasured "too sick to transfer" characteristics by drawing our control group from episodes for non-LTCH users admitted to hospitals with historically low LTCH referral rates. ***Section 3.4***, which discusses the various robustness checks conducted on this study, comments further on this aspect of our study design.

SECTION 2
APPROACH, DATA, AND INTERIM MODELING RESULTS

2.1 Overview of Approach

Figure 1 presents an overview of the study approach. ***Sections 2.2*** through ***2.7*** provide additional information on study design, episode construction, and analytic samples. ***Sections 2.8*** and ***2.9*** describe the results of the propensity score models and final matching.

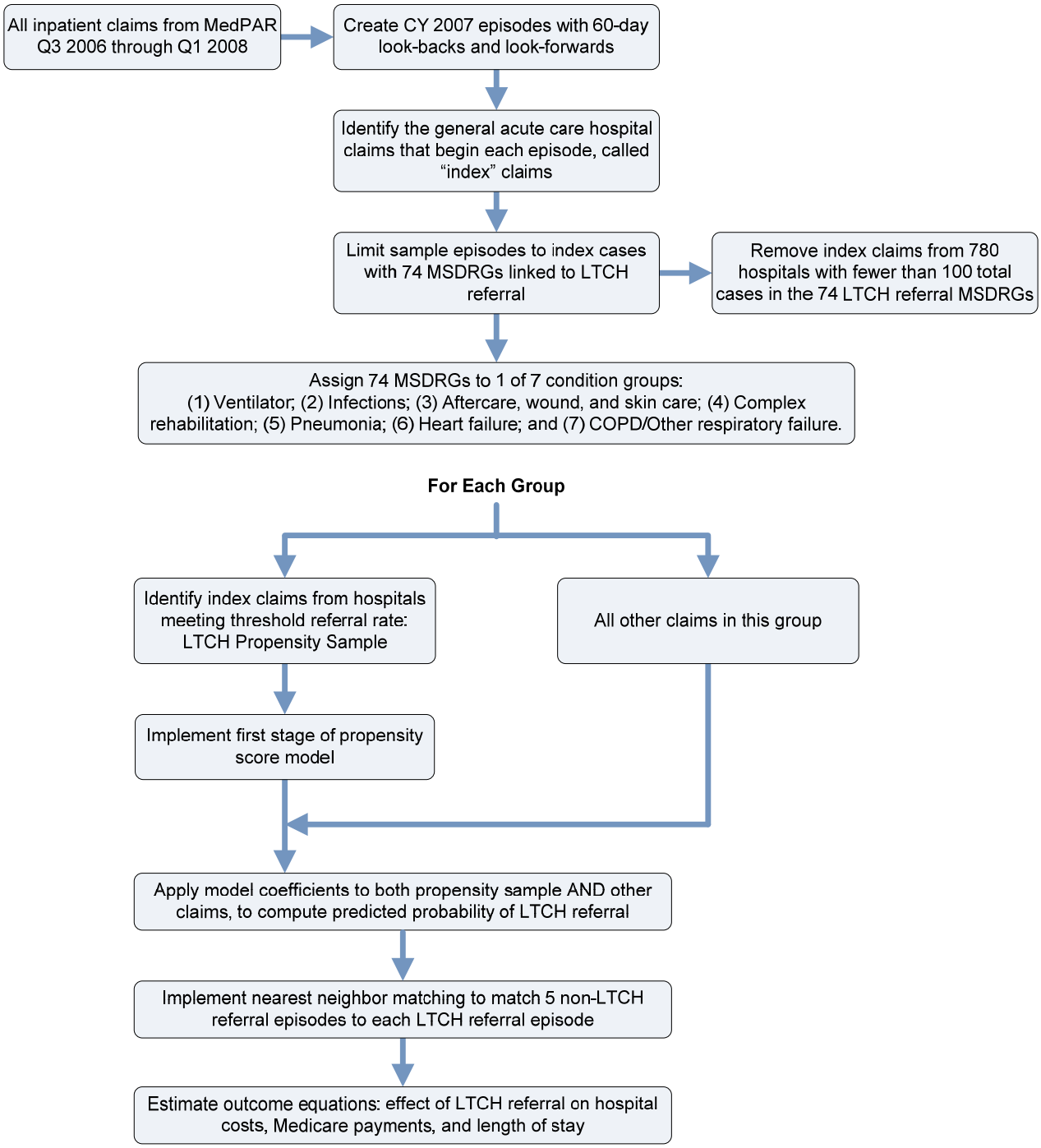
2.2 Episode Definition and Study Population

The initial study population for the payment, cost, and margins analysis was chosen from among the Medicare beneficiaries who had at least one discharge from a general acute care hospital in calendar year (CY) 2007. From that initial population of claims, we constructed episodes of care and identified an index admission for each episode. We then limited the sample to the episodes for which the index admission was coded with one of a subset of MS-DRGs that are closely related to LTCH admissions, as described in ***Section 2.3***.

To create the CY 2007 episode sample, we began with the set of acute claims from CY 2007 and used the unique beneficiary identification codes to search for possible earlier index admissions. The index admission for each episode was defined as the first acute hospitalization that was preceded by at least 60 days with no evidence of any inpatient hospital or SNF stay. The look-backs continued until the beneficiary had 60 consecutive days outside of any inpatient facility and therefore extended back to the CY 2006 MedPAR files. SNF stays did not qualify as index admissions. Episodes were considered closed (terminated) as of the discharge date for the inpatient stay (hospital or SNF) that was followed by a 60-day period without another admission. To capture readmissions and any PAC within the episode, we searched for claims with admission dates within 60 days of the discharge date of the index stay, added these to the episode, and repeated the process until the beneficiary died or spent at least 60 days outside of any inpatient facility. Look-forwards extended into the CY 2008 MedPAR files.

In cases in which the index admission was a 1-day stay that transferred to another acute hospital, the second admission became the index admission, because this is where the first post-acute decision making occurred. Consistent with the approach taken by RTI in its ventilator episode study (Cite), index admissions in which the patient died within the first 3 days were removed from the sample that was used to predict LTCH referral, because no PAC decision was made for these patients. Similarly, patients who were discharged home within the first 3 days of their index general acute care hospital admissions were removed from the prediction sample.

Figure 1
Technical approach for episode analysis



NOTE: MedPAR = Medicare Provider Analysis and Review File; MS-DRG = Medicare severity diagnosis-related groups; LTCH = long-term acute care hospitals; COPD = chronic obstructive pulmonary disease.

2.3 The Subset of Medicare Severity Diagnosis-Related Groups

RTI's earlier estimates of LTCH referral effects focused on episodes that began with an acute diagnosis involving ventilator support. This study expands upon previous research by including a wider range of acute diagnosis groups. Exploratory work using data on LTCH episodes of care in CY 2006 allowed us to develop the following four selection criteria to identify appropriate acute MS-DRGs for the 2007 study sample:

1. Tracheotomy or Ventilator Support

We included all IPPS patients assigned to MS-DRGs that involved tracheotomy or mechanical ventilation in this study. Acute hospital admissions that involve ventilator support have been the focus of many LTCH episode analyses, in part because many LTCHs specialize in ventilator weaning for complex patients. These MS-DRGs have a high rate of referral from IPPS hospitals (as high as 40 percent in our 2007 claims data for some states), and patients requiring mechanical ventilation in the LTCH account for a high and rising proportion of all LTCH Medicare admissions (from 11.7% in 2004 to 15.5% in 2008).

2. Significant Proportion of Admissions

Starting with LTCH claims from CY 2006, we searched for initial index acute admissions that marked the beginning of the LTCH episodes. The top 10 acute MS-DRGs in terms of the number of LTCH episodes were then selected for inclusion in the study sample. Each of these acute MS-DRGs was responsible for at least 1,200 subsequent LTCH admissions. Together, these 10 acute diagnoses resulted in one-third of all LTCH episodes in the preliminary analysis.

3. High Rate of Referrals

Using the entire sample of general acute care hospital claims from CY 2006, we selected the 25 acute MS-DRGs that had the highest rates of referral into LTCHs (as determined by the discharge destination on the acute claim). Each of these MS-DRGs had an LTCH referral rate of 5.9% or more (compared with the sample average of less than 1%).

4. Related Categories That Met Certain Volume Thresholds

Acute MS-DRGs that were closely related to any identified by the above criteria were also included in the analysis, as long as they had either an LTCH referral rate of at least 1.0% or they accounted for at least 1.0% of the LTCH episodes. For example, MS-DRG 592 (Skin ulcers with major co-morbidities/complicating conditions [MCC]) was chosen as a diagnosis group because it had a high LTCH referral rate. The two related MS-DRGs, 593 (Skin ulcers with co-morbidities/complicating conditions [CC]) and 594 (Skin ulcers without CC/MCC), both with LTCH referral rates of more than 1.0%, were added to the group.[2]

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[2] The following three exceptions were included in the sample, even though they fell below the 1% criteria, because of their close relationships with other important LTCH diagnoses: MS-DRG 191 (Chronic obstructive pulmonary disease w CC), MS-DRG 330 (Major small & large bowel procedures w CC), and MS-DRG 578 (Skin graft &/or debridement except for skin ulcer or cellulitis w/o CC/MCC).

There was considerable overlap among all four criteria. Altogether, 74 index admission MS-DRGs were chosen to be included in the study sample. These MS-DRGs made up less than 15% of all general acute care hospital claims in the 2006 MedPAR file but accounted for 45% of the total LTCH referrals from index admissions in the 2006 episode file.

The 74 acute MS-DRGs chosen for inclusion in the study sample are shown in ***Table 1***. We also report the total number of episodes in our study sample that begin with each MS-DRG, and the proportion that are referred to an LTCH. We define an LTCH referral as an LTCH admission that immediately follows the index acute admission, with the admission date on the LTCH claim within 2 days of the discharge date on the index acute hospital claim. We have divided these 74 MS-DRGs into seven condition groups based on the typical diagnoses seen in the LTCH, which are as follows:

- Ventilator[3]
- Infections
- Aftercare, wound, and skin care
- Complex rehabilitation
- Pneumonia
- Heart failure
- COPD/other respiratory

Not surprisingly, the MS-DRGs with the highest rates of referral into LTCH are MS-DRG 003 and MS-DRG 004 in the ventilator group. More than 40% of these patients are referred to an LTCH. The septicemia MS-DRGs make up the bulk of the infections group. The aftercare, wound, and skin care group contains the largest number of MS-DRGs—more than one-third (26) of the 74 included in the sample—and is the most diverse, containing surgical patients; burn patients; and patients with skin ulcers, skin grafts, cellulitis, or wound debridement. Complex rehabilitation is the smallest group, with fewer than 24,000 index acute care hospital claims. The pneumonia, heart failure, and COPD/other respiratory groups have the lowest rates of LTCH referral; however, because there are a large number of index claims for these groups, they account for a relatively large number of LTCH claims.

[3] Note that three of the MS-DRGs included in this group (011, 012, and 013) included a tracheostomy procedure but do not necessarily include the use of a ventilator; however, for simplicity, we will refer to this group as the ventilator group. Note also that some MS-DRGs for septicemia (included in the infections group) also include patients receiving mechanical ventilation.

Table 1
Acute Medicare severity diagnosis-related groups in the long-term care hospital study sample

MS-DRG	MS-DRG description	Total acute index claims	Percentage of index claims referred to LTCH
003	ECMO or tracheostomy with MV 96+ hrs with major O.R. procedure	19,433	43.0%
004	Tracheostomy with MV 96+ hrs without major O.R. procedure	15,022	46.1%
011	Tracheostomy for face, mouth & neck diagnoses with MCC	1,102	9.6%
012	Tracheostomy for face, mouth & neck diagnoses with CC	1,638	4.6%
013	Tracheostomy for face, mouth & neck diagnoses without CC/MCC	1,084	3.2%
207	Respiratory system diagnosis with ventilator support 96+ hours	23,738	6.6%
208	Respiratory system diagnosis with ventilator support <96 hours	45,680	2.1%
Multiple	**Ventilator subtotal**	**107,697**	**16.7%**
094	Bacterial & tuberculous infections of nervous system with MCC	1,008	6.3%
095	Bacterial & tuberculous infections of nervous system with CC	711	3.2%
096	Bacterial & tuberculous infections of nervous system without CC/MCC	507	1.4%
097	Non-bacterial infections of nervous system excluding viral meningitis with MCC	892	4.9%
098	Non-bacterial infections of nervous system excluding viral meningitis with CC	750	2.1%
099	Non-bacterial infections of nervous system excluding viral meningitis without CC/MCC	460	0.9%
288	Acute & subacute endocarditis with MCC	1,500	8.6%
289	Acute & subacute endocarditis with CC	802	6.6%
290	Acute & subacute endocarditis without CC/MCC	278	4.7%
485	Knee procedures with pdx of infection with MCC	774	11.0%
486	Knee procedures with pdx of infection with CC	1,383	6.4%
487	Knee procedures with pdx of infection without CC/MCC	951	4.0%
539	Osteomyelitis with MCC	2,091	10.6%

(continued)

Table 1 (continued)
Acute Medicare severity diagnosis related groups in the long-term care hospital study sample

MS-DRG	MS-DRG description	Total acute index claims	Percentage of index claims referred to LTCH
540	Osteomyelitis with CC	2,862	7.4%
541	Osteomyelitis without CC/MCC	1,229	4.0%
853	Infectious & parasitic diseases with O.R. procedure with MCC	20,639	8.7%
854	Infectious & parasitic diseases with O.R. procedure with CC	4,550	4.1%
856	Postoperative or post-traumatic infections with O.R. procedure with MCC	1,273	6.8%
857	Postoperative or post-traumatic infections with O.R. procedure with CC	3,009	3.2%
858	Postoperative or post-traumatic infections with O.R. procedure without CC/MCC	1,106	0.9%
870	Septicemia with MV 96+ hours	10,900	7.6%
871	Septicemia without MV 96+ hours with MCC	129,797	2.6%
872	Septicemia without MV 96+ hours without MCC	63,896	1.1%
Multiple	**Infections subtotal**	**251,368**	**3.2%**
329	Major small & large bowel procedures with MCC	38,338	4.7%
330	Major small & large bowel procedures with CC	53,289	0.7%
463	Wound debridements & skin graft excluding hand, for musculo-connective tissue disease with MCC	2,711	13.3%
464	Wound debridements & skin graft excluding hand, for musculo-connective tissue disease with CC	3,503	5.8%
465	Wound debridements & skin graft excluding hand, for musculo-connective tissue disease without CC/MCC	1,501	2.2%
573	Skin graft &/or debridements for skin ulcer or cellulitis with MCC	3,700	10.0%
574	Skin graft &/or debridements for skin ulcer or cellulitis with CC	8,011	7.8%
575	Skin graft &/or debridements for skin ulcer or cellulitis without CC/MCC	4,136	3.5%

(continued)

Table 1 (continued)
Acute Medicare severity diagnosis related groups in the long-term care hospital study sample

MS-DRG	MS-DRG description	Total acute index claims	Percentage of index claims referred to LTCH
576	Skin graft &/or debridements excluding for skin ulcer or cellulitis with MCC	457	6.3%
577	Skin graft &/or debridements excluding for skin ulcer or cellulitis with CC	1,988	1.6%
578	Skin graft &/or debridements excluding for skin ulcer or cellulitis without CC/MCC	2,865	0.4%
592	Skin ulcers with MCC	2,921	7.2%
593	Skin ulcers with CC	9,568	5.3%
594	Skin ulcers without CC/MCC	2,256	4.4%
622	Skin grafts & wound debridements for endocrine, nutrit & metabolic disease with MCC	635	9.1%
623	Skin grafts & wound debridements for endocrine, nutrit & metabolic disease with CC	2,336	6.5%
624	Skin grafts & wound debridements for endocrine, nutrit & metabolic disease without CC/MCC	289	1.4%
901	Wound debridements for injuries with MCC	371	6.2%
902	Wound debridements for injuries with CC	841	2.1%
903	Wound debridements for injuries without CC/MCC	630	1.0%
927	Extensive burns or full thickness burns with MV 96+ hrs with skin graft	211	8.1%
928	Full thickness burn with skin graft or inhal inj with CC/MCC	142	2.1%
929	Full thickness burn with skin graft or inhal inj without CC/MCC	701	3.4%
933	Extensive burns or full thickness burns with MV 96+ hrs without skin graft	334	1.5%
934	Full thickness burn without skin graft or inhal inj	568	3.5%
935	Non-extensive burns	1,976	2.2%
Multiple	**Aftercare, wound, and skin subtotal**	**144,278**	**3.6%**

(continued)

Table 1 (continued)
Acute Medicare severity diagnosis related groups in the long-term care hospital study sample

MS-DRG	MS-DRG description	Total acute index claims	Percentage of index claims referred to LTCH
028	Spinal procedures with MCC	1,175	6.0%
029	Spinal procedures with CC or spinal neurostimulators	2,290	1.1%
474	Amputation for musculoskeletal system & connective tissue disease with MCC	1,013	6.8%
475	Amputation for musculoskeletal system & connective tissue disease with CC	1,477	3.5%
476	Amputation for musculoskeletal system & connective tissue disease without CC/MCC	850	0.5%
495	Local excision & removal int fix devices excluding hip & femur with MCC	1,304	11.3%
496	Local excision & removal int fix devices excluding hip & femur with CC	4,124	4.4%
497	Local excision & removal int fix devices excluding hip & femur without CC/MCC	5,585	1.2%
616	Amputation of lower limb for endocrine, nutrit, & metabolic disease with MCC	714	6.3%
617	Amputation of lower limb for endocrine, nutrit, & metabolic disease with CC	4,847	4.8%
618	Amputation of lower limb for endocrine, nutrit, & metabolic disease without CC/MCC	186	2.2%
Multiple	**Complex rehabilitation subtotal**	**23,565**	**3.8%**
193	Simple pneumonia & pleurisy with MCC	65,825	1.2%
194	Simple pneumonia & pleurisy with CC	203,415	0.5%
Multiple	**Pneumonia subtotal**	**269,240**	**0.7%**
291	Heart failure & shock with MCC	112,928	1.0%
292	Heart failure & shock with CC	132,115	0.4%
Multiple	**Heart failure subtotal**	**245,043**	**0.6%**

(continued)

Table 1 (continued)
Acute Medicare severity diagnosis related groups in the long-term care hospital study sample

MS-DRG	MS-DRG description	Total acute index claims	Percentage of index claims referred to LTCH
189	Pulmonary edema & respiratory failure	69,734	1.7%
190	Chronic obstructive pulmonary disease with MCC	52,907	1.1%
191	Chronic obstructive pulmonary disease with CC	89,404	0.6%
Multiple	**COPD/other respiratory subtotal**	**212,045**	**1.1%**
Multiple	**Total**	**1,253,236**	**3.0%**

NOTES: MS-DRG = Medicare severity diagnosis-related group; LTCH = long-term care hospital; ECMO = extracorporeal membrane oxygenation; MV = mechanical ventilator supports; O.R. = operating room; MCC = major comorbidities/complicating condition; CC = comorbidities/complicating conditions; COPD = chronic obstructive pulmonary disease.

SOURCE: Analysis of RTI 2007 Episode Margins file.

In our study, we assign every episode to one of these seven LTCH condition groups. For the most part, the conditions associated with the general acute care hospital index admissions are similar to the conditions associated with the LTCH admission, but there are two exceptions: referrals after major bowel surgery are often admitted for LTCH postsurgical aftercare; and referrals after spinal surgery are frequently admitted for LTCH rehabilitation.

2.4 Sample Selection Criteria

After identifying the 74 acute MS-DRGs that are significant for LTCH referral, we further limited our estimation by applying both hospital-level and patient-level edits. In the logistic propensity score regressions (described in ***Section 2.7***), our goal is to identify the *clinical* characteristics that predict LTCH referral. We first limit the hospital sample to those facilities with at least 100 index claims within the 74 sample MS-DRGs (see ***Table 2***). From an initial sample of 3,600 hospitals with index claims in the sample MS-DRGs, this criterion reduces the hospital sample to 2,820 acute hospitals. As we would expect, the excluded hospitals have, on average, fewer beds than the sample hospitals (63 vs. 209). The sample hospitals are more likely to be in urban areas than the excluded hospitals, and they have a higher average case mix and a higher resident-to-bed ratio.

Table 2
Hospital characteristics for sample hospitals and excluded hospitals

Characteristics	All hospitals	Excluded hospitals	Study sample hospitals
Number of hospitals	3,600	780	2,820
Average bed size	180	63	209
Percent urban	71.9%	57.6%	75.3%
Average Medicare days as a percent of total inpatient days	49.9%	47.0%	50.5%
Average case mix index	1.38	1.24	1.41
Average resident-to-bed ratio	0.06	0.02	0.07
Index claims in 74 sample MS-DRGs	333	43	413
Further criteria for in-sample hospitals			
LTCH referral rate for ventilator >5%	--	--	1,774
LTCH referral rate for infection >5%	--	--	567
LTCH referral rate for aftercare, wound, and skin care >5%	--	--	734
LTCH referral rate for complex rehabilitation >5%	--	--	780
LTCH referral rate for pneumonia >5%	--	--	149
LTCH referral rate for heart failure >5%	--	--	107
LTCH referral rate for COPD/other respiratory >5%	--	--	203

NOTES: MS-DRG = Medicare severity diagnosis-related group; LTCH = long-term care hospital; COPD = chronic obstructive pulmonary disease.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Because we found significant variation in LTCH referral rates by hospital, we limited our propensity score sample to those hospitals that had a minimum threshold (5%) of LTCH referrals within each of the seven condition groups. For example, the hospital sample for the ventilator group consisted of the 1,774 hospitals that referred at least 5% of their ventilator claims to LTCHs; the hospital sample for the infection claims contained the 567 hospitals that referred at least 5% of their infection claims to LTCHs. Only 107 of the sample acute hospitals referred 5% or more of their heart failure MS-DRGs to LTCHs. The hospital sample was unique for each of the seven MS-DRG groups, although there was significant overlap because many hospitals refer multiple types of patients to LTCHs.

We also excluded any patients who died or were discharged home within the first 3 days of the index admission. For the ventilator group, we further excluded patients who died or were discharged home within the first 10 days of the index admission. We excluded these patients because we wanted to capture the important clinical characteristics that influence a transfer/no transfer decision; including patients for whom no transfer decision is being made—whether due to extremely high acuity (rapid mortality) or extremely low acuity (rapid discharge home)—would only add noise to the estimation. Examining the empirical length of stay and transfer patterns informed the choice of 3 and 10 days for the cut-offs.

Although we estimated the logistic propensity score equations using data only from hospitals with at least 5% of the condition group referred to LTCH, when we used the propensity scores to create the matched control group of non-LTCH patients, we used the episodes in all hospitals with at least 100 index claims within the sample 74 MS-DRGs.

2.5 Definition of Outcome Variables

The first outcome of interest was Medicare payments, both at the index acute level and the episode level. Total Medicare payments were calculated for each claim by summing the payment made by the Medicare program (which included outlier payments) and the payments owed by the beneficiary, such as deductibles and coinsurance. Episode payments were computed as the sum of the previously described payments for all inpatient stays in the episode (not including SNF stays). Total facility costs were obtained at the level of the individual claims by converting the charges on the MedPAR files to costs (described in more detail in ***Section 2.6***). As with the payments, episode-level costs excluded the costs for SNF stays within the episode because we did not calculate SNF costs.

PPS margins were defined as the difference between total payments received (or receivable, as in the case of deductibles or coinsurance) and Medicare allowable costs, expressed as a percentage of total payments. Stated arithmetically, we calculated the margin as Margin = [(TotalPayment − TotalCost) / TotalPayment] * 100, a value that can range from negative infinity to 100. A negative margin indicates that the total costs to the facility were greater than the total Medicare payments. A margin of 100 would indicate that total costs were equal to zero, so in practice we do not see margins this high. In some multivariate models, we use the payment-to-cost ratio [TotalPayment / TotalCost] as an alternative measure of profitability because it is nonnegative and therefore can be log transformed. A negative margin will correspond to a payment-to-cost ratio between 0.0 and 1.0. We calculated margins and payment-to-cost ratios at both the claim level and the episode level.

Although the focus of the analysis was on the financial outcomes for LTCH referral and non-LTCH referral episodes, we also considered the episode length of stay as an outcome of interest. We calculated two measures of episode days by summing the Medicare-covered days from all of the claims within the episode. Our first measure looked only at inpatient days within the claims, and our second measure included SNF days as well as the inpatient days.

2.6 Claims-Level Cost Estimates

To compute the margins and payment-to-cost ratios described above at the level of individual episodes, we first estimated allowable Medicare costs at the level of individual claims. We used cost-to-charge ratios (CCRs) computed from individual hospital cost reports that were matched—by provider and reporting period—to each MedPAR claim. Ratios were computed for each of 17 service charge areas.[4] The CCRs were computed separately for each hospital provider and subprovider, then applied as charge adjusters to individual claims. MedPAR claims charges were summarized into the same 17 groups, and service-level costs were estimated by multiplying each hospital-specific CCR by its applicable charges. To compute claims-level margins, costs and payments were summed across the claim; to compute episode-level margins, costs and payments were summed across all claims comprising the episode of care.

Using an algorithm developed for earlier CMS work, we aggregated the cost report lines to the 17 ratios and aggregated the MedPAR charge groups to map to those same ratios. With two exceptions, the service charge aggregates that we used to estimate claims costs are the same as those defined in the Federal Register to compute aggregate CCRs for the MS-DRG weights under IPPS (Centers for Medicare & Medicaid Services, 2007). The first exception is that we separated intermediate care charges into a category of their own, rather than combining them with critical care charges as the MedPAR files currently do. Intermediate care charges were obtained from the Inpatient Standard Analytic File and merged into the MedPAR file at the individual claim level. The second exception is that we identified separate routine CCRs for subprovider units (primarily rehabilitation units) and applied these to routine charges on MedPAR subprovider claims.

2.7 Description of Propensity Score

After constructing the appropriate sample, we estimated random-effects logistic models with LTCH referral as the outcome of interest. The predicted values from the regression were then used to assign each non-LTCH observation a propensity score, which is the likelihood that a patient will be referred to an LTCH. The important explanatory variables in the propensity score model included

- patient demographics (age, sex);
- organ failures (including heart, kidney, liver, and skin);

[4] CMS computes CCRs for 15 charge groups when computing IPPS DRG weights. We will follow the same charge groupings but will add one to distinguish step-down from other critical care charges and another to convert routine charges in a rehabilitation unit.

- critical care days;
- wound care procedures;
- other secondary diagnoses, procedures, and interactions; and
- important interactions between types of organ failure.

Appendix A contains a list of the covariates that we created for this analysis and their definitions.

We did *not* use length of stay as an explanatory variable in the propensity score model, because length of stay is endogenous to the LTCH referral. Explanatory variables are appropriate if they influence the LTCH referral decision and if they are not themselves influenced by the LTCH referral decision. For example, beneficiary age is included as a predictor of LTCH referral. All else being equal, an older beneficiary may not be as good a transfer candidate as a younger beneficiary and so may have a lower probability of LTCH referral. LTCH referral will have no effect on beneficiary age.

Length of stay does not make a good predictor because it can be influenced by the LTCH referral. For example, a patient referred to LTCH may have fewer index hospital days than a similar patient not referred because part of the hospital-level care the patient needs would be provided in the LTCH. At the episode level, we would expect LTCH users to have more episode utilization days than clinically similar non-users because the financial incentives in the LTCH PPS penalize LTCHs for short-staying patients. The short-stay outlier payment adjustments, intended to motivate LTCHs to admit only patients who truly need long-term, hospital-level care, also encourage LTCHs to delay discharging patients who might otherwise be suitable for discharge or transfer to a less-intensive care setting so that the LTCHs can receive the full MS-DRG payment.

2.8 Results from Logistic Propensity Score

We estimated the same basic logistic propensity score model for each of the seven condition groups. Although there were several commonalities across these models, there were important differences that reflected the unique characteristics of patients in each group and their probability of LTCH referral. For example, critical care days were a significant predictor of LTCH referral in all seven of the groups. In most of the groups, the likelihood of LTCH use increased monotonically with the number of critical care days, but in the ventilator group, the peak of LTCH referral probability came for patients with between 16 and 25 critical care days. More than 25 critical care days tended to reduce the likelihood of LTCH referral for the ventilator group. Therefore, the indicators for critical care days in the propensity score regression reflected the different patterns seen across the groups. Another example of the differences in the logistic models across condition groups is the inclusion of various organ failure interaction terms. For each model, we selected the more important interaction terms to include. Full logistic regression results are presented in ***Appendix B***. In the sections that follow, we describe some of the important predictors of LTCH referral for each of the seven condition groups.

2.8.1 Ventilator Group

Within the ventilator group, the patients with tracheostomy MS-DRGs (003, 004, 011, 012, and 013) are much more likely to be referred to LTCHs than are ventilator patients without tracheostomies, as ***Appendix Table B.1*** shows. Critical care days are also very important predictors of LTCH referral among this population, although patients with more than 30 critical care days are less likely to be referred to LTCH than are patients with 16−25 critical care days. Organ failures are also prominent predictors of LTCH referral, including critical illness myopathy, both acute and chronic respiratory failure, and skin failure. The most important interactions that increase the probability of LTCH referral are chronic respiratory failure combined with acute renal failure and acute respiratory failure combined with liver failure.

In constructing the logistic propensity score models, we focused not only on characteristics that increased the likelihood of LTCH referral but also on clinical indicators that made LTCH referral less likely. Clinical characteristics could make LTCH referral less likely if they help to identify patients who are not stable enough to make good LTCH candidates—those who are "too sick to transfer." Conversely, other clinical predictors may have negative coefficients because they flag patients who are less likely to need long-term hospital care and therefore are not sick enough to transfer to an LTCH. In the ventilator group, the more important (large in magnitude and statistically significant) negative predictors of LTCH referral tend to fall into the first category, identifying patients who, although they may need long-term hospital care, are too severely ill to leave the acute hospital. Patients with extracorporeal membrane oxygenation, disseminated intravascular coagulopathy (DIC), septic shock, or dialysis have lower probabilities of LTCH referral, all else being equal. Interestingly, patients who are treated in index acute hospitals that have a larger proportion of resident physicians (teaching hospitals) are also less likely to be transferred to LTCHs. This is consistent also with our preliminary findings from the qualitative interviews; large teaching hospitals, on average, report keeping these types of ventilator patients rather than referring them to LTCHs.

2.8.2 Infection Group

Although there are 23 different MS-DRGs included in the infection group, the three septicemia MS-DRGs (870, 871, and 872) make up the majority of this group (see Table 1). In addition to many of the MS-DRGs, the important positive predictors of LTCH referral include endocarditis, osteomyelitis, ulcers, cellulitis, ICU procedures, and nutritional deficiencies. Critical care days also increased the probability of LTCH referral (see ***Appendix Table B.2***).

Larger hospitals and those with higher resident physician–to-bed ratios are less likely to refer their infection patients to LTCH; we saw similar results for the ventilator patients. The combination of skin failure with heart failure, acute respiratory failure, or septic shock reduced the probability of LTCH referral, as did the presence of systemic inflammatory response syndrome.

2.8.3 Aftercare, Wound, and Skin Care Group

In the aftercare, wound, and skin care group, indicators for the number of critical care days are among the largest significant predictors of LTCH referral, with the probability of LTCH referral increasing as the patient spends more days in critical care (see ***Appendix Table B.3***).

Ulcers, osteomyelitis, sepsis, nutritional deficiencies, wound procedures, and ICU procedures are also large, positive, and statistically significant predictors of LTCH referral. Heart disease (other chronic ischemic disease and other heart disease) emerged as a negative predictor of LTCH referral for this condition group, as well as the interaction between acute respiratory failure and heart disease.

2.8.4 Complex Rehabilitation Group

Indicators for having 26 or more critical care days or for having 11 to 25 critical care days were the largest statistically significant predictors of LTCH referral in the complex rehabilitation group (see ***Appendix Table B.4***). Other significant predictors that increased the likelihood of LTCH referral included MS-DRG 495 (Local excision & removal int fix devices exc hip & femur w MCC), nutritional deficiencies, ICU procedures, and wound procedures. Unlike the other six LTCH condition groups, for which the coefficient is always negative and usually significant, in the complex rehabilitation group, the coefficient on dialysis is positive and statistically significant.

2.8.5 Pneumonia Group

From the logistic regression output in ***Appendix Table B.5***, we see that the clinical characteristics that increased the probability of LTCH referral in the pneumonia group included ICU procedures, nutritional deficiencies, cellulitis, osteomyelitis, and increasing amounts of time spent in the intensive (or critical) care unit. Patients whose diagnosis was pneumonia with MCC (MS-DRG 193) were more likely to be referred to LTCH than those with CC (MS-DRG 194, the reference group). Having a combination of acute respiratory failure and acute renal failure significantly increased the likelihood of LTCH referral for patients in the pneumonia group. None of the predictors with negative coefficients were statistically significant at the 5% level.

2.8.6 Heart Failure Group

Increasing number of critical care days, ICU procedures, skin problems such as cellulitis or ulcers, nutritional deficiencies, and acute respiratory failure were all significant positive predictors of LTCH referral for patients whose acute index hospitalization was for heart failure (see ***Appendix Table B.6***). Heart failure with MCC (MS-DRG 291) was another positive predictor. Other ischemic heart disease and dialysis were both significant negative predictors of LTCH referral.

2.8.7 Chronic Obstructive Pulmonary Disease/Other Respiratory Group

Among patients with COPD or pulmonary edema and respiratory failure, those who are younger than 65 or older than 85 are significantly less likely to be referred to LTCH than are those who are aged 65 to 74. Chronic renal failure, dialysis, and acute coronary syndrome also significantly reduce the probability of the patient's discharge to an LTCH (see ***Appendix Table B.7***). Important positive predictors include critical care days, sepsis, ICU procedures, nutritional deficiencies, and respiratory failure (either chronic or acute).

2.9 Matching Results

2.9.1 Description of the Matching Procedure

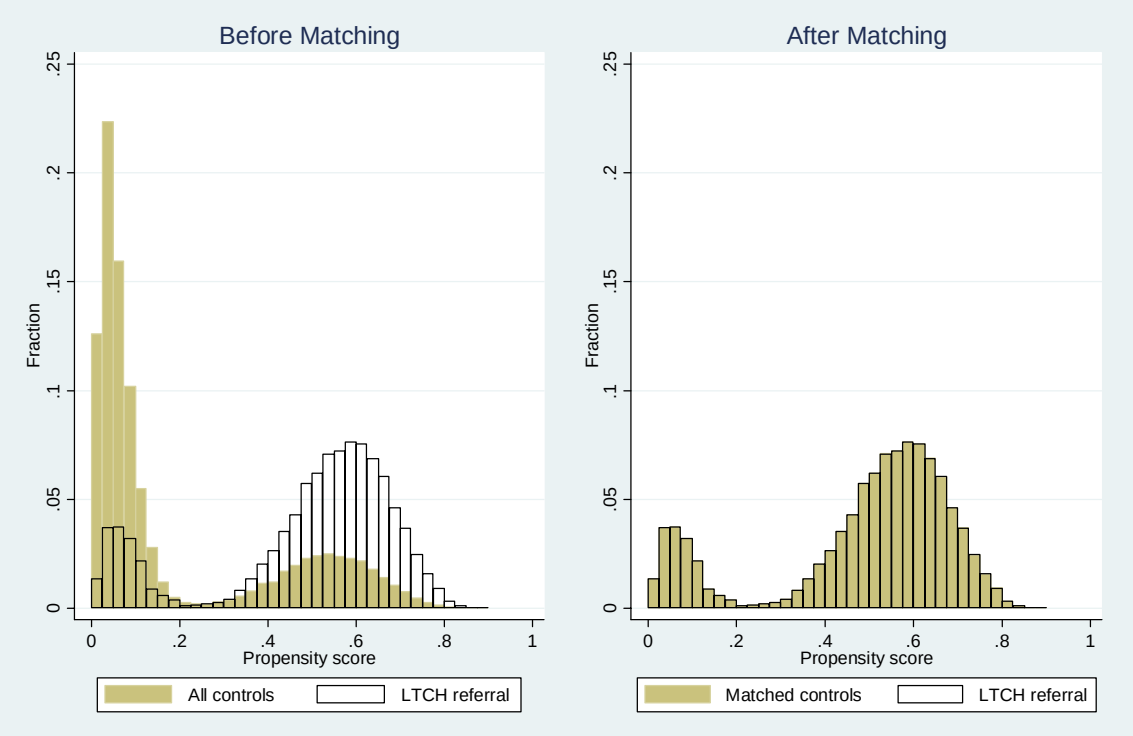
Although the propensity score model was estimated using only the sample of hospitals with more than 5% of LTCH referrals within the MS-DRG group, the propensity score assignment was extended to patients in other hospitals who did not use LTCHs. Once the logistic regressions predicting LTCH referral had been finalized for each of the seven condition groups, predicted values were computed for each observation in the propensity sample. Out-of-sample predicted values were then computed for each observation in the set of index claims that were excluded from the propensity estimation due to lower overall LTCH referral rates (this can be done by applying the coefficients from each regression to the respective covariate values of any sample). A propensity score (i.e., a numerical probability of LTCH referral, between 0 and 1) was thus available for every observation in the final analysis sample.

For each LTCH episode, the matching procedure chose the five non-LTCH referral episodes with the propensity score values closest to that of the LTCH episode. Matching was done with replacement, which means that a non-LTCH referral episode could be chosen as the nearest neighbor for more than one LTCH episode. If a non-LTCH episode was chosen more than once, that episode was weighted to reflect how many times it was matched to an LTCH episode.

2.9.2 Matching Results: Compare Propensity Score Distributions before and after Matching

To ascertain whether the matching resulted in similar LTCH user and matched control groups, we compare the distributions of the propensity scores before and after matching. The first panel of ***Figure 2*** (also presented as ***Appendix Figure C.1***) displays the histogram of the propensity score for LTCH users and the full set of non-LTCH users in the ventilator group, before any matching took place. The solid bars show the propensity score distribution for index admissions that were not referred to LTCH, and the empty outlined bars show the propensity score distribution for index admissions that were admitted to an LTCH within 2 days of the general acute care hospital index discharge date. Both distributions are bimodal. The propensity scores for the non-LTCH users are concentrated at lower probabilities of LTCH-referral, below a score value of 0.2 (indicating a low probability of LTCH referral), whereas the bulk of the LTCH referral propensity scores are concentrated between 0.3 and 0.8. After matching, the propensity score distributions appear identical—the solid bars (matched non-LTCH referral episodes) in the second panel of Figure 1 follow the same distribution as the empty outlined bars (LTCH referral episodes). We obtain similar figures when we compare the propensity score distributions before and after matching for the remaining six condition groups (see ***Appendix Figures C.2*** through ***C.7***). For all of these condition groups, the non-LTCH users have lower propensity scores than

Figure 2
Ventilator group: Propensity score distributions before and after matching



NOTE: LTCH = long-term care hospital.

SOURCE: Analysis of RTI 2007 Episode Margins file.

the LTCH users; significant portions of the distribution of propensity scores among non-LTCH referral episodes are less than 0.1. In each figure, the distribution of the propensity scores among the non-LTCH users is very similar to those of the LTCH users after the matching has been implemented. These figures provide evidence that the matched controls (non-LTCH referral episodes) have propensity score distributions very similar to those of the LTCH referral episodes.

2.9.3 Matching Results: Compare Predictors before and after Matching

An additional way to judge the success of the propensity score matching procedure is to compare the weighted means of the LTCH user and matched control groups and determine whether any significant differences remain after the matching has been implemented. In ***Table 3***, we present some summary statistics for selected covariates used in the propensity score equation for the ventilator group. The table includes the sample means for both the LTCH users and non-LTCH users, before and after the matching procedure is implemented. Consider the indicator for MS-DRGs 003 and 004 in this table. In the first line associated with this variable we see that, before matching, 83.7% of the LTCH referral episodes have either MS-DRG 003 or 004, whereas only 28.5 of the non-LTCH referral episodes have one of these MS-DRGs. The difference between these two means, not surprisingly, is statistically significant, as we see in the last column, which reports a *p*-value of 0.000. (For the purposes of this study, we use the standard

cutoff value of $p = 0.050$ to determine statistical significance. Values of p above 0.050 indicate that the differences are not statistically significant; values of p at or below 0.050 indicate statistically significant differences.) However, after matching, there is no longer a significant difference between the means for the LTCH user and control groups. In the second line for MS-DRGs 003 and 004, we see that both the LTCH users and non-users now have 83.7% of episodes with 003 or 004, and the difference between these means is not significant ($p = 0.840$). Full summary statistics for the ventilator group, before and after matching, are reported in ***Appendix Table D.1***. The remaining tables in ***Appendix D*** contain similar statistics for the other six condition groups.

Table 3
Selected covariates before and after matching: Ventilator group

Variable	Sample	Treated	Control	$p > \|t\|$
Female	Unmatched	0.477	0.496	0.000
Female	Matched	0.477	0.473	0.470
MS-DRGs 003–004	Unmatched	0.837	0.285	0.000
MS-DRGs 003–004	Matched	0.837	0.837	0.840
MS-DRGs 011–013	Unmatched	0.012	0.037	0.000
MS-DRGs 011–013	Matched	0.012	0.012	0.623
MS-DRG 207	Unmatched	0.092	0.290	0.000
MS-DRG 207	Matched	0.092	0.085	0.034
Acute renal failure	Unmatched	0.311	0.257	0.000
Acute renal failure	Matched	0.311	0.307	0.381
Wound procedures	Unmatched	0.183	0.685	0.000
Wound procedures	Matched	0.183	0.193	0.047
COPD	Unmatched	0.276	0.383	0.000
COPD	Matched	0.276	0.274	0.673
PEG	Unmatched	0.294	0.114	0.000
PEG	Matched	0.294	0.284	0.059

NOTES: MS-DRG = Medicare severity diagnosis-related group; COPD = chronic obstructive pulmonary disease; PEG = percutaneous endoscopic gastrostomy.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Overall, the tables in Appendix D show that the propensity score matching is fairly successful at producing a matched control group of non-LTCH users who have a profile of covariates similar to that of the LTCH users. The majority of the significant differences between the means in the unmatched groups are eliminated by the matching procedure. Even in cases in which the difference between the means remains statistically significant, often the mean for the matched control group is still much closer to that of the LTCH user group than is the mean of the unmatched control group. For example, consider the indicator for MS-DRG 207 in Table 3. Before matching, 29.0% of the control group has MS-DRG 207, but after matching, the proportion is 8.5%, much closer to the 9.2% for the LTCH users. Even though the difference is still statistically significant ($p = 0.034$), we would not expect this difference to produce much bias in the results. The covariates whose matched means are still significantly different from each other are included in the outcome regressions described in ***Section 3.1*** to further control for any bias that might be introduced by the differences.

2.9.4 Matching Results: Mean Values in Utilization and Financial Outcome Variables

Before estimating the second-stage outcome regressions, it is helpful to examine unadjusted mean differences in our financial outcome variables for LTCH users and clinically matched non-LTCH users. ***Table 4*** (also included as ***Appendix Table F.1***) shows aggregate average values for eight financial and utilization variables of interest, where the non-LTCH user group is stratified by key alternatives in the trajectory of care following the index admission. As expected, index admission payments and costs are lower for the LTCH users because care in the LTCH provides a substitute for a longer, costlier acute index stay. The index payment-to-cost ratio is also lower for the LTCH episodes. In contrast, the episode payments and costs are much higher for the LTCH referral episodes than for the non-LTCH referral episodes, and the LTCH referral episodes have considerably more episode days.

The non-LTCH users are stratified into six groups based on the type of care received after the index acute admission. The first line includes only the index acute admissions that have no follow-up inpatient events; these episodes end with either the death or discharge to home (with or without home health care) or group living. As would be expected, these index admission-only episodes have some of the highest index admission payments and costs. They also have the lowest episode payments and costs.[5]

The next two lines show data for non-LTCH users that are transferred to a general acute hospital, where transfers are defined to include direct transfers as well as readmissions within 2 days of the index discharge date. We have split these into episodes with and without a subsequent LTCH referral, because we know that LTCHs can also be a post-transfer destination, and that this later transfer could have a significant effect on episode payments and costs. Note that the acute transfer with a subsequent LTCH stay is *not* included in our LTCH user study

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5 The index and episode payments and costs are not identical on this line because of the way we handled 1-day transfers in constructing the episodes. A small number of the index admissions were 1-day stays where the patient was stabilized and sent to a larger hospital For these immediate transfers we treated the transfer destination as the index admission, as this is where the bulk of care was delivered and this was where a post-acute transfer decision would first be considered. In these instances, however, we included costs and payments from the initial (non-index) 1-day stay in the episode costs and payments.

population, because we modeled only the initial LTCH referral decision in the propensity scores. However, this group makes up only 1.1% of the matched non-LTCH user group, and indicator variables for subsequent LTCH use are included in all multivariate outcome models.

Non-LTCH users transferred from the index admission to a skilled nursing facility ("First PAC SNF") are the second largest group of matched controls, at 29.6%. Their index payments and costs are higher than those of the LTCH referral episodes, providing further evidence that LTCH care is substituting for the latter portions of the acute hospitalization. SNF first PAC episodes have lower episode payments and costs than the LTCH referral episodes (but keep in mind that these are hospital payments and costs only, as the study data did not include SNF payments and costs).

A small proportion of the matched control episodes are referred to IRFs after their index acute hospitalization. As with the SNF first PAC episodes, the index payments and costs are higher than those of the LTCH referral episodes, so IRF does not appear to be an exact substitute for LTCH care. Episode-level payments and costs are most similar between the IRF first PAC episodes and the LTCH referral episodes, and their utilization days are also fairly similar.

Finally, the "all other" category of episodes includes those episodes in which there were more than 2 days in between the index acute discharge date and the subsequent acute admission date. It would be more appropriate to consider these later acute claims as readmissions rather than transfers. These episodes have the very lowest payments and costs at both the index and the episode levels, and they have the fewest number of utilization days, with the exception of the index-only episodes.

Similar patterns emerge when we examine the differences in the weighted means for the other six condition groups (***Appendix Tables F.2*** through ***F.7***). LTCH referral episodes have higher episode payments and costs than all non-LTCH referral episodes, but those differences vary based on the trajectory of the episode. The largest differences are typically seen between the LTCH referral episodes and the episodes that contain only the index acute hospitalization. The episode payments and costs for the LTCH referral episodes are closest in magnitude to the episodes in which the beneficiary receives the first PAC in the IRF. However, very few of the IRF first PAC episodes are matched to the LTCH episodes. The majority of the matched episodes are index-only episodes or SNF first PAC episodes.

Table 4
Ventilator patients: Unadjusted mean values for matched LTCH user and non-LTCH user groups

Episode type	Percentage of total	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
LTCH referral	100.0	$62,542	$60,755	1.03	$136,052	$126,144	1.08	71.0	97.1
No LTCH referral	100.0	76,388	68,775	1.11	91,486	83,142	1.10	43.2	63.0
Index only	44.8	84,668	73,840	1.15	84,733	73,905	1.15	32.8	32.8
Transfers to general acute hospitals:									
Without subsequent LTCH	11.3	72,536	69,268	1.05	113,466	106,021	1.07	58.2	75.3
With subsequent LTCH	1.1	60,667	58,536	1.04	175,898	176,485	1.00	91.1	123.7
First PAC to SNF	29.6	75,265	69,634	1.08	93,286	88,239	1.06	49.2	102.7
First PAC to IRF	3.4	84,922	79,597	1.07	128,213	120,237	1.07	65.2	88.3
All other	9.8	42,458	36,708	1.16	70,349	65,415	1.08	41.2	49.2

NOTES: SNF = skilled nursing facility; LTCH = long-term care hospital; PAC = post-acute care; IRF = inpatient rehabilitation facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

2.9.5 Matching Results: Costs in the Index Acute Care Admission

Although the financial outcomes of interest in this report are the Medicare payments, costs, margins, and number of utilization days at the episode level, in this section we draw attention to the hospital costs for the index hospitalization alone. We assume that LTCH care is a substitute for prolonged care in the index general acute care hospital setting. The job of propensity matching is to set up "pseudo-randomization" for the LTCH transfer decisions, we would expect to find that index admissions are shorter and less costly in the LTCH user group than in the control group

In this test, we have mixed results (see Appendix Tables F1 through F7). Among ventilator patients and patients in the aftercare, wound, and skin care group, the index admissions for LTCH users are less costly than the index admissions for the matched non-LTCH users. This is consistent with the notion of LTCHs substituting for the latter portion of the index admission in the general acute care hospital. In the infections group, index admissions are less costly for LTCH users among patients with higher LTCH propensity scores, but not for the infections group as a whole.

For the four remaining condition groups—complex rehabilitation, pneumonia, heart failure, and COPD/other respiratory—the index admission costs for the LTCH users are *higher* than the costs for the non-users. One interpretation of this finding is that general acute care hospitals have developed established protocols for identifying ventilator, infection, and wound patients who are suitable for LTCH transfer, whereas transfer for these other condition groups is less common, and may occur only as a last resort after the patients have had extremely long initial stays.

The other interpretation, however, is that among these condition groups, higher index costs for the LTCH users is an indicator that matching has not sufficiently controlled for the selection of complex and high-cost cases into LTCHs. As previously shown, the LTCH user groups and the non-user control groups have similar distributions of their propensity scores, and most of the covariates used for the propensity score estimation are statistically balanced between LTCH users and non-users in the final matched sample.

Successful matching on observed characteristics, however, does not protect the model from bias due to omitted or unobserved characteristics. For the propensity score approach to work, any important unobserved patient characteristics that affect both likelihood of LTCH and total episode costs must be correlated with the joint effect of the observed characteristics that are included in the propensity model. The fact that we find higher index admission costs among the non-LTCH users for four of our seven condition groups suggests that those models may not be complete. We return to this subject in ***Sections 3.4*** and ***3.5***, when we discuss robustness checks and study limitations.

SECTION 3
OUTCOMES

3.1 Description of Outcomes Equations

Once the propensity score matching identified appropriate control episodes to compare with the LTCH user episodes, we investigated the differences in the financial outcomes for LTCH users compared with non-LTCH users for each of the seven LTCH condition groups. This is the second stage of propensity score modeling, and although it is possible to use simple bivariate testing at this stage, it is more typical to use a second round of regression estimates of the outcomes of interest on other covariates of interest. Specifically, we estimated linear regressions, with standard errors clustered at the hospital level

The financial and utilization outcomes of interest are Medicare payments, allowable costs, inpatient PPS payment-to-cost ratios, and episode length of stay. We used payment-to-cost ratios instead of the more common measure of profit margins because payment-to-cost ratios are restricted to values above zero and so can be log-transformed. We used two measures for episode length of stay, one that included only covered hospital days and one that included both hospital and SNF days.

The outcomes equations include control variables for hospital and geographic factors that are expected to have an independent effect on costs and payments. Because the episode matching provides control for patient characteristics, the second-stage equations in analyses include only those patient-level clinical characteristics that were not balanced in the final matched sample. The financial outcome equations take the following general form:

$$\ln(Financial_{i,h}) = g(PAC_i, Org_h, Market_h, Control_i), \quad (1)$$

where $Financial_{i,h}$ is one of the four outcomes of interest (costs, payments, the payment-to-cost ratio, or utilization days) for episode *i* originating in index hospital *h*. The vector PAC_i includes the key indicator variables for LTCH care and indicators for acute transfers (with and without subsequent LTCH use), for SNF as the first PAC setting, and for IRF as the first PAC setting. The coefficients on the LTCH indicators estimate the impact of LTCH use on the financial outcome, and therefore identify our key study questions.

We expect that the LTCH effect may vary according to the likelihood of LTCH referral, as previous analyses by both MedPAC and RTI have shown. To test whether the LTCH effect on the outcomes of interest is larger or smaller depending on the likelihood of LTCH referral, we categorized the LTCH patients and their matched controls based on the propensity score (likelihood of LTCH referral) and interacted the LTCH indicators on these categories.

Org_h is a vector of organizational characteristics of the index hospital, such as teaching status, size, or case-mix index. $Market_h$ is a vector of area characteristics such as the local wage index. Finally, $Control_i$ is a vector representing any covariates from the propensity score regressions that continued to show a statistically significant difference ($p < .05$) between the LTCH users and non-LTCH users in the matched samples. For example, notice in Table 3 that, within the ventilator condition group, the proportion of LTCH users receiving complex wound

care procedures is much higher among those not referred to LTCHs (0.685) than in those that are referred (0.183). After matching, the proportions are much closer (0.193 versus 0.183) but the difference is still statistically significant (p=0.047).The indicator for wound procedures would therefore be included as an explanatory variable in the outcome regressions for the ventilator group.

The ventilator group had a total of nine unmatched covariates (see ***Appendix Table D.1***). The infection group had the largest number of additional patient covariates (16), possibly because this group was the most heterogeneous in terms of the MS-DRGs included (see ***Appendix Table D.2***). The remaining five condition groups had only one or two unmatched covariates (see ***Appendix Tables D.3***, ***D.4***, ***D.5***, ***D.6***, and ***D.7***). Many of the differences between the LTCH patients and the matched non-LTCH patients that were statistically significant were still of small magnitude, however, and are not likely to be clinically significant.

We also control for outlier status in the index acute hospitalization because this would affect both Medicare payments and facility costs; the endogeneity of outlier status makes it inappropriate to include in the propensity score logistic regression, so it can appear only in the second-stage outcome regressions.

3.2 Baseline Results from Outcome Equations

Our equations are estimated as log-linear regressions, thus the coefficients can be transformed and expressed as expected percent differences in the outcome that are attributed to each particular dichotomous independent variable, relative to the baseline reference case.[6] Recall that we interacted the LTCH use variable in each model with a categorical variable representing low to high *likelihood* of LTCH referral.

To aid interpretation of our results, we present a series of graphs showing the differences between LTCH users and the matched non-users. The graphs show multiple points that represent patients who are more or less likely to be referred to LTCH based on the value of the propensity score. Full regression results are reported in ***Appendix E***.

For a brief guide to interpreting the following graphs, consider the "Percent Difference in Episode Payments" panel of ***Figure 3.*** This panel graphs the effect of LTCH referral on ventilator group episode payments, where the effect (the percent difference) is relative to a "reference case" that is a non-LTCH user in the lowest category of LTCH referral.[7]

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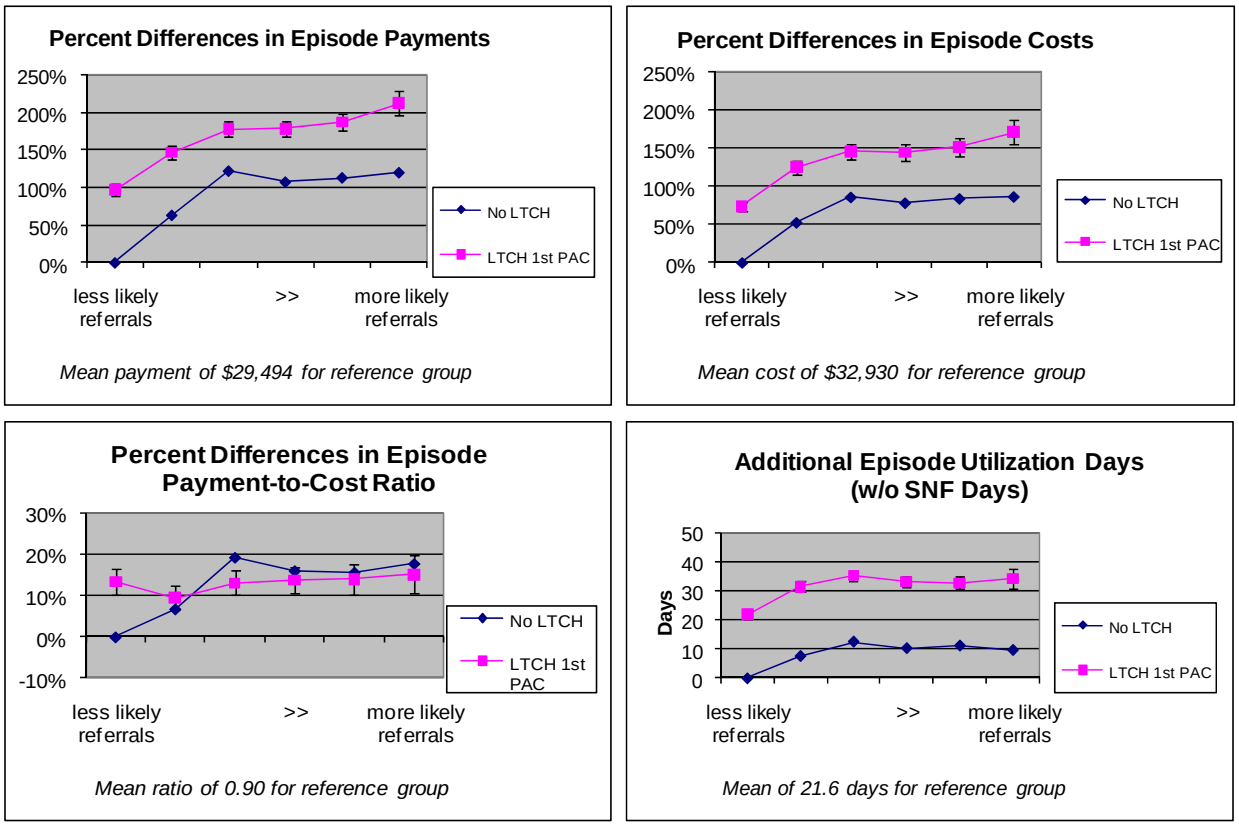
6 The percent difference is calculated by exp(β) – 1, where β is the coefficient of interest.

7 The reference case is also an episode for a patient who is discharged alive, with no general acute care hospital, IRF or SNF transfers. The effects of these other characteristics are captured by additional indicators in the outcome regressions.

Figure 3
Ventilator group: Outcomes for episodes with and without long-term care hospital referral



NOTES: Bars indicate 95% confidence interval for long-term care hospital (LTCH) first post-acute care (PAC) estimates. SNF = skilled nursing facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

This point is graphed as zero (the blue diamond point furthest to the left). All other points graphed in the figure are percentage differences from that reference value. The mean index Medicare payment for the reference case is $29,494, as reported in the bottom of the graph.

The remaining points graphed with the blue diamonds show the expected percent difference in episode payments associated with being in each category of LTCH referral likelihood, among non-LTCH users. The pink square points represent the percentage difference between the reference non-LTCH referral episodes and the LTCH episodes. Within each grouping of episodes by propensity score, the vertical distance between the "No LTCH" data points and the "LTCH 1st PAC data points represents the "LTCH effect" for that propensity score group. The LTCH 1st PAC data points are bracketed by 95 confidence intervals; if the non-LTCH referral point is within the confidence interval of the LTCH referral point, then there is not a statistically significant LTCH effect within that propensity score group.

The entire series of graphs from Figures 3–9 can be interpreted as described in the previous paragraphs, with the exception of the Additional Episode Utilization Days (w/o SNF

Days) panels of each figure. These panels contain not the percentage difference but the actual difference in episode days between the baseline non-LTCH referral episodes with the lowest propensity scores and the LTCH referral and non-LTCH referral episodes. All other aspects of these graphs are similar to those described for Figure 3.

3.2.1 Ventilator Group

We start our analysis with the ventilator group because prior research on LTCH outcomes has focused on these patients. Figure 3 displays the differences in episode Medicare payments and facility costs for patients who were referred to LTCH compared with those who completed their care in the index hospital. As we see in the Percent Difference in Episode Payments and Percent Difference in Episode Cost panels of Figure 3, both the episode-level payments and costs for patients referred to LTCH are significantly higher than those who are not referred to LTCHs. The episode payment differences are not surprising, given that the referral to LTCH generates an additional Medicare payment, whereas patients who remain in the index hospital receive at most an outlier payment in addition to their MS-DRG payment.

In the Percent Differences in Episode Payment-to-Cost Ratio panel of Figure 3, we see that for episodes with lower propensity scores, the episode payment-to-cost ratio is significantly higher for the LTCH episodes than for the acute-only episodes, but for the more likely LTCH referrals, the episode payment-to-cost ratio is not significantly different between the two types of episodes. The higher costs for the LTCH-referral episodes are offset by their higher payments; and for those patients most likely to be referred to LTCHs, we see no difference in the overall profitability of episodes of care between those who actually are referred and those who are not referred. In the Additional Episode Utilization Days (w/o SNF Days) panel of Figure 3, the difference in total episode days (not including SNF days) are plotted. LTCH users have at least 20 more days of inpatient care than clinically similar patients who do not use LTCHs, and this difference is stable across all levels of likelihood of LTCH referral.

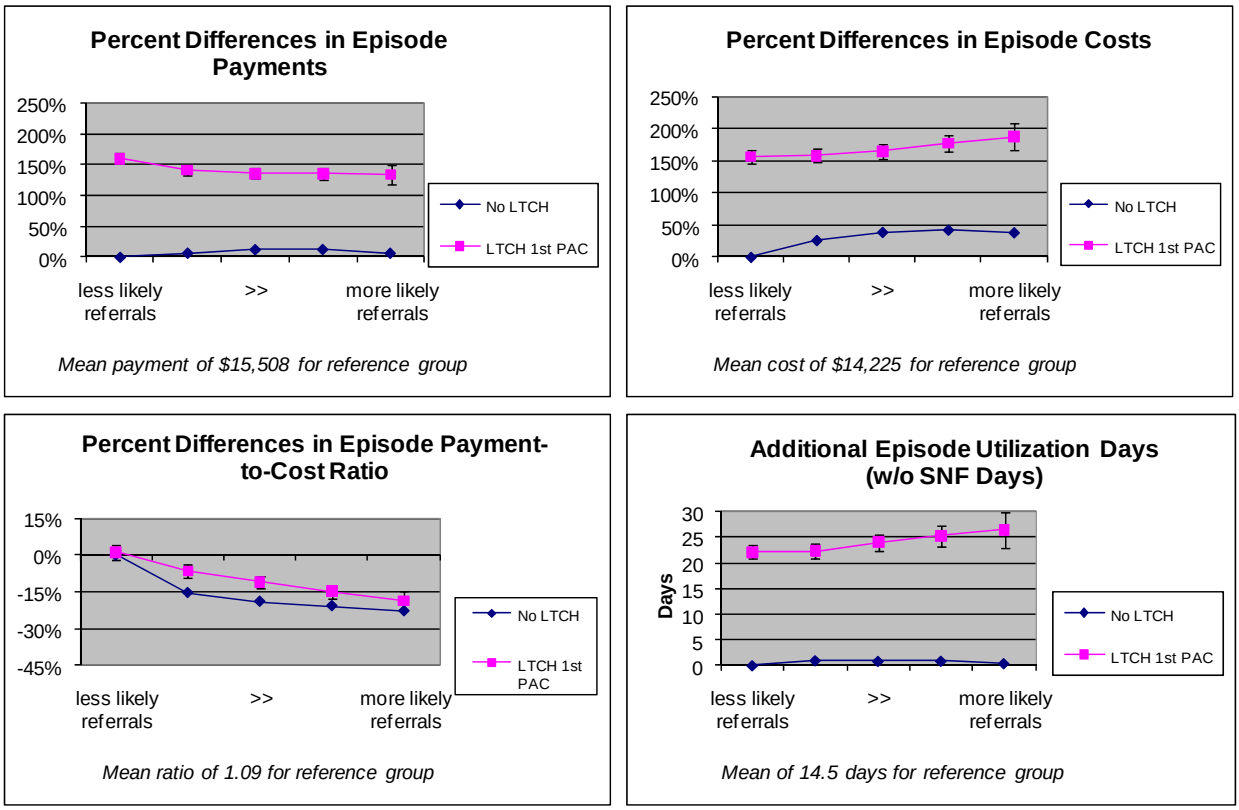
3.2.2 Infection Group

The episode payments and costs are again much larger and significantly higher for the LTCH episodes than for the acute-only episodes (Percent Difference in Episode Payments and Percent Difference in Episode Cost panels of ***Figure 4***). We also see that LTCH users have somewhat higher episode payment-to-cost ratios (Percent Differences in Episode Payment-to-Cost Ratio panel of Figure 4). The additional episode utilization days for the LTCH users range from 22 to 26 days (Additional Episode Utilization Days (w/o SNF Days) panel of Figure 4).

3.2.3 Aftercare, Wound, and Skin Care Group

Episode payments and costs are significantly higher for the LTCH episodes, but the magnitude is smaller than what we show for many of the other condition groups (Percent Difference in Episode Payments and Percent Difference in Episode Cost panels of ***Figure 5***). In the Percent Differences in Episode Payment-to-Cost Ratio panel of Figure 5, we see that LTCH payment-to-cost ratios at the episode level are lower than the non-LTCH ratios for the less likely referrals and higher than the non-LTCH ratios for the more likely referrals. In particular, the

Figure 4
Infection group: Outcomes for episodes with and without long-term care hospital referral

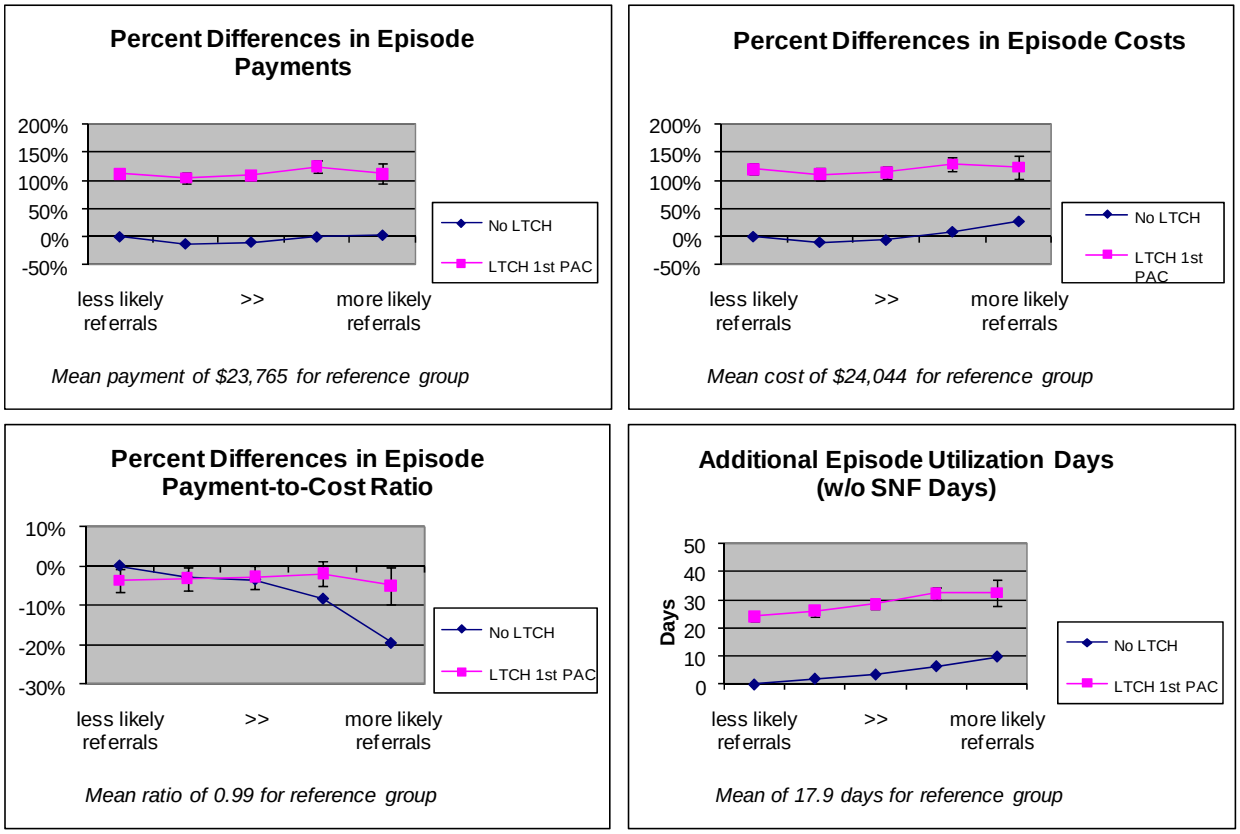


NOTE: Bars indicate 95% confidence interval for long-term care hospital (LTCH) first post-acute care (PAC) estimates. SNF = skilled nursing facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

figure shows us that the additional payment received for the LTCH portion of the LTCH referral episodes helps to keep these episodes from being as financially unprofitable as the non-LTCH episodes. LTCH referral increases the utilization days between 22 and 32 days (Additional Episode Utilization Days (w/o SNF Days) panel of Figure 5), which is consistent with the federal requirement that LTCHs have an average length of stay of at least 25 days for their Medicare patient population.

Figure 5
Aftercare, wound, and skin care group: Outcomes for episodes with and without long-term care hospital referral



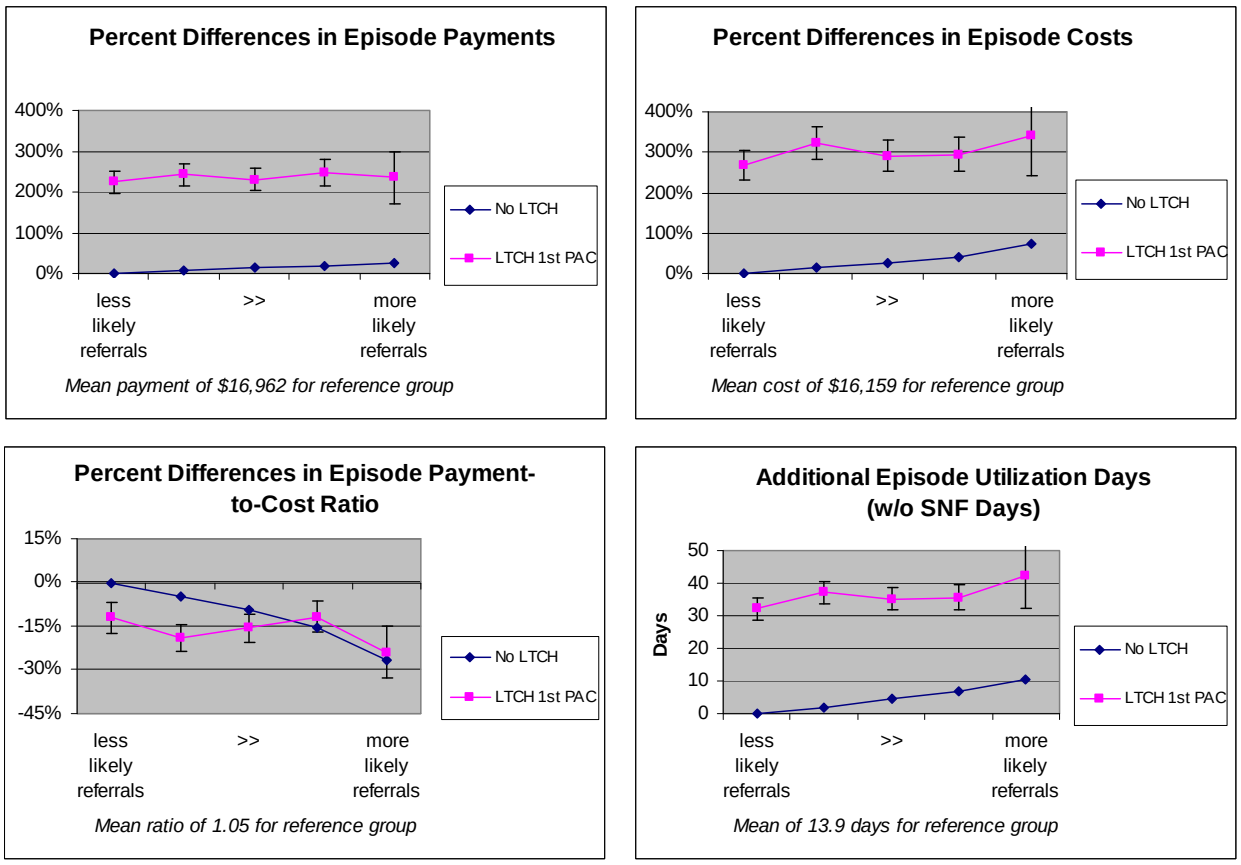
NOTE: Bars indicate 95% confidence interval for long-term care hospital (LTCH) first post-acute care (PAC) estimates. SNF = skilled nursing facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

3.2.4 Complex Rehabilitation Group

Both episode payments and costs are more than 200% higher for the LTCH episodes, but the cost differences are larger (Percent Difference in Episode Payments and Percent Difference in Episode Cost panels of ***Figure 6***). Thus, in the Percent Differences in Episode Payment-to-Cost Ratio panel of Figure 6, we see that the episode cost-to-payment ratios for LTCH users in the complex rehabilitation group are significantly lower than or not significantly different from the non-LTCH users. LTCH referral adds about 30 Medicare utilization days to the episode of care (Additional Episode Utilization Days (w/o SNF Days) panel of Figure 6).

Figure 6
Complex rehabilitation group: Outcomes for episodes with and without long-term care hospital referral



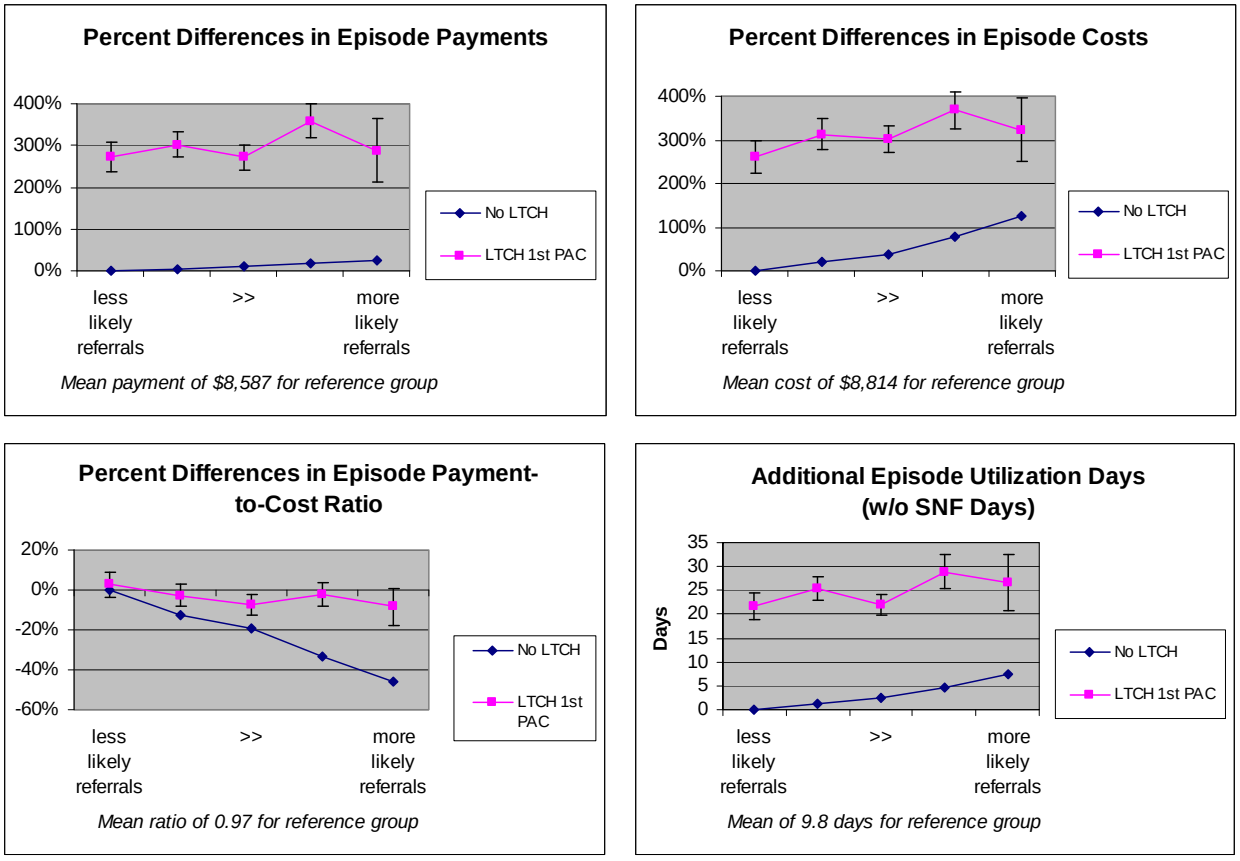
NOTE: Bars indicate 95% confidence interval for long-term care hospital (LTCH) first post-acute care (PAC) estimates. SNF = skilled nursing facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

3.2.5 Pneumonia Group; Heart Failure Group; and Chronic Obstructive Pulmonary Disease/Other Respiratory Group

Figures 7, 8, and ***9*** graph the episode-level outcomes for the pneumonia, heart failure, and COPD/other respiratory group, respectively. Because the patterns in these three cardiopulmonary groups are quite similar, we will describe them together. For all three of these condition groups, the episode payments and costs are more than 200% higher for the LTCH-referral episodes than for the non-LTCH episodes. Although the episode payment stays fairly stable when moving from less likely to more likely LTCH referrals, which is consistent with the prospective payment system, the episode-level costs trend upward as the likelihood of LTCH referral increases. Thus, in the Percent Differences in Episode Payment-to-Cost Ratio panels, we see that the payment-to-cost ratios fall as the propensity score of the episode increases. For all

Figure 7
Pneumonia group: Outcomes for episodes with and without long-term care hospital referral

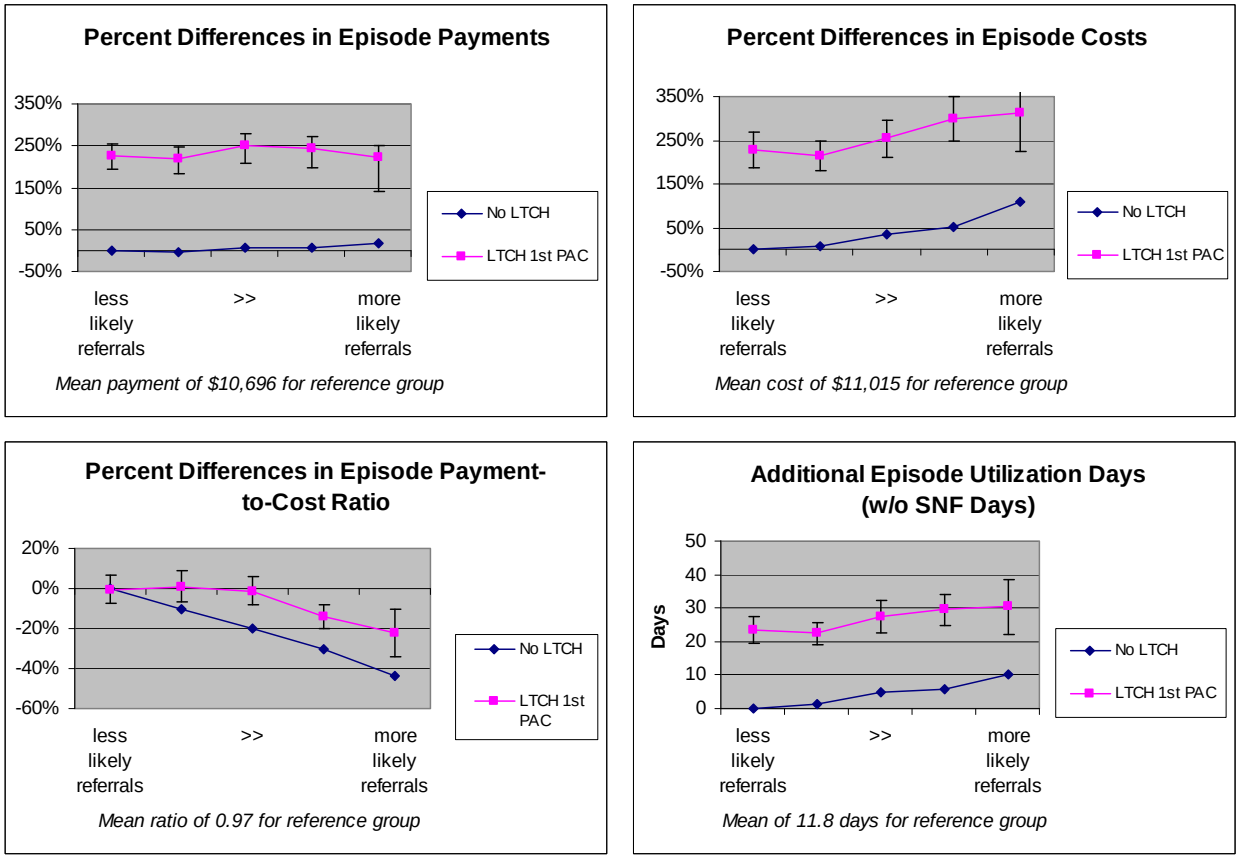


NOTE: Bars indicate 95% confidence interval for long-term care hospital (LTCH) first post-acute care (PAC) estimates. SNF = skilled nursing facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

three condition groups, the payment-to-cost ratio for the index-only episodes is significantly lower than the episode margin for the LTCH-referral episodes, for all but the least likely LTCH-referrals. Utilization days are always significantly higher for the LTCH-referral episodes, by 20 additional days or more.

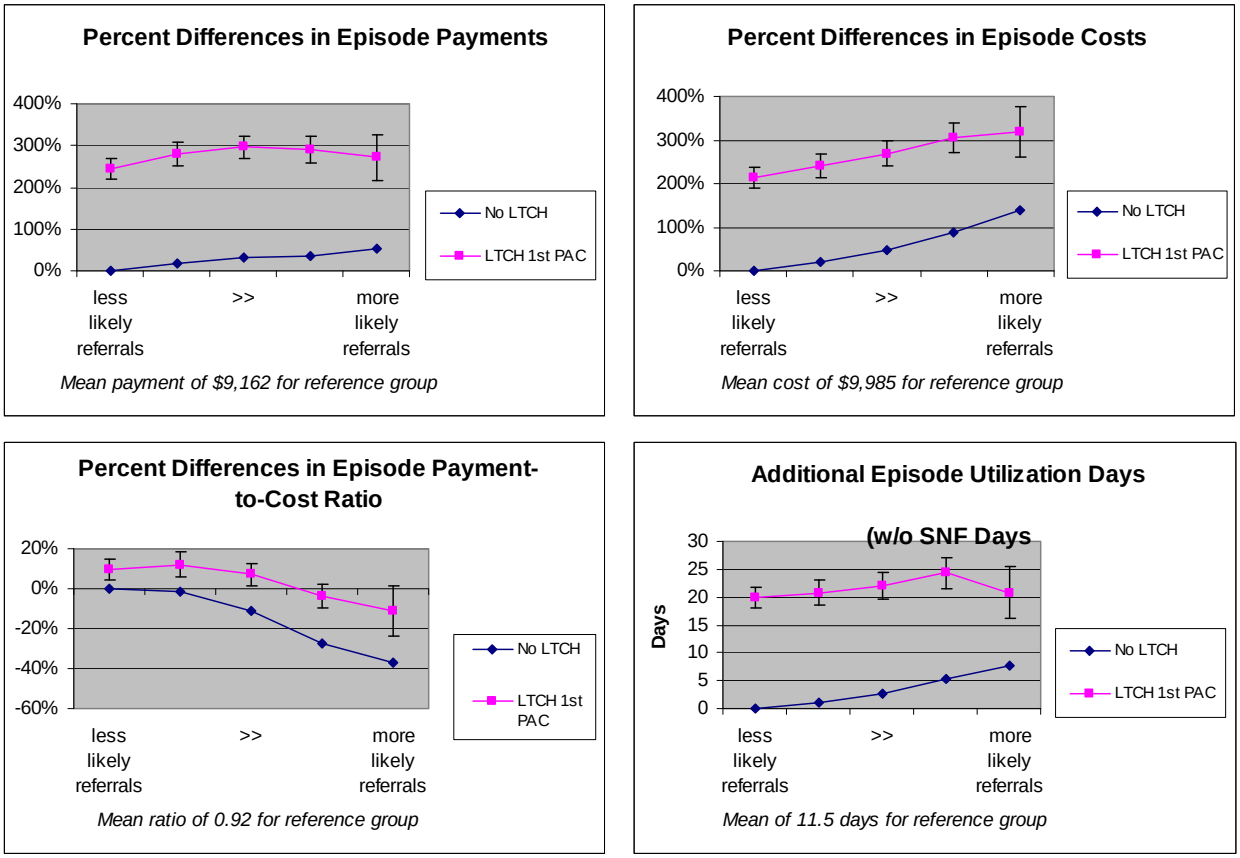
Figure 8
Heart failure group: Outcomes for episodes with and without long-term care hospital referral



NOTE: Bars indicate 95% confidence interval for long-term care hospital (LTCH) first post-acute care (PAC) estimates. SNF = skilled nursing facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Figure 9
Chronic obstructive pulmonary disease/other respiratory group: Outcomes for episodes with and without long-term care hospital referral



NOTE: Bars indicate 95% confidence interval for long-term care hospital (LTCH) first post-acute care (PAC) estimates. SNF = skilled nursing facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

3.3 Simulated Differences for Most Likely Referral Episodes

Our payment and cost models in our primary analysis were estimated in log-linear form. For the most part we express our results in the form of proportional effects—that is, the percent difference in the outcome variable that can be expected from a one-unit change in the independent variable of interest (in this case, LTCH transfer). We also constructed simulations to illustrate the absolute level of the estimated LTCH referral effects; for these simulations, we used the group of patients with the highest referral likelihood within each condition group. We predicted episode payments, episode costs, and episode lengths of stay for each observation in the highest quartile of LTCH referral probability for each condition group, under two scenarios: the first predicts the outcome variable *as if all patients were LTCH users*; the second predicts it *as if all patients were non-LTCH users.*

There are two typical approaches to construct simulations from regression results. One is to identify covariate values associated with a typical or important type of "reference" episode, and then compute the expected difference in an outcome for that reference episode if it were referred to an LTCH, compared to that same reference episode if it were not referred to an LTCH. The other approach uses all of the covariate values as they appear in the sample observations and computes the difference in the sample average of outcome values if all observations were referred to an LTCH, compared to the sample average of outcome values if none of the observations were referred to an LTCH. Our simulations follow the second approach; thus, all covariate values for the observations in our simulation samples were unchanged except for the variable for LTCH referral from the index hospital. The indicator variable for LTCH referral was set equal to 1 in the first scenario and 0 in the second.

Simulation results are presented in ***Table 5***. They provide substantial evidence that LTCH referral is associated with large increases in Medicare stays, payments, and cost of care.

Episode days, with and without days in skilled nursing —In ***Panel A-1*** we show the LTCH-related differences in the predicted number of Medicare covered hospital days, including general acute and all specialty facilities. LTCH referral is associated with additional hospital utilization ranging from 17.8 days (COPD group) to 29.5 days (complex rehabilitation group). The lowest proportional effect is for ventilator patients (48% increase) and the highest is for pneumonia patients (128% increase).

Panel A-2 shows the same information where covered SNF days were included in the computation of the model's outcome variable. These data provide important information on the issue of substitution of care between these two settings. In our matched samples, we had found that LTCH users tended to use slightly more SNF days than matched non-LTCH users. In these simulations from multivariate models, we find that the predicted LTCH referral effect on total days and acute-only days is very similar for patients in the ventilator, infection, wound care and complex rehabilitation groups. For pneumonia, heart failure and COPD, the LTCH referral effect is actually greater when SNF days are included. We conclude from this that in the 2007 data, there is no evidence that LTCH care is substituting for high-level SNF care.

Medicare payments—In ***Panel B***, the smallest LTCH-related increase in Medicare episode payments is $24,143 in the COPD/other respiratory group, and the largest increase is $39,547 in the complex rehabilitation group. While the ventilator group has the highest average Medicare payments, the simulated LTCH effect is proportionally the smallest of the seven condition groups, an increase of 36%, compared to increases in the other six groups ranging from 111% (infections) to 276% (pneumonia).

Medicare episode costs—In ***Panel C***, episodes in the complex rehabilitation group have the largest LTCH-related increase in costs, both in value and proportionally. The smallest proportional increase in costs occurs in the ventilator group (38%), while the smallest dollar increase is in the COPD/other respiratory group ($23,500). The longer stays are driving much, but clearly not all, of the higher costs. Except for the ventilator group, the referral effect on provider costs is substantially greater than the effect on hospital days.

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Table 5
Simulation of the impact of long-term care hospital use on episode days, payments, costs and margins: Matched sample of patients with the highest likelihood of long-term care hospital referral

Panel A-1: Number of acute episode days simulation

Condition group	N	If all cases referred to LTCH	If no cases referred to LTCH	Difference	Percent difference
Ventilator group	6,546	68.0	45.8	22.2	48%
Infection group	6,851	51.8	27.1	24.7	91%
Aftercare, wound, and skin care group	4,015	55.8	30.4	25.4	84%
Complex rehabilitation group	805	54.6	25.1	29.5	118%
Pneumonia group	1,306	41.5	18.2	23.3	128%
Heart failure group	915	43.2	20.1	23.1	115%
COPD/other respiratory group	1,706	37.2	19.4	17.8	92%

Panel A-2: Number of total episode days (including SNF) simulation

Condition group	N	If all cases referred to LTCH	If no cases referred to LTCH	Difference	Percent difference
Ventilator group	6,546	92.4	71.7	20.7	29%
Infection group	6,851	77.2	52.5	24.7	47%
Aftercare, wound, and skin care group	4,015	82.3	58.3	24.0	41%
Complex rehabilitation group	805	84.1	52.8	31.3	59%
Pneumonia group	1,306	60.1	34.7	25.4	73%
Heart failure group	915	63.2	34.2	29.0	85%
COPD/other respiratory group	1,706	52.3	30.9	21.4	69%

Panel B: Medicare episode payment simulation

Condition group	N	If all cases referred to LTCH	If no cases referred to LTCH	Difference	Percent difference
Ventilator group	6,546	$135,351	$99,316	$36,035	36%
Infection group	6,851	59,918	28,350	31,568	111%
Aftercare, wound, and skin care group	4,015	59,357	26,878	32,479	121%
Complex rehabilitation group	805	60,682	21,135	39,547	187%
Pneumonia group	1,306	41,435	11,030	30,405	276%
Heart failure group	915	38,881	12,415	26,466	213%
COPD/other respiratory group	1,706	37,652	13,509	24,143	179%

Panel C: Medicare episode cost simulation

Condition group	N	If all cases referred to LTCH	If no cases referred to LTCH	Difference	Percent difference
Ventilator group	6,546	$119,163	$86,135	$33,028	38%
Infection group	6,851	61,495	31,187	30,308	97%
Aftercare, wound, and skin care group	4,015	65,301	32,238	33,063	103%
Complex rehabilitation group	805	68,670	24,977	43,693	175%
Pneumonia group	1,306	45,624	18,414	27,210	148%
Heart failure group	915	51,707	20,909	30,798	147%
COPD/other respiratory group	1,706	45,274	21,774	23,500	108%

Panel D: Aggregate average Medicare margins simulation

Condition group	N	If all cases referred to LTCH	If no cases referred to LTCH	Percent Point Difference
Ventilator group	6,546	12.0%	13.3%	−1.3
Infection group	6,851	−2.6%	−10.0%	7.4
Aftercare, wound, and skin care group	4,015	−10.0%	−19.9%	9.9
Complex rehabilitation group	805	−13.2%	−18.2%	5.0
Pneumonia group	1,306	−10.1%	−66.9%	56.8
Heart failure group	915	−33.0%	−68.4%	35.4
COPD/other respiratory group	1,706	−20.2%	−61.2%	40.9

NOTES: LTCH = long-term care hospital; COPD = chronic obstructive coronary disease. Highest likelihood of LTCH referral defined as those cases in the top quartile of the propensity score.

SOURCE: Analysis of RTI 2007 Episode Margins file. Panel A: Medicare episode payment simulation

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Medicare margins—In ***Panel D***, we present the aggregate average Medicare margins for the full episode of care implied by the simulated episode payments and costs. Recall that margins are defined as the difference between Medicare payments and Medicare costs, expressed as a percent of Medicare payments. Episode margins are aggregates computed from payments and costs across the multiple sites of care that are present in each sample observation; thus they are not representative of the profitability of any one stay within the episode. In the ventilator group, margins would be 1.3 percentage points lower if all patients were LTCH users than they would be if no patients were LTCH users, but ventilator patients are the only condition where we see this. In all other condition groups, the episode margins would be higher if all the patients were LTCH users. There is substantial variation across the other condition groups in the LTCH effect on episode margins, ranging from an increase of 5.0 percentage points (complex rehabilitation) to 56.8 percentage points (pneumonia).

Higher margins for the full episode of care for LTCH users in these groups suggest that there could be a payment parity problem between general acute care hospitals and LTCHs, for at least some MS-DRGs. Note that, with the exception of the ventilator group, the simulated margins for the episodes of care among these patients are negative and often quite large.

3.4 Robustness Checks for Outcome Equations

Extensive sensitivity tests were conducted to assess the impact of the decisions made in the analysis design regarding estimation samples, variable specifications, and statistical techniques.

3.4.1 Alternative Specifications to Account for Mortality

We tested a number of different methods of controlling for patient death, from restricting our analysis sample to those who survive the index hospital stay to including a variety indicator variables identify mortality within specified time frames. Correctly controlling for mortality is of particular importance for the ventilator episodes because almost 40% of the episodes we constructed in the ventilator group ended in death. Although the LTCH effect was smaller in the ventilator group when the analysis was limited to those who survived at least 30 days after the end of their inpatient episode of care, they were still quite large and statistically significant. The coefficients on a variety of indicator variables identify time to death tended to be large, significant and in the expected direction, but adding them to the models did not substantially reduce the LTCH effects.

3.4.2 Alternative Study Populations from Which to Draw Control Observations

As discussed in ***Section 1.2.3***, we had some concern that unobserved selection could bias the results if the sample of non-LTCH user episodes is drawn from the same hospitals from which we draw the LTCH user episodes. To mitigate this source of bias, our study design expanded the population from which we selected matched controls to include patients from hospitals that had been excluded from the propensity estimation sample because they had low LTCH referral rates. As a further check we restricted the control group to patients only from hospitals with a less than 1% rate of LTCH referral within each condition group and re-estimated the outcome equations. The estimated LTCH effects were very similar to those presented in the current report, where the controls are drawn from hospitals with both high and low referral rates.

3.4.3 Reconstructing the Earlier RTI Model on LTCH Ventilator Outcomes to Test for Changes over Time

The Kennell/RTI analysis team also replicated the LTCH episode analysis from the earlier RTI analysis of outcomes in ventilator patients (as discussed in ***Section 1.2.3***). That study compared outcomes for LTCH and non-LTCH users in a few states selected for their high LTCH referral rates (Louisiana, Oklahoma, and Texas), using stratified propensity groups and a sample drawn from ventilator episodes in 2004. In that study, the difference between payments for the index-only episodes and payments for the LTCH-referral episodes was highest for those patients least likely to go to an LTCH and then declined as the likelihood of LTCH referral increased. The payment difference was small and not statistically significant for the group of patients most likely to go to LTCH.

We found a similar *pattern* when we used the 2007 episode files for that same selected group of states, with larger differences among patients with lower propensity scores and smaller differences among patients with higher propensity scores. However, across all propensity strata, the proportional difference in Medicare payments between LTCH-referral episodes and index-only episodes was much larger in the 2007 episode data than in the 2004 episode data. From this we concluded that the magnitude of the results from the study described in this paper is not attributable to the change in analytic methods (propensity matching rather than stratification) or study population (national rather than state-specific). This suggests that the LTCH effect on utilization and payments that we are seeing in our analysis of episodes from 2007 might reflect recent changes in the LTCH patient population or recent changes in patterns of care, or both.

3.4.4 Geographic Comparisons: Regions with High versus Low LTCH Use

As a final test, we limited our LTCH-referral population to patients from index hospitals in states with many LTCHs and historically high referral rates (Oklahoma and Texas) and matched these with non-LTCH user episodes for patients from index hospitals in states with few or no LTCHs (New York, Oregon, and Virginia). Once again, although the sample sizes were much reduced and the estimates less precise, we still found similar, large LTCH effects on our utilization and financial variables with this more limited population.

Although we are still concerned that some uncontrolled selection effects could be introducing bias into our results, the robustness of the results to many specification changes suggests that the differences we find between LTCH episodes of care and non-LTCH episodes are too large to be attributed solely to selection.

3.5 Limitations

The primary limitation in this analysis is the reliance on the clinical information in the Medicare claims data to accurately predict the probability of LTCH referral. Many clinical factors that are relevant to LTCH referral are not available in the claims data. Nonclinical (and unobservable) factors, such as physician preferences and practice patterns or patient and family preferences, also play an important role in the LTCH referral decision, but these predictors cannot be captured in claims data. There is also some variation in the acuity of patients that different LTCHs have the capacity to accept; for example, some LTCHs have designated ICU beds to allow them to accept more critically ill patients, but not all LTCHs have this capability.

At this time neither general acute care hospitals nor LTCHs are required to complete patient assessment instruments (as are used in IRFs and SNFs), from which additional information on functional status, patient mobility, mental status, and nursing needs might greatly improve the referral prediction equations. The Continuity Assessment Record and Evaluation (CARE) tool is a new assessment instrument with variables that are commonly defined across post-acute care settings, and required use of this tool in LTCH settings is under consideration. If implemented, this assessment tool could potentially improve the modeling of LTCH referral from secondary data.

The absence of data on SNF costs is another limitation of this episode analysis. By excluding SNF financial information from our calculations of episode-level payments and costs, we fail to capture any substitution effects between LTCH and SNF care. If there is significant substitution, our estimates of the effect of LTCH use are overstated. Our analyses of covered episode days with and without SNF stays, however, have not provided any evidence of substitution between LTCHs and SNFs. Because the LTCH users have similar or higher SNF use than the matched non-LTCH users in the study, it is likely that had we included SNF financial data in the analyses, the estimated LTCH referral effect would have been greater, not smaller.

Failing to capture hospice use presents another possible source of bias in this study. Hospice referral indicates that the patient, patient's family, and patient's physician have stopped active intervention in medical care. We did not have hospice claims data for this study, and it is not clear that those referred to hospice from the index hospital would necessarily have shorter or less expensive stays than those not referred to hospice. Approximately 3.4% of the matched non-LTCH episodes across all seven condition groups had a discharge destination code indicating hospice care, but hospital discharge records and claims destination coding are likely to understate actual use. We did not use this indicator as a control variable in our second stage equations.

Unmeasured selection factors can affect the likelihood of LTCH use from both sides of the transfer decision—those influencing the index hospital's decisions to transfer and those influencing the LTCH's decisions accept. We conducted extensive modeling to identify transfer predictors from the index hospital's perspective and controlled for their effects either through matching or as covariates in the second stage (outcome) equations. We may not have been as successful at capturing factors that identify the best LTCH admission from the perspective of the LTCH. LTCHs are looking for specific types of patients that fit their clinical expertise, but they must also function within regulatory restrictions that promote long-staying patients (an overall average of 25 days) and penalize shorter-than-expected stays. We acknowledge that our model may not control for this adequately.

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SECTION 4
CONCLUSIONS

4.1 Summary of Results

In this study we have examined differences in utilization, payments, provider costs and Medicare margins, between medically complex LTCH users and clinically similar non-LTCH users. We have estimated and compared LTCH referral effects across patients who are the most likely LTCH referral candidates and the least likely LTCH referral candidates. In all seven of the medically complex condition groups that we have examined, LTCH users have much higher Medicare PPS payments than non-users, and they also have longer stays and higher costs. These differences persist for all levels of LTCH referral probability. We see the smallest differences among ventilator patients, where Medicare inpatient episode payments and inpatient episode costs are 75% higher for LTCH users than for non-users. In other condition groups, however, predicted payments and costs are up to 2 or 3 times higher for those referred to LTCHs. Payment rates also tend to be more generous (relative to cost) in the LTCH settings; with the exception of the ventilator group and the complex rehabilitation groups, Medicare payment-to-cost ratios averaged over the episode are higher for the LTCH users, particularly for those who were the more likely referrals.

4.2 Implications for Payment Equity across Sites of Care

With the exception of the ventilator and complex rehabilitation groups, the overall margins for the episodes of care are significantly higher for patients who use LTCHs than for those who do not. Both costs and payments are significantly higher for LTCH episodes, but the payment difference is larger, implying that the margins on the LTCH portion of the episode are higher. While a desire for payment parity across sites of care would suggest that Medicare payments be adjusted to bring these payment-to-cost ratios closer together, aggregate margins for all condition groups except those for ventilator and COPD patients were negative. For the majority of episodes, aggregate Medicare payments in this study population were less than provider costs.

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APPENDIX A:
PROPENSITY SCORE ANALYSIS COVARIATE DEFINITIONS

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Appendix Table A
Propensity score analysis variable definitions

Covariate	ICD-9 Diagnosis Codes	ICD-9 Procedure Codes
Acute respiratory failure	518.81, 518.82, 518.84, 518.5	none
Chronic respiratory failure	518.83	none
Heart failure	402.01, 402.11, 402.91, 404.01-404.03, 404.11-404.13, 404.91-404.93, 428.0-428.99, 997.1	none
Liver failure	570	none
Acute renal failure	584.5-584.9	none
Chronic renal failure	403.90-403.91, 585.4-585.9	none
Skin failure	see note	see note
Septic shock	785.52	none
Encephalopathy	348.31	none
Disseminated intravascular coagulopathy (DIC)	286.6	none
Critical illness myopathy/polyneuropathy (CIM/CIP)	357.82, 359.81	none
Vent < 96 hours	none	96.70, 96.71
Vent 96+ hours	none	96.72
Vent with tracheostomy	none	31.1, 31.21, 31.29
Extracorporeal membrane oxygenation (ECMO)	none	39.65
Ulcers	707.00-707.99	none
Cellulitis	682-682.99	none
Wound procedures	none	85.82-85.85, 86.22, 86.4-86.49, 86.60-86.75, 86.91, 86.93
Sepsis	038.0-038.99	none
Nosocomial pneumonia	482.0-482.99	none
Chronic obstructive pulmonary disease (COPD)	490-429.99, 493.2, 496	none
Pleural effusion	511.0-511.99	none
Shock	785.50-785.59	none
Systemic inflammatory response syndrome (SIRS)	995.90-995.94	none
Malnutrition	261-263.9	none

(continued)

Appendix Table A (continued)
Propensity score analysis variable definitions

Covariate	ICD-9 Diagnosis Codes	ICD-9 Procedure Codes
Thrombocytopenia	287.0-287.99	none
Cardiac dysrhythmias	427.0-427.99	none
Endocarditis	421.0-421.9	none
Acute myocardial infarction	410.0-410.99	none
Acute coronary syndrome	411.0-411.99	none
Other chronic ischemic disease	414.0-414.99	none
Other pulmonary disease	415.0-417.99	none
Cardiomyopathy	425.0-425.9	none
Other heart disease	420.0-429.99	none
Osteomyelitis	730.00-730.99	none
Other bacterial infection	040.0-041.99	none
Percutaneous endoscopic gastrostomy (PEG)	none	43.11, 43.19
Critical care unit procedures	none	38.91, 38.93, 38.95
Dialysis	399.5	none
Dementia	290.1-290.99, 293.0, 293.1	none

NOTE: Skin failure is defined as the combination of ulcers and either cellulitis or wound procedures.

APPENDIX B:
TABLES OF REGRESSION RESULTS FROM LOGISTIC PROPENSITY SCORE

LIST OF TABLES IN APPENDIX B

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Appendix Table B.1
Ventilator group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Female	0.041	0.015	0.005
Ages < 65	−0.010	0.020	0.628
Ages 75–84	−0.011	0.018	0.550
Ages 85+	−0.038	0.026	0.141
MS-DRGs 003–004	2.273	0.467	0.000
MS-DRGs 011–013	1.140	0.463	0.014
MS-DRG 207	−0.131	0.662	0.843
Log beds	−0.207	0.032	0.000
Log resident ratio	−0.365	0.121	0.003
Case mix index	−0.020	0.088	0.819
Urban	−0.022	0.055	0.691
Acute respiratory failure	0.187	0.069	0.007
Chronic respiratory failure	0.352	0.098	0.000
Heart failure	0.042	0.063	0.506
Liver failure	−0.181	0.163	0.269
Acute renal failure	0.055	0.068	0.418
Chronic renal failure	−0.083	0.071	0.244
Skin failure	0.320	0.060	0.000
Septic shock	−0.181	0.052	0.001
Encephalopathy	−0.121	0.070	0.084
Disseminated intravascular coagulopathy (DIC)	−0.207	0.079	0.009
Critical illness myopathy/polyneuropathy (CIM/CIP)	0.367	0.151	0.015
Acute and chronic respiratory failure	−0.141	0.228	0.536
Respiratory and heart failure	−0.011	0.064	0.869
Respiratory and liver failure	0.153	0.174	0.380
Respiratory and acute renal failure	−0.078	0.069	0.254
Respiratory and chronic renal failure	0.080	0.074	0.280
Chronic respiratory and acute renal failure	0.178	0.214	0.404
Chronic respiratory failure and CIM/CIP	−4.907	378.204	0.990
Liver failure and encephalopathy	−0.538	0.509	0.291
Liver failure and CIM/CIP	−5.553	4,388.339	0.999
Renal failure and septic shock	−0.034	0.052	0.513
Skin failure and CIM/CIP	−4.965	383.055	0.990
DIC and CIM/CIP	−5.119	1,474.188	0.997
Vent < 96 hours	0.280	0.473	0.554
Vent 96+ hours	0.664	0.486	0.172
Vent with tracheostomy	−0.148	0.116	0.201
Extracorporeal membrane oxygenation (ECMO)	−1.721	0.411	0.000
Ulcers	−0.036	0.038	0.350

(continued)

Appendix Table B.1 (continued)
Ventilator group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Cellulitis	0.028	0.045	0.530
Wound procedures	−0.062	0.039	0.113
1–2 organ failures	0.064	0.077	0.402
3–6 organ failures	0.113	0.088	0.200
Sepsis	0.012	0.026	0.649
Nosocomial pneumonia	0.135	0.024	0.000
Chronic obstructive pulmonary disease (COPD)	0.130	0.018	0.000
Pleural effusion	0.156	0.026	0.000
Shock	0.100	0.036	0.005
Systemic inflammatory response syndrome (SIRS)	−0.028	0.027	0.300
Malnutrition	0.094	0.021	0.000
Thrombocytopenia	−0.017	0.031	0.589
Cardiac dysrhythmias	0.015	0.016	0.367
Endocarditis	−0.140	0.115	0.226
Acute myocardial infarction	−0.024	0.023	0.304
Acute coronary syndrome	0.125	0.070	0.072
Other chronic ischemic disease	−0.035	0.027	0.201
Other pulmonary disease	0.084	0.036	0.021
Cardiomyopathy	−0.033	0.033	0.324
Other heart disease	0.018	0.053	0.728
Osteomyelitis	−0.101	0.169	0.550
Other bacterial infection	0.124	0.050	0.014
Percutaneous endoscopic gastrostomy (PEG)	0.199	0.019	0.000
6–10 critical care days	0.290	0.031	0.000
11–15 critical care days	0.271	0.033	0.000
16–25 critical care days	0.379	0.034	0.000
26–30 critical care days	0.332	0.040	0.000
31+ critical care days	0.192	0.037	0.000
Critical care unit procedures	0.061	0.016	0.000
Dialysis	−0.149	0.037	0.000
Dementia	−0.020	0.090	0.825
Constant	−1.356	0.499	0.007

NOTE: Number of observations: 49,622; Log likelihood: −20,973.761.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table B.2
Infection group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Female	−0.082	0.019	0.000
Ages < 65	0.007	0.028	0.812
Ages 75–84	−0.013	0.026	0.608
Ages 85+	−0.048	0.028	0.087
MS-DRG 095	0.086	0.171	0.616
MS-DRG 096	0.036	0.272	0.893
MS-DRG 097	0.480	0.132	0.000
MS-DRG 098	0.148	0.196	0.449
MS-DRG 099	0.175	0.316	0.578
MS-DRG 288	0.249	0.131	0.058
MS-DRG 289	0.364	0.164	0.026
MS-DRG 290	0.418	0.278	0.133
MS-DRG 485	1.130	0.120	0.000
MS-DRG 486	0.789	0.110	0.000
MS-DRG 487	0.963	0.144	0.000
MS-DRG 539	0.359	0.105	0.001
MS-DRG 540	0.292	0.105	0.005
MS-DRG 541	0.382	0.151	0.012
MS-DRG 853	0.537	0.042	0.000
MS-DRG 854	0.317	0.068	0.000
MS-DRG 856	0.561	0.112	0.000
MS-DRG 857	0.408	0.104	0.000
MS-DRG 858	0.502	0.214	0.019
MS-DRG 870	0.105	0.082	0.202
MS-DRG 871	0.196	0.034	0.000
MS-DRG 094	0.587	0.120	0.000
Log beds	−0.086	0.038	0.023
Log resident ratio	−0.668	0.165	0.000
Case mix index	−0.010	0.110	0.928
Urban	−0.060	0.076	0.428
Acute respiratory failure	0.185	0.039	0.000
Chronic respiratory failure	−0.036	0.126	0.775
Heart failure	0.043	0.027	0.114
Liver failure	0.064	0.084	0.450
Acute renal failure	0.022	0.025	0.380
Chronic renal failure	−0.050	0.028	0.078
Skin failure	−0.036	0.057	0.523
Septic shock	0.117	0.099	0.236
Encephalopathy	0.018	0.076	0.815

(continued)

Appendix Table B.2 (continued)
Infection group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Disseminated intravascular coagulopathy (DIC)	−0.149	0.089	0.094
Critical illness myopathy/polyneuropathy (CIM/CIP)	−0.231	0.476	0.627
Acute respiratory failure and septic shock	−0.100	0.054	0.062
Acute respiratory and skin failure	−0.167	0.085	0.050
Chronic respiratory and liver failure	−4.189	1,281.082	0.997
Chronic respiratory and acute renal failure	0.388	0.241	0.107
Chronic respiratory failure and septic shock	0.351	0.219	0.109
Heart and skin failure	−0.172	0.080	0.032
Heart failure and CIM/CIP	1.937	0.965	0.045
Renal failure and CIM/CIP	−3.502	814.942	0.997
Septic shock and skin failure	−0.160	0.090	0.077
Vent < 96 hours	−0.053	0.050	0.286
Vent 96+ hours	0.082	0.071	0.248
Ulcers	0.434	0.033	0.000
Cellulitis	0.348	0.032	0.000
Wound procedures	0.160	0.027	0.000
1–4 organ failures	−0.008	0.034	0.807
5–7 organ failures	0.188	0.136	0.167
Sepsis	0.097	0.049	0.048
Nosocomial pneumonia	0.117	0.053	0.027
Chronic obstructive pulmonary disease (COPD)	0.062	0.026	0.017
Pleural effusion	0.065	0.047	0.168
Shock	0.009	0.094	0.926
Systemic inflammatory response syndrome (SIRS)	−0.075	0.023	0.001
Malnutrition	0.257	0.028	0.000
Thrombocytopenia	−0.016	0.039	0.674
Cardiac dysrhythmias	0.024	0.024	0.326
Endocarditis	0.677	0.086	0.000
Acute myocardial infarction	−0.065	0.044	0.140
Acute coronary syndrome	−0.067	0.149	0.655
Other chronic ischemic disease	−0.135	0.037	0.000
Other pulmonary disease	0.004	0.076	0.957
Cardiomyopathy	−0.033	0.050	0.502
Other heart disease	0.004	0.065	0.954

(continued)

Appendix Table B.2 (continued)
Infection group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Osteomyelitis	0.492	0.060	0.000
Other bacterial infection	0.098	0.031	0.002
Percutaneous endoscopic gastrostomy (PEG)	0.025	0.048	0.595
6–10 critical care days	0.180	0.028	0.000
11–15 critical care days	−0.057	0.037	0.120
16–20 critical care days	0.052	0.050	0.295
21+ critical care days	0.164	0.053	0.002
Critical care unit procedures	0.304	0.021	0.000
Dialysis	−0.090	0.038	0.018
Dementia	−0.145	0.096	0.131
Constant	−1.009	0.190	0.000

NOTE: Number of observations: 27,823; Log likelihood: −12,109.747.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table B.3
Aftercare, wound, and skin group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Female	0.013	0.024	0.589
Ages < 65	0.065	0.036	0.068
Ages 75–84	0.003	0.031	0.928
Ages 85+	−0.064	0.036	0.072
MS-DRG 463	0.851	0.106	0.000
MS-DRG 464	0.664	0.106	0.000
MS-DRG 465	0.469	0.169	0.006
MS-DRG 573	0.920	0.105	0.000
MS-DRG 574	0.931	0.098	0.000
MS-DRG 575	0.838	0.112	0.000
MS-DRG 576	0.815	0.181	0.000
MS-DRG 577	0.435	0.158	0.006
MS-DRG 578	0.322	0.199	0.105
MS-DRG 592	0.821	0.093	0.000
MS-DRG 593	0.781	0.074	0.000
MS-DRG 594	0.751	0.112	0.000
MS-DRG 622	0.639	0.149	0.000
MS-DRG 623	0.691	0.118	0.000
MS-DRG 624	0.167	0.367	0.649
MS-DRG 901	0.323	0.223	0.148
MS-DRG 902	0.473	0.180	0.009
MS-DRG 903	0.337	0.311	0.278
MS-DRG 927	−0.101	0.240	0.673
MS-DRG 928	0.046	0.178	0.796
MS-DRG 929	0.093	0.289	0.749
MS-DRG 933	0.231	0.671	0.731
MS-DRG 934	1.121	0.185	0.000
MS-DRG 935	0.521	0.127	0.000
MS-DRG 329	0.425	0.043	0.000
Log beds	−0.067	0.039	0.089
Log resident ratio	−0.465	0.164	0.005
Case mix index	0.315	0.121	0.009
Urban	−0.123	0.066	0.063
Acute respiratory failure	0.093	0.052	0.075
Chronic respiratory failure	−0.011	0.222	0.961
Heart failure	0.071	0.045	0.114
Liver failure	0.146	0.277	0.599
Acute renal failure	0.039	0.053	0.466
Chronic renal failure	0.034	0.060	0.565

(continued)

Appendix Table B.3 (continued)
Aftercare, wound, and skin group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Skin failure	−0.175	0.062	0.005
Septic shock	−0.050	0.192	0.792
Encephalopathy	0.552	0.253	0.029
Disseminated intravascular coagulopathy (DIC)	0.157	0.317	0.620
Critical illness myopathy/polyneuropathy (CIM/CIP)	0.269	0.401	0.503
Acute respiratory and heart failure	−0.170	0.085	0.044
Acute respiratory failure and septic shock	0.009	0.168	0.960
Acute respiratory failure and encephalopathy	−0.784	0.433	0.070
Heart and skin failure	−0.070	0.081	0.389
Heart failure and encephalopathy	−1.006	0.675	0.136
Heart failure and CIM/CIP	−4.697	1,662.523	0.998
Liver and chronic renal failure	−5.182	709.346	0.994
Liver failure and septic shock	−0.682	0.789	0.387
Liver failure and encephalopathy	−4.816	2,619.575	0.999
Liver failure and DIC	−4.849	1,559.313	0.998
Acute and chronic renal failure	−0.075	0.089	0.398
Renal and skin failure	−0.034	0.082	0.674
Renal failure and DIC	−4.577	1,949.042	0.998
Renal failure and CIM/CIP	−0.386	3,652.962	1.000
Septic shock and DIC	−1.210	0.652	0.064
Encephalopathy and DIC	−5.834	1,976.501	0.998
Vent < 96 hours	−0.001	0.057	0.984
Vent 96+ hours	−0.096	0.069	0.163
Ulcers	0.454	0.066	0.000
Cellulitis	0.001	0.036	0.975
Wound procedures	0.241	0.075	0.001
2 organ failures	0.060	0.062	0.334
3–5 organ failures	0.092	0.120	0.444
Sepsis	0.305	0.072	0.000
Nosocomial pneumonia	−0.083	0.132	0.530
Chronic obstructive pulmonary disease (COPD)	0.058	0.034	0.085
Pleural effusion	0.044	0.060	0.461
Shock	−0.022	0.130	0.867
Systemic inflammatory response syndrome (SIRS)	−0.025	0.076	0.741
Malnutrition	0.271	0.033	0.000
Thrombocytopenia	−0.015	0.071	0.830

(continued)

Appendix Table B.3 (continued)
Aftercare, wound, and skin group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Cardiac dysrhythmias	−0.022	0.031	0.482
Endocarditis	0.667	0.524	0.203
Acute myocardial infarction	0.104	0.077	0.175
Acute coronary syndrome	−0.394	0.318	0.216
Other chronic ischemic disease	−0.103	0.040	0.010
Other pulmonary disease	−0.039	0.095	0.681
Cardiomyopathy	−0.070	0.076	0.355
Other heart disease	−0.189	0.088	0.031
Osteomyelitis	0.351	0.054	0.000
Other bacterial infection	0.120	0.036	0.001
Percutaneous endoscopic gastrostomy (PEG)	0.169	0.070	0.015
1–5 critical care days	0.157	0.037	0.000
6–10 critical care days	0.364	0.044	0.000
11–15 critical care days	0.485	0.052	0.000
16–20 critical care days	0.673	0.065	0.000
21+ critical care days	0.851	0.063	0.000
Critical care unit procedures	0.233	0.026	0.000
Dialysis	−0.043	0.071	0.546
Dementia	0.263	0.121	0.030
Constant	−1.979	0.171	0.000

NOTE: Number of observations: 19,890; Log likelihood: −8,014.392.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table B.4
Complex rehabilitation group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Female	0.022	0.053	0.685
Ages < 65	−0.040	0.065	0.536
Ages 75–84	−0.041	0.070	0.564
Ages 85+	−0.041	0.102	0.688
MS-DRG 029	−0.305	0.147	0.038
MS-DRG 474	0.037	0.149	0.805
MS-DRG 475	−0.173	0.137	0.207
MS-DRG 476	−0.622	0.277	0.025
MS-DRG 495	0.551	0.132	0.000
MS-DRG 496	0.140	0.099	0.159
MS-DRG 616	−0.414	0.177	0.019
MS-DRG 617	−0.126	0.120	0.290
MS-DRG 618	−0.240	0.331	0.469
MS-DRG 028	0.253	0.143	0.076
Log beds	−0.163	0.063	0.010
Log resident ratio	−0.225	0.224	0.316
Case mix index	−0.409	0.178	0.022
Urban	−0.167	0.126	0.186
Acute respiratory failure	−0.009	0.186	0.962
Chronic respiratory failure	−5.438	4,960.474	0.999
Heart failure	0.046	0.110	0.676
Liver failure	−5.857	4,372.356	0.999
Acute renal failure	0.085	0.140	0.544
Chronic renal failure	0.028	0.119	0.816
Skin failure	0.169	0.153	0.270
Septic shock	−0.195	0.672	0.772
Encephalopathy	0.580	0.544	0.286
Disseminated intravascular coagulopathy (DIC)	−5.284	4,581.322	0.999
Acute respiratory failure and DIC	11.090	5,059.127	0.998
Chronic respiratory and renal failure	0.354	6,973.491	1.000
Heart failure and septic shock	5.775	1,909.668	0.998
Liver and acute renal failure	11.985	4,917.088	0.998
Renal and skin failure	−0.200	0.281	0.476
Renal failure and DIC	−0.136	12,694.890	1.000
Septic shock and skin failure	−5.510	4,572.487	0.999
Septic shock and encephalopathy	−6.134	9,184.554	0.999

(continued)

Appendix Table B.4 (continued)
Complex rehabilitation group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Vent < 96 hours	0.063	0.264	0.811
Vent 96+ hours	−0.023	0.368	0.949
Ulcers	0.120	0.085	0.156
Cellulitis	0.234	0.082	0.004
Wound procedures	0.442	0.116	0.000
1–2 organ failures	−0.043	0.128	0.738
3–4 organ failures	−0.189	0.324	0.559
Sepsis	0.227	0.234	0.332
Nosocomial pneumonia	−0.414	0.558	0.459
Chronic obstructive pulmonary disease (COPD)	0.186	0.082	0.024
Pleural effusion	0.440	0.249	0.077
Shock	0.343	0.561	0.540
Systemic inflammatory response syndrome (SIRS)	0.247	0.244	0.313
Malnutrition	0.479	0.114	0.000
Thrombocytopenia	0.334	0.175	0.056
Cardiac dysrhythmias	0.032	0.080	0.690
Endocarditis	0.215	0.599	0.720
Acute myocardial infarction	−0.189	0.280	0.499
Acute coronary syndrome	0.007	0.813	0.993
Other chronic ischemic disease	−0.140	0.080	0.080
Other pulmonary disease	0.340	0.242	0.160
Cardiomyopathy	0.076	0.145	0.600
Other heart disease	−0.048	0.172	0.779
Osteomyelitis	0.173	0.064	0.007
Other bacterial infection	0.188	0.062	0.002
Percutaneous endoscopic gastrostomy (PEG)	−0.189	0.331	0.568
11–25 critical care days	0.623	0.130	0.000
26+ critical care days	1.370	0.399	0.001
Critical care unit procedures	0.424	0.057	0.000
Dialysis	0.247	0.120	0.039
Dementia	−1.011	0.535	0.059
Constant	0.347	0.322	0.282

NOTE: Number of observations: 3,841; Log likelihood: −1,602.1851.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table B.5
Pneumonia group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Female	−0.014	0.041	0.736
Ages < 65	−0.081	0.073	0.262
Ages 75–84	0.143	0.054	0.008
Ages 85+	0.104	0.057	0.067
MS-DRG 193	0.208	0.064	0.001
Log beds	−0.012	0.048	0.802
Log resident ratio	−0.474	0.408	0.245
Case mix index	−0.154	0.157	0.325
Urban	0.147	0.085	0.085
Acute respiratory failure	0.064	0.154	0.679
Chronic respiratory failure	0.026	0.215	0.904
Heart failure	−0.017	0.135	0.901
Liver failure	−5.120	4,031.857	0.999
Acute renal failure	−0.217	0.146	0.138
Chronic renal failure	−0.209	0.135	0.121
Skin failure	0.103	0.228	0.651
Septic shock	−0.966	0.658	0.142
Encephalopathy	0.129	0.294	0.661
Disseminated intravascular coagulopathy (DIC)	0.566	0.666	0.395
Acute and chronic respiratory failure	−5.596	2,208.580	0.998
Respiratory and heart failure	0.451	0.203	0.026
Acute respiratory failure and encephalopathy	−5.317	2,231.374	0.998
Acute respiratory failure and DIC	−6.364	4,150.685	0.999
Chronic respiratory and skin failure	6.471	824.929	0.994
Liver and acute renal failure	−0.280	2,956.457	1.000
Liver and chronic renal failure	0.631	3,091.022	1.000
Renal failure and septic shock	−5.116	1,599.190	0.997
Ulcers	0.053	0.103	0.603
Cellulitis	0.333	0.128	0.010
Wound procedures	0.131	0.056	0.018
1 organ failure	0.137	0.136	0.315
2–3 organ failures	0.382	0.278	0.170
4–5 organ failures	0.755	0.576	0.190

(continued)

Appendix Table B.5 (continued)
Pneumonia group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Sepsis	−0.186	0.251	0.460
Nosocomial pneumonia	0.399	0.169	0.018
Chronic obstructive pulmonary disease (COPD)	0.170	0.043	0.000
Pleural effusion	0.113	0.072	0.117
Shock	0.693	0.398	0.081
Systemic inflammatory response syndrome (SIRS)	0.320	0.264	0.226
Malnutrition	0.489	0.066	0.000
Thrombocytopenia	0.037	0.120	0.761
Cardiac dysrhythmias	−0.019	0.047	0.694
Endocarditis	0.517	0.770	0.502
Acute myocardial infarction	−0.047	0.173	0.786
Acute coronary syndrome	−0.490	0.309	0.113
Other chronic ischemic disease	−0.075	0.050	0.136
Other pulmonary disease	0.093	0.114	0.419
Cardiomyopathy	−0.181	0.104	0.083
Other heart disease	−0.020	0.121	0.869
Osteomyelitis	1.165	0.404	0.004
Other bacterial infection	0.055	0.089	0.534
Percutaneous endoscopic gastrostomy (PEG)	0.129	0.188	0.495
1–5 critical care days	0.154	0.051	0.003
6–10 critical care days	0.281	0.066	0.000
11+ critical care days	0.279	0.114	0.015
Critical care unit procedures	0.584	0.071	0.000
Dialysis	−0.145	0.128	0.256
Dementia	0.013	0.183	0.942
Constant	−1.536	0.249	0.000

NOTE: Number of observations: 8,148; Log likelihood: −2,626.8836.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table B.6
Heart failure group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Female	−0.105	0.049	0.034
Ages < 65	−0.136	0.091	0.136
Ages 75–84	0.104	0.066	0.117
Ages 85+	0.048	0.068	0.479
MS-DRG 291	0.229	0.059	0.000
Log beds	−0.012	0.053	0.823
Log resident ratio	−0.542	0.340	0.110
Case mix index	0.182	0.200	0.363
Urban	0.044	0.099	0.657
Acute respiratory failure	0.323	0.090	0.000
Chronic respiratory failure	0.299	0.208	0.151
Heart failure	−0.223	0.117	0.056
Liver failure	−0.525	0.704	0.456
Acute renal failure	0.072	0.070	0.306
Chronic renal failure	−0.103	0.056	0.065
Skin failure	−0.018	0.188	0.924
Septic shock	−0.419	0.534	0.433
Encephalopathy	0.548	0.349	0.116
Disseminated intravascular coagulopathy (DIC)	−4.933	2,746.924	0.999
Critical illness myopathy/polyneuropathy (CIM/CIP)	−4.754	1,842.497	0.998
Vent < 96 hours	−0.479	0.200	0.017
Vent 96+ hours	−0.247	0.255	0.334
Ulcers	0.453	0.110	0.000
Cellulitis	0.517	0.086	0.000
Wound procedures	0.125	0.064	0.050
4–6 organ failures	−0.087	0.193	0.653
Sepsis	0.112	0.337	0.740
Nosocomial pneumonia	−0.196	0.455	0.666
Chronic obstructive pulmonary disease (COPD)	0.031	0.053	0.552
Pleural effusion	0.044	0.088	0.615
Shock	0.019	0.266	0.943
Systemic inflammatory response syndrome (SIRS)	0.353	0.368	0.337
Malnutrition	0.281	0.098	0.004
Thrombocytopenia	0.090	0.133	0.497

(continued)

Appendix Table B.6 (continued)
Heart failure group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Cardiac dysrhythmias	−0.058	0.049	0.238
Endocarditis	0.346	0.543	0.523
Acute myocardial infarction	−4.551	2,314.629	0.998
Acute coronary syndrome	−0.072	0.175	0.680
Other chronic ischemic disease	−0.157	0.053	0.003
Other pulmonary disease	0.087	0.090	0.332
Cardiomyopathy	0.031	0.062	0.614
Other heart disease	−4.982	879.873	0.995
Osteomyelitis	0.951	0.510	0.062
Other bacterial infection	0.044	0.141	0.755
Percutaneous endoscopic gastrostomy (PEG)	0.209	0.294	0.476
6–10 critical care days	0.168	0.064	0.008
11–20 critical care days	0.255	0.112	0.023
21–25 critical care days	0.662	0.335	0.048
26+ critical care days	−5.337	3,934.009	0.999
Critical care unit procedures	0.434	0.089	0.000
Dialysis	−0.223	0.109	0.041
Dementia	0.006	0.268	0.983
Constant	−1.505	0.335	0.000

NOTE: Number of observations: 5,446; Log likelihood: −1,786.618.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table B.7
Chronic obstructive pulmonary disease (COPD)/Other respiratory group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Female	−0.044	0.036	0.226
Ages < 65	−0.110	0.055	0.045
Ages 75–84	−0.040	0.042	0.341
Ages 85+	−0.214	0.055	0.000
MS-DRG 189	0.120	0.080	0.131
MS-DRG 190	0.106	0.054	0.048
Log beds	−0.010	0.049	0.840
Log resident ratio	0.260	0.237	0.274
Case mix index	−0.178	0.154	0.249
Urban	0.077	0.099	0.435
Acute respiratory failure	0.238	0.076	0.002
Chronic respiratory failure	0.270	0.100	0.007
Heart failure	−0.020	0.044	0.644
Liver failure	0.427	0.832	0.608
Acute renal failure	−0.018	0.062	0.774
Chronic renal failure	−0.122	0.060	0.041
Skin failure	−0.152	0.215	0.480
Septic shock	0.048	0.564	0.932
Encephalopathy	−0.522	0.327	0.110
Disseminated intravascular coagulopathy (DIC)	7.037	8,211.274	0.999
Acute and chronic respiratory failure	−6.050	8,068.074	0.999
Skin and chronic respiratory failure	−5.742	18,837.670	1.000
Liver and skin failure	6.970	5,642.290	0.999
Liver failure and DIC	−13.119	21,826.070	1.000
Ulcers	0.211	0.131	0.108
Cellulitis	0.103	0.120	0.390
Wound procedures	0.156	0.044	0.000
1–6 organ failures	0.178	0.065	0.007
Sepsis	0.480	0.137	0.000
Nosocomial pneumonia	0.293	0.243	0.227
Chronic obstructive pulmonary disease (COPD)	0.163	0.045	0.000
Pleural effusion	0.239	0.103	0.020

(continued)

Appendix Table B.7 (continued)
Chronic obstructive pulmonary disease (COPD)/Other respiratory group: Regressions results from logistic propensity score

Covariate	Coefficient	Standard error	*p*-value
Shock	−0.168	0.403	0.677
Malnutrition	0.375	0.073	0.000
Thrombocytopenia	0.062	0.117	0.598
Acute coronary syndrome	−0.585	0.252	0.020
Other chronic ischemic disease	−0.071	0.044	0.105
Other pulmonary disease	0.158	0.061	0.010
Cardiomyopathy	−0.054	0.073	0.460
Other heart disease	−0.186	0.130	0.151
Osteomyelitis	−5.494	5,167.768	0.999
Percutaneous endoscopic gastrostomy (PEG)	0.200	0.247	0.417
1–5 critical care days	0.170	0.044	0.000
6–10 critical care days	0.325	0.056	0.000
11–25 critical care days	0.482	0.097	0.000
26+ critical care days	0.401	0.425	0.346
Critical care unit procedures	0.406	0.064	0.000
Dialysis	−0.347	0.142	0.015
Dementia	−0.346	0.247	0.160
Constant	−1.489	0.243	0.000

NOTE: Number of observations: 9,569; Log likelihood: −3,333.471.

SOURCE: Analysis of RTI 2007 Episode Margins file.

APPENDIX C:
FIGURES OF PROPENSITY SCORE DISTRIBUTIONS BEFORE AND AFTER MATCHING

LIST OF TABLES IN APPENDIX C

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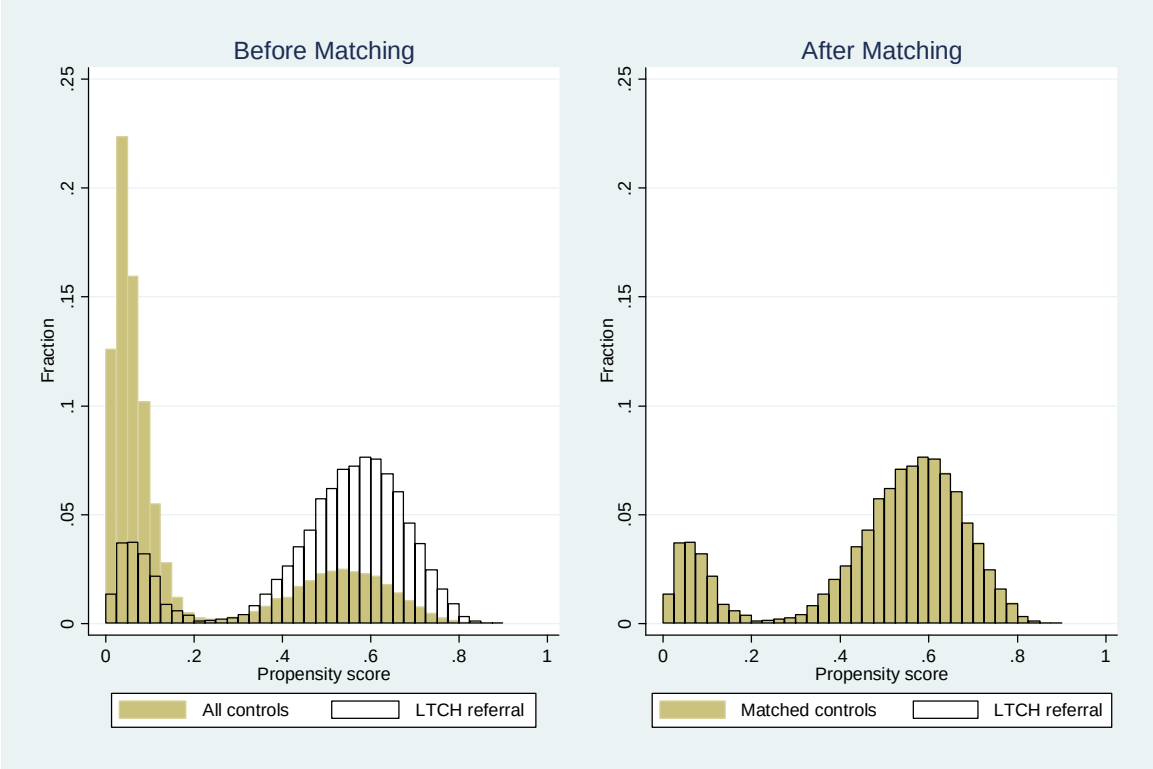
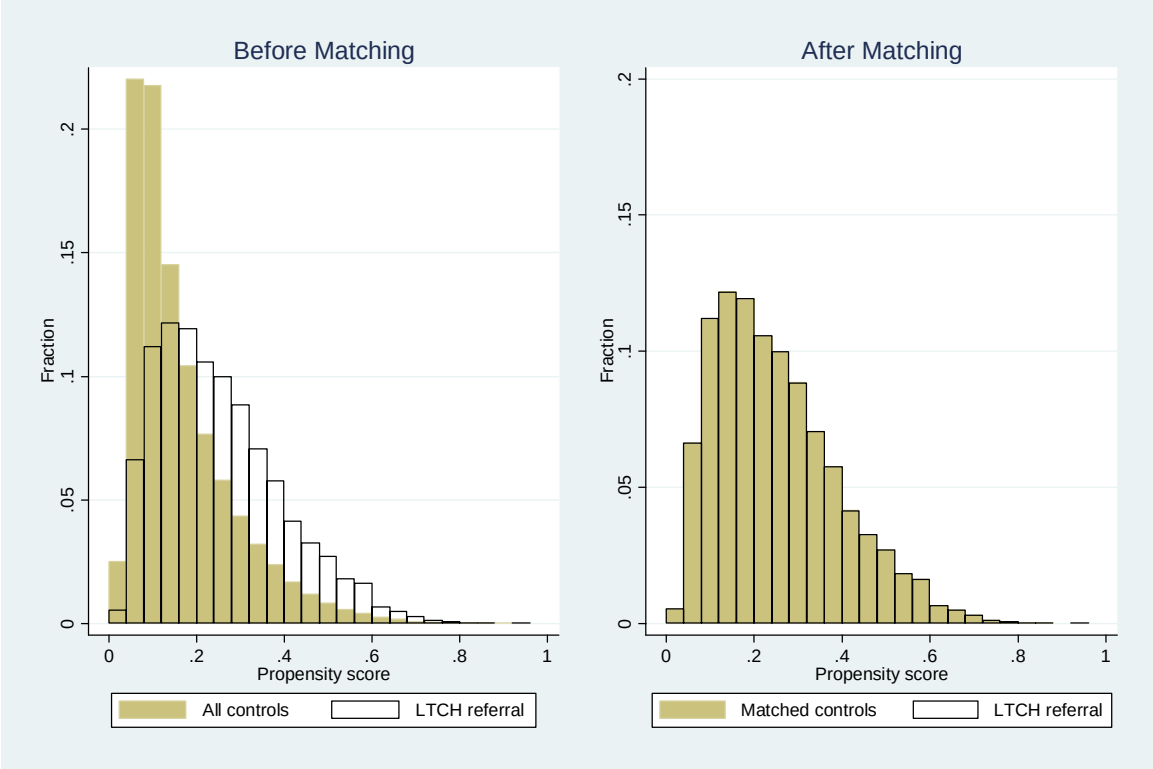
Appendix Figure C.1
Ventilator group: Propensity score distributions before and after matching



NOTE: LTCH = long-term care hospital.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Figure C.2
Infection group: Propensity score distributions before and after matching



NOTE: LTCH = long-term care hospital.

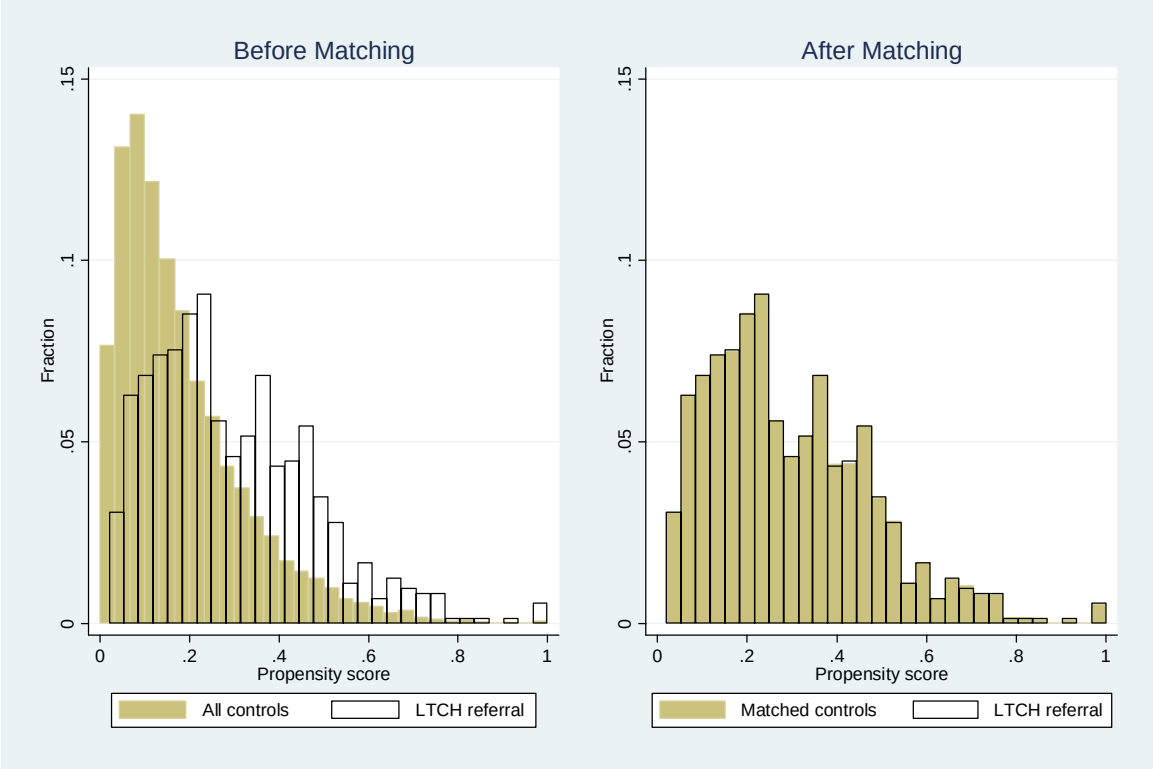
SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Figure C.3
Aftercare, wound, and skin group: Propensity score distributions before and after matching

NOTE: LTCH = long-term care hospital.

SOURCE: Analysis of RTI 2007 Episode Margins file.

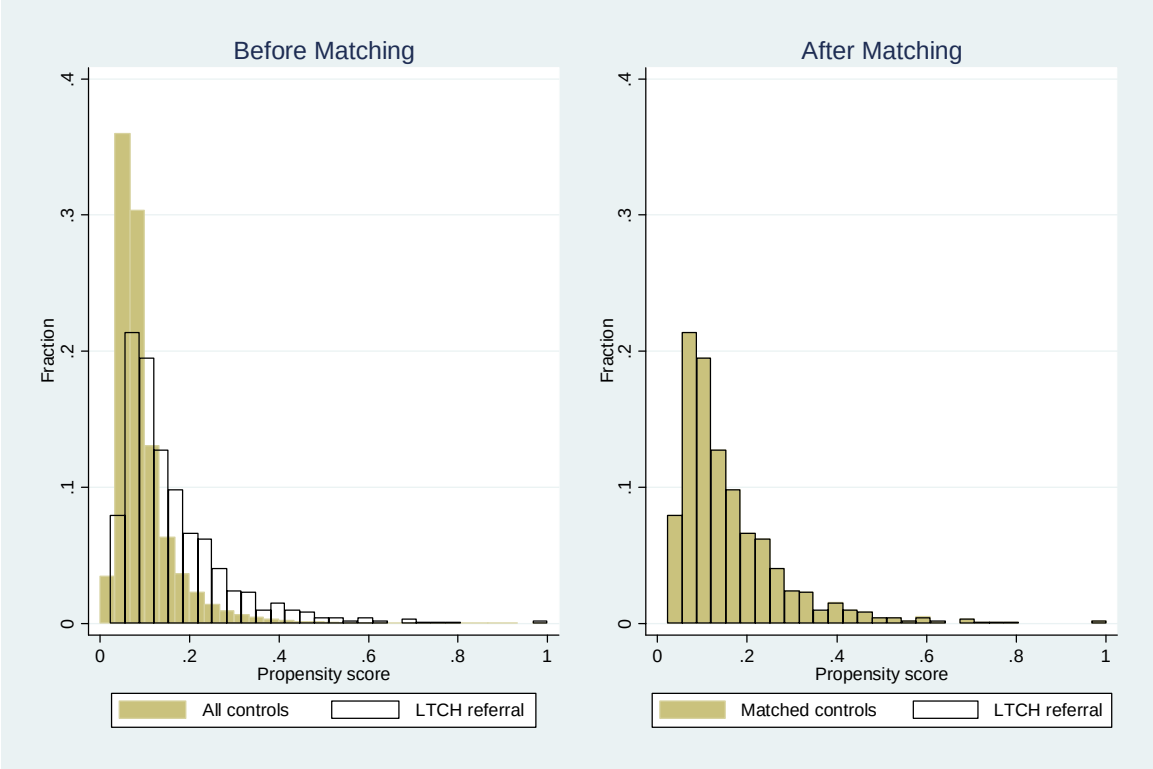
Appendix Figure C.4
Complex rehabilitation group: Propensity score distributions before and after matching



NOTE: LTCH = long-term care hospital.

SOURCE: Analysis of RTI 2007 Episode Margins file.

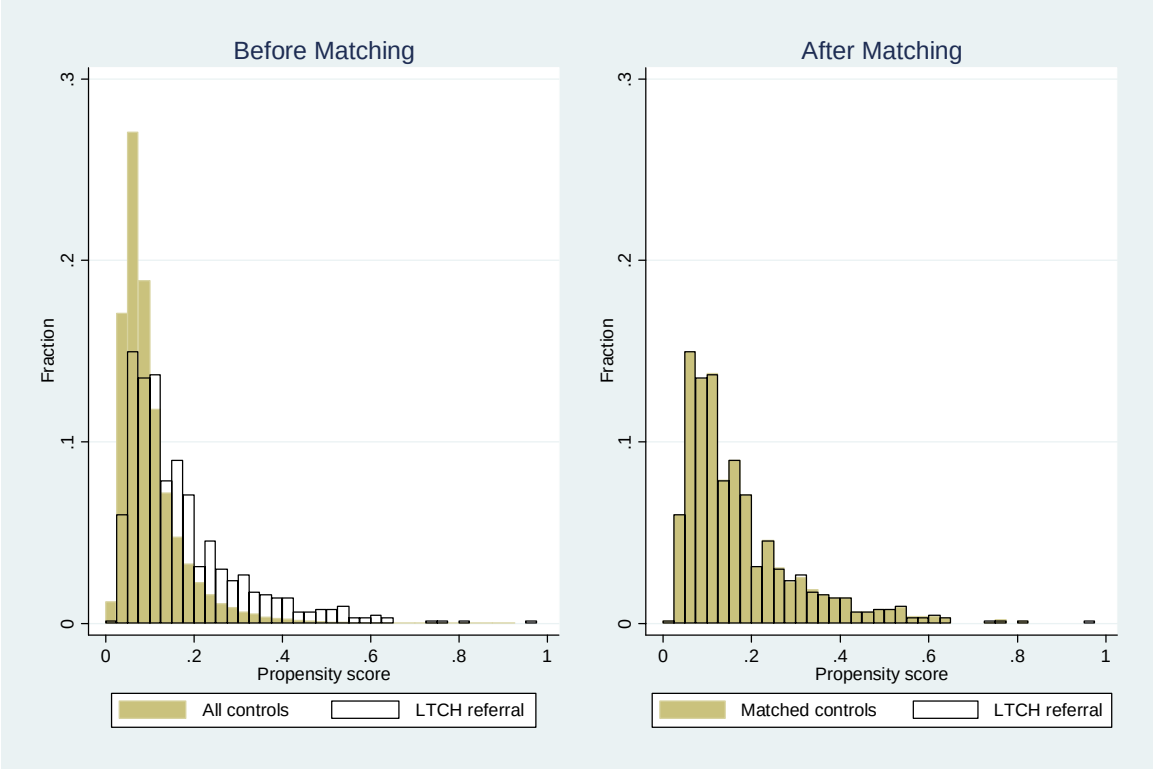
Appendix Figure C.5
Pneumonia group: Propensity score distributions before and after matching



NOTE: LTCH = long-term care hospital.

SOURCE: Analysis of RTI 2007 Episode Margins file.

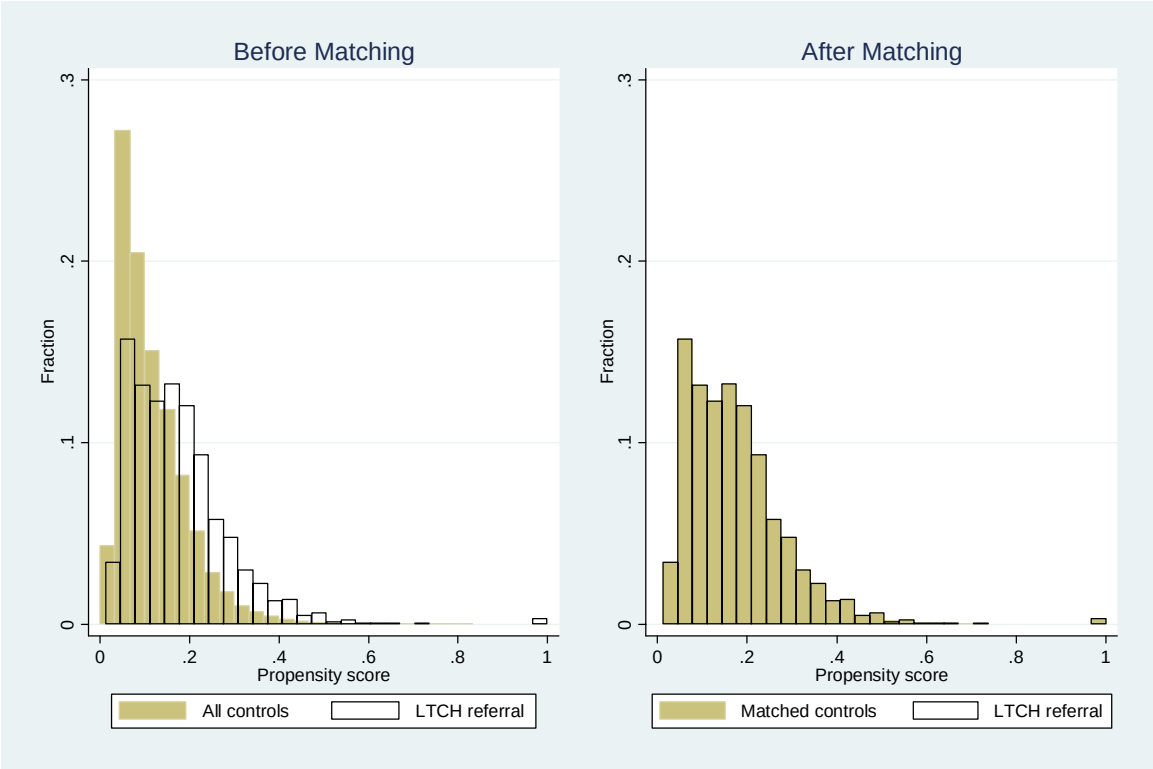
Appendix Figure C.6
Heart failure group: Propensity score distributions before and after matching



NOTE: LTCH = long-term care hospital.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Figure C.7
Chronic obstructive pulmonary disease (COPD)/other respiratory group: Propensity score distributions before and after matching



NOTE: LTCH = long-term care hospital.

SOURCE: Analysis of RTI 2007 Episode Margins file.

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APPENDIX D:
TABLES OF COVARIATES BEFORE AND AFTER MATCHING

LIST OF TABLES IN APPENDIX D

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Appendix Table D.1
All covariates before and after matching: Ventilator group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Female	Unmatched	0.477	0.496	0.000
Female	Matched	0.477	0.473	0.470
Ages < 65	Unmatched	0.218	0.213	0.258
Ages < 65	Matched	0.218	0.214	0.398
Ages 75–84	Unmatched	0.326	0.318	0.066
Ages 75–84	Matched	0.326	0.318	0.134
Ages 85+	Unmatched	0.101	0.140	0.000
Ages 85+	Matched	0.101	0.114	0.000
MS-DRGs 003–004	Unmatched	0.837	0.285	0.000
MS-DRGs 003–004	Matched	0.837	0.837	0.840
MS-DRGs 011–013	Unmatched	0.012	0.037	0.000
MS-DRGs 011–013	Matched	0.012	0.012	0.623
MS-DRG 207	Unmatched	0.092	0.290	0.000
MS-DRG 207	Matched	0.092	0.085	0.034
Log beds	Unmatched	5.761	5.598	0.000
Log beds	Matched	5.761	5.656	0.000
Log resident ratio	Unmatched	0.131	0.113	0.000
Log resident ratio	Matched	0.131	0.128	0.171
Case mix index	Unmatched	1.628	1.546	0.000
Case mix index	Matched	1.628	1.586	0.000
Urban	Unmatched	0.946	0.885	0.000
Urban	Matched	0.946	0.912	0.000
Acute respiratory failure	Unmatched	0.899	0.889	0.001
Acute respiratory failure	Matched	0.899	0.895	0.304
Chronic respiratory failure	Unmatched	0.010	0.011	0.503
Chronic respiratory failure	Matched	0.010	0.011	0.352
Heart failure	Unmatched	0.320	0.385	0.000
Heart failure	Matched	0.320	0.313	0.236
Liver failure	Unmatched	0.015	0.013	0.044
Liver failure	Matched	0.015	0.016	0.426

(continued)

Appendix Table D.1 (continued)
All covariates before and after matching: Ventilator group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Acute renal failure	Unmatched	0.311	0.257	0.000
Acute renal failure	Matched	0.311	0.307	0.381
Chronic renal failure	Unmatched	0.126	0.150	0.000
Chronic renal failure	Matched	0.126	0.123	0.437
Skin failure	Unmatched	0.024	0.037	0.000
Skin failure	Matched	0.023	0.028	0.018
Septic shock	Unmatched	0.101	0.066	0.000
Septic shock	Matched	0.101	0.106	0.186
Encephalopathy	Unmatched	0.011	0.011	0.473
Encephalopathy	Matched	0.011	0.011	0.902
Disseminated intravascular coagulopathy (DIC)	Unmatched	0.009	0.007	0.066
Disseminated intravascular coagulopathy (DIC)	Matched	0.009	0.009	0.780
Critical illness myopathy/polyneuropathy (CIM/CIP)	Unmatched	0.003	0.002	0.001
Critical illness myopathy/polyneuropathy (CIM/CIP)	Matched	0.003	0.003	0.914
Acute and chronic respiratory failure	Unmatched	0.002	0.001	0.094
Acute and chronic respiratory failure	Matched	0.002	0.002	0.225
Acute respiratory and heart failure	Unmatched	0.291	0.358	0.000
Acute respiratory and heart failure	Matched	0.291	0.285	0.224
Acute respiratory and liver failure	Unmatched	0.013	0.012	0.079
Acute respiratory and liver failure	Matched	0.013	0.014	0.459
Acute respiratory and renal failure	Unmatched	0.281	0.236	0.000
Acute respiratory and renal failure	Matched	0.281	0.275	0.285
Acute respiratory and chronic renal failure	Unmatched	0.112	0.137	0.000
Acute respiratory and chronic renal failure	Matched	0.112	0.110	0.489
Chronic respiratory and acute renal failure	Unmatched	0.002	0.001	0.017
Chronic respiratory and acute renal failure	Matched	0.002	0.001	0.337
Chronic respiratory failure and CIM/CIP	Unmatched	0.000	0.000	0.600
Chronic respiratory failure and CIM/CIP	Matched	0.000	0.000	1.000
Liver failure and encephalopathy	Unmatched	0.000	0.000	0.345
Liver failure and encephalopathy	Matched	0.000	0.000	0.650

(continued)

Appendix Table D.1 (continued)
All covariates before and after matching: Ventilator group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Liver failure and CIM/CIP	Unmatched	0.000	0.000	0.240
Liver failure and CIM/CIP	Matched	0.000	0.000	1.000
Renal failure and septic shock	Unmatched	0.048	0.031	0.000
Renal failure and septic shock	Matched	0.048	0.051	0.296
Skin failure and CIM/CIP	Unmatched	0.000	0.000	0.205
Skin failure and CIM/CIP	Matched	0.000	0.000	1.000
DIC and CIM/CIP	Unmatched	0.000	0.000	0.300
DIC and CIM/CIP	Matched	0.000	0.000	1.000
Ventilator < 96 hours	Unmatched	0.058	0.388	0.000
Ventilator < 96 hours	Matched	0.058	0.067	0.002
Ventilator 96+ hours	Unmatched	0.093	0.291	0.000
Ventilator 96+ hours	Matched	0.093	0.086	0.036
Ventilator with tracheostomy	Unmatched	0.847	0.315	0.000
Ventilator with tracheostomy	Matched	0.847	0.846	0.854
ECMO	Unmatched	0.000	0.000	0.070
ECMO	Matched	0.000	0.000	0.300
Ulcers	Unmatched	0.072	0.060	0.000
Ulcers	Matched	0.072	0.089	0.000
Cellulitis	Unmatched	0.031	0.024	0.000
Cellulitis	Matched	0.031	0.032	0.655
Wound procedures	Unmatched	0.183	0.685	0.000
Wound procedures	Matched	0.183	0.193	0.047
1–2 organ failures	Unmatched	0.727	0.712	0.001
1–2 organ failures	Matched	0.727	0.728	0.892
3–6 organ failures	Unmatched	0.233	0.232	0.900
3–6 organ failures	Matched	0.232	0.230	0.674
Sepsis	Unmatched	0.306	0.203	0.000
Sepsis	Matched	0.306	0.324	0.001
Nosocomial pneumonia	Unmatched	0.133	0.080	0.000
Nosocomial pneumonia	Matched	0.133	0.132	0.821

(continued)

Appendix Table D.1 (continued)
All covariates before and after matching: Ventilator group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Chronic obstructive pulmonary disease (COPD)	Unmatched	0.276	0.383	0.000
Chronic obstructive pulmonary disease (COPD)	Matched	0.276	0.274	0.673
Pleural effusion	Unmatched	0.111	0.081	0.000
Pleural effusion	Matched	0.111	0.112	0.961
Shock	Unmatched	0.153	0.104	0.000
Shock	Matched	0.153	0.152	0.833
Systemic inflammatory response syndrome (SIRS)	Unmatched	0.198	0.149	0.000
Systemic inflammatory response syndrome (SIRS)	Matched	0.198	0.212	0.003
Malnutrition	Unmatched	0.195	0.111	0.000
Malnutrition	Matched	0.195	0.176	0.000
Thrombocytopenia	Unmatched	0.064	0.051	0.000
Thrombocytopenia	Matched	0.064	0.060	0.144
Cardiac dysrhythmias	Unmatched	0.323	0.319	0.302
Cardiac dysrhythmias	Matched	0.323	0.320	0.535
Endocarditis	Unmatched	0.004	0.002	0.000
Endocarditis	Matched	0.004	0.003	0.083
Acute myocardial infarction	Unmatched	0.119	0.131	0.000
Acute myocardial infarction	Matched	0.119	0.119	0.945
Acute coronary syndrome	Unmatched	0.014	0.009	0.000
Acute coronary syndrome	Matched	0.014	0.012	0.214
Other chronic ischemic disease	Unmatched	0.078	0.117	0.000
Other chronic ischemic disease	Matched	0.078	0.072	0.034
Other pulmonary disease	Unmatched	0.040	0.048	0.000
Other pulmonary disease	Matched	0.040	0.042	0.409
Cardiomyopathy	Unmatched	0.048	0.067	0.000
Cardiomyopathy	Matched	0.048	0.046	0.496
Other heart disease	Unmatched	0.021	0.019	0.322
Other heart disease	Matched	0.021	0.022	0.675
Osteomyelitis	Unmatched	0.002	0.002	0.396
Osteomyelitis	Matched	0.002	0.002	0.957

(continued)

Appendix Table D.1 (continued)
All covariates before and after matching: Ventilator group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Other bacterial infection	Unmatched	0.021	0.028	0.000
Other bacterial infection	Matched	0.021	0.023	0.177
Percutaneous endoscopic gastrostomy (PEG)	Unmatched	0.294	0.114	0.000
Percutaneous endoscopic gastrostomy (PEG)	Matched	0.294	0.284	0.059
6–10 critical care days	Unmatched	0.104	0.226	0.000
6–10 critical care days	Matched	0.104	0.100	0.263
11–15 critical care days	Unmatched	0.160	0.166	0.108
11–15 critical care days	Matched	0.161	0.131	0.000
16–25 critical care days	Unmatched	0.348	0.159	0.000
16–25 critical care days	Matched	0.348	0.305	0.000
26–30 critical care days	Unmatched	0.115	0.045	0.000
26–30 critical care days	Matched	0.115	0.117	0.676
31+ critical care days	Unmatched	0.222	0.116	0.000
31+ critical care days	Matched	0.222	0.278	0.000
Critical care unit procedures	Unmatched	0.390	0.382	0.090
Critical care unit procedures	Matched	0.390	0.377	0.021
Dialysis	Unmatched	0.040	0.051	0.000
Dialysis	Matched	0.040	0.039	0.729
Dementia	Unmatched	0.005	0.008	0.001
Dementia	Matched	0.005	0.005	0.467

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table D.2
All covariates before and after matching: Infection group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Female	Unmatched	0.520	0.557	0.000
Female	Matched	0.519	0.506	0.148
Ages < 65	Unmatched	0.218	0.158	0.000
Ages < 65	Matched	0.218	0.201	0.024
Ages 75–84	Unmatched	0.300	0.325	0.000
Ages 75–84	Matched	0.300	0.320	0.024
Ages 85+	Unmatched	0.217	0.277	0.000
Ages 85+	Matched	0.217	0.218	0.820
MS-DRG 095	Unmatched	0.002	0.004	0.124
MS-DRG 095	Matched	0.002	0.002	0.343
MS-DRG 096	Unmatched	0.001	0.002	0.027
MS-DRG 096	Matched	0.001	0.001	0.705
MS-DRG 097	Unmatched	0.005	0.004	0.243
MS-DRG 097	Matched	0.005	0.005	0.938
MS-DRG 098	Unmatched	0.002	0.003	0.023
MS-DRG 098	Matched	0.002	0.002	0.889
MS-DRG 099	Unmatched	0.001	0.002	0.041
MS-DRG 099	Matched	0.001	0.001	1.000
MS-DRG 288	Unmatched	0.013	0.007	0.000
MS-DRG 288	Matched	0.013	0.015	0.587
MS-DRG 289	Unmatched	0.007	0.004	0.000
MS-DRG 289	Matched	0.007	0.009	0.264
MS-DRG 290	Unmatched	0.002	0.001	0.106
MS-DRG 290	Matched	0.002	0.003	0.286
MS-DRG 485	Unmatched	0.010	0.004	0.000
MS-DRG 485	Matched	0.010	0.010	0.939
MS-DRG 486	Unmatched	0.011	0.006	0.000
MS-DRG 486	Matched	0.011	0.012	0.387
MS-DRG 487	Unmatched	0.005	0.004	0.045
MS-DRG 487	Matched	0.006	0.007	0.385

(continued)

Appendix Table D.2 (continued)
All covariates before and after matching: Infection group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
MS-DRG 539	Unmatched	0.026	0.009	0.000
MS-DRG 539	Matched	0.026	0.022	0.206
MS-DRG 540	Unmatched	0.027	0.011	0.000
MS-DRG 540	Matched	0.027	0.028	0.697
MS-DRG 541	Unmatched	0.006	0.004	0.010
MS-DRG 541	Matched	0.006	0.007	0.346
MS-DRG 853	Unmatched	0.189	0.099	0.000
MS-DRG 853	Matched	0.189	0.176	0.084
MS-DRG 854	Unmatched	0.023	0.021	0.356
MS-DRG 854	Matched	0.023	0.025	0.544
MS-DRG 856	Unmatched	0.009	0.005	0.000
MS-DRG 856	Matched	0.009	0.009	0.922
MS-DRG 857	Unmatched	0.012	0.010	0.346
MS-DRG 857	Matched	0.012	0.014	0.202
MS-DRG 858	Unmatched	0.002	0.003	0.035
MS-DRG 858	Matched	0.002	0.003	0.095
MS-DRG 870	Unmatched	0.096	0.053	0.000
MS-DRG 870	Matched	0.096	0.083	0.023
MS-DRG 871	Unmatched	0.449	0.511	0.000
MS-DRG 871	Matched	0.449	0.454	0.596
MS-DRG 094	Unmatched	0.007	0.005	0.005
MS-DRG 094	Matched	0.007	0.008	0.760
Log beds	Unmatched	5.616	5.420	0.000
Log beds	Matched	5.616	5.383	0.000
Log resident ratio	Unmatched	0.057	0.067	0.000
Log resident ratio	Matched	0.057	0.056	0.631
Case mix index	Unmatched	1.554	1.487	0.000
Case mix index	Matched	1.554	1.479	0.000
Urban	Unmatched	0.952	0.836	0.000
Urban	Matched	0.952	0.834	0.000

(continued)

Appendix Table D.2 (continued)
All covariates before and after matching: Infection group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Acute respiratory failure	Unmatched	0.251	0.164	0.000
Acute respiratory failure	Matched	0.251	0.249	0.882
Chronic respiratory failure	Unmatched	0.011	0.006	0.000
Chronic respiratory failure	Matched	0.011	0.009	0.175
Heart failure	Unmatched	0.253	0.236	0.003
Heart failure	Matched	0.253	0.244	0.282
Liver failure	Unmatched	0.015	0.010	0.002
Liver failure	Matched	0.015	0.016	0.621
Acute renal failure	Unmatched	0.328	0.289	0.000
Acute renal failure	Matched	0.328	0.330	0.857
Chronic renal failure	Unmatched	0.207	0.196	0.038
Chronic renal failure	Matched	0.207	0.190	0.025
Skin failure	Unmatched	0.136	0.059	0.000
Skin failure	Matched	0.136	0.124	0.075
Septic shock	Unmatched	0.212	0.146	0.000
Septic shock	Matched	0.212	0.204	0.292
Encephalopathy	Unmatched	0.016	0.013	0.029
Encephalopathy	Matched	0.016	0.013	0.239
Disseminated intravascular coagulopathy (DIC)	Unmatched	0.012	0.008	0.015
Disseminated intravascular coagulopathy (DIC)	Matched	0.012	0.011	0.627
Critical illness myopathy/polyneuropathy (CIM/CIP)	Unmatched	0.001	0.000	0.434
Critical illness myopathy/polyneuropathy (CIM/CIP)	Matched	0.001	0.001	0.934
Acute respiratory failure and septic shock	Unmatched	0.107	0.065	0.000
Acute respiratory failure and septic shock	Matched	0.107	0.103	0.500
Acute respiratory and skin failure	Unmatched	0.025	0.011	0.000
Acute respiratory and skin failure	Matched	0.025	0.022	0.199
Chronic respiratory and liver failure	Unmatched	0.000	0.000	0.840
Chronic respiratory and liver failure	Matched	0.000	0.000	1.000
Chronic respiratory and acute renal failure	Unmatched	0.003	0.001	0.000
Chronic respiratory and acute renal failure	Matched	0.003	0.002	0.489

(continued)

Appendix Table D.2 (continued)
All covariates before and after matching: Infection group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Chronic respiratory failure and septic shock	Unmatched	0.004	0.001	0.000
Chronic respiratory failure and septic shock	Matched	0.004	0.003	0.296
Chronic respiratory failure and encephalopathy	Unmatched	0.000	0.000	0.690
Chronic respiratory failure and encephalopathy	Matched	0.000	0.000	0.650
Chronic respiratory failure and DIC	Unmatched	0.000	0.000	0.780
Chronic respiratory failure and DIC	Matched	0.000	0.000	0.650
Heart and skin failure	Unmatched	0.024	0.013	0.000
Heart and skin failure	Matched	0.024	0.023	0.627
Heart failure and CIM/CIP	Unmatched	0.000	0.000	0.050
Heart failure and CIM/CIP	Matched	0.000	0.000	1.000
Liver failure and CIM/CIP	Unmatched	0.000	0.000	0.730
Liver failure and CIM/CIP	Matched	0.000	0.000	0.650
Renal failure and CIM/CIP	Unmatched	0.000	0.000	0.690
Renal failure and CIM/CIP	Matched	0.000	0.000	1.000
Septic shock and skin failure	Unmatched	0.021	0.009	0.000
Septic shock and skin failure	Matched	0.021	0.016	0.089
DIC and CIM/CIP	Unmatched	0.000	0.000	0.650
DIC and CIM/CIP	Matched	0.000	0.000	1.000
Ventilator < 96 hours	Unmatched	0.054	0.041	0.000
Ventilator < 96 hours	Matched	0.054	0.060	0.198
Ventilator 96+ hours	Unmatched	0.127	0.065	0.000
Ventilator 96+ hours	Matched	0.127	0.109	0.003
Ulcers	Unmatched	0.261	0.130	0.000
Ulcers	Matched	0.261	0.240	0.011
Cellulitis	Unmatched	0.165	0.092	0.000
Cellulitis	Matched	0.165	0.163	0.827
Wound procedures	Unmatched	0.320	0.238	0.000
Wound procedures	Matched	0.320	0.309	0.194
1–4 organ failures	Unmatched	0.741	0.634	0.000
1–4 organ failures	Matched	0.741	0.717	0.004

(continued)

Appendix Table D.2 (continued)
All covariates before and after matching: Infection group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
5–7 organ failures	Unmatched	0.008	0.004	0.000
5–7 organ failures	Matched	0.008	0.008	0.983
Sepsis	Unmatched	0.843	0.879	0.000
Sepsis	Matched	0.843	0.830	0.056
Nosocomial pneumonia	Unmatched	0.040	0.024	0.000
Nosocomial pneumonia	Matched	0.040	0.033	0.046
Chronic obstructive pulmonary disease (COPD)	Unmatched	0.175	0.178	0.577
Chronic obstructive pulmonary disease (COPD)	Matched	0.175	0.183	0.255
Pleural effusion	Unmatched	0.044	0.040	0.095
Pleural effusion	Matched	0.045	0.047	0.488
Shock	Unmatched	0.222	0.155	0.000
Shock	Matched	0.222	0.214	0.286
Systemic inflammatory response syndrome (SIRS)	Unmatched	0.430	0.583	0.000
Systemic inflammatory response syndrome (SIRS)	Matched	0.430	0.457	0.004
Malnutrition	Unmatched	0.177	0.083	0.000
Malnutrition	Matched	0.177	0.131	0.000
Thrombocytopenia	Unmatched	0.063	0.061	0.481
Thrombocytopenia	Matched	0.063	0.062	0.840
Cardiac dysrhythmias	Unmatched	0.213	0.225	0.039
Cardiac dysrhythmias	Matched	0.213	0.234	0.009
Endocarditis	Unmatched	0.039	0.019	0.000
Endocarditis	Matched	0.039	0.044	0.220
Acute myocardial infarction	Unmatched	0.050	0.051	0.670
Acute myocardial infarction	Matched	0.050	0.055	0.194
Acute coronary syndrome	Unmatched	0.004	0.004	1.000
Acute coronary syndrome	Matched	0.004	0.004	0.781
Other chronic ischemic disease	Unmatched	0.061	0.101	0.000
Other chronic ischemic disease	Matched	0.061	0.066	0.280
Other pulmonary disease	Unmatched	0.016	0.015	0.798
Other pulmonary disease	Matched	0.016	0.018	0.299

(continued)

Appendix Table D.2 (continued)
All covariates before and after matching: Infection group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Cardiomyopathy	Unmatched	0.038	0.035	0.294
Cardiomyopathy	Matched	0.038	0.039	0.821
Other heart disease	Unmatched	0.021	0.024	0.109
Other heart disease	Matched	0.021	0.021	0.874
Osteomyelitis	Unmatched	0.100	0.039	0.000
Osteomyelitis	Matched	0.100	0.095	0.364
Other bacterial infection	Unmatched	0.133	0.150	0.000
Other bacterial infection	Matched	0.133	0.154	0.001
Percutaneous endoscopic gastrostomy (PEG)	Unmatched	0.046	0.026	0.000
Percutaneous endoscopic gastrostomy (PEG)	Matched	0.046	0.035	0.005
6–10 critical care days	Unmatched	0.200	0.127	0.000
6–10 critical care days	Matched	0.200	0.188	0.101
11–15 critical care days	Unmatched	0.098	0.060	0.000
11–15 critical care days	Matched	0.098	0.077	0.000
16–20 critical care days	Unmatched	0.050	0.024	0.000
16–20 critical care days	Matched	0.050	0.039	0.005
21+ critical care days	Unmatched	0.048	0.021	0.000
21+ critical care days	Matched	0.048	0.038	0.012
Critical care unit procedures	Unmatched	0.477	0.293	0.000
Critical care unit procedures	Matched	0.477	0.472	0.551
Dialysis	Unmatched	0.090	0.063	0.000
Dialysis	Matched	0.090	0.069	0.000
Dementia	Unmatched	0.007	0.015	0.000
Dementia	Matched	0.007	0.008	0.669

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table D.3
All covariates before and after matching: Aftercare, wound, and skin care group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Female	Unmatched	0.555	0.572	0.034
Female	Matched	0.555	0.546	0.435
Ages < 65	Unmatched	0.248	0.153	0.000
Ages < 65	Matched	0.248	0.231	0.085
Ages 75–84	Unmatched	0.306	0.349	0.000
Ages 75–84	Matched	0.306	0.317	0.330
Ages 85+	Unmatched	0.189	0.200	0.084
Ages 85+	Matched	0.189	0.196	0.413
MS-DRG 463	Unmatched	0.060	0.020	0.000
MS-DRG 463	Matched	0.060	0.060	0.890
MS-DRG 464	Unmatched	0.039	0.024	0.000
MS-DRG 464	Matched	0.039	0.042	0.455
MS-DRG 465	Unmatched	0.005	0.007	0.160
MS-DRG 465	Matched	0.005	0.007	0.428
MS-DRG 573	Unmatched	0.070	0.025	0.000
MS-DRG 573	Matched	0.070	0.068	0.733
MS-DRG 574	Unmatched	0.119	0.051	0.000
MS-DRG 574	Matched	0.119	0.122	0.719
MS-DRG 575	Unmatched	0.030	0.023	0.002
MS-DRG 575	Matched	0.030	0.037	0.142
MS-DRG 576	Unmatched	0.006	0.003	0.002
MS-DRG 576	Matched	0.006	0.006	0.831
MS-DRG 577	Unmatched	0.006	0.009	0.031
MS-DRG 577	Matched	0.006	0.006	0.808
MS-DRG 578	Unmatched	0.002	0.009	0.000
MS-DRG 578	Matched	0.002	0.004	0.393
MS-DRG 592	Unmatched	0.043	0.018	0.000
MS-DRG 592	Matched	0.043	0.039	0.443
MS-DRG 593	Unmatched	0.104	0.059	0.000
MS-DRG 593	Matched	0.104	0.095	0.186

(continued)

Appendix Table D.3 (continued)
All covariates before and after matching: Aftercare, wound, and skin care group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
MS-DRG 594	Unmatched	0.020	0.012	0.000
MS-DRG 594	Matched	0.020	0.019	0.919
MS-DRG 622	Unmatched	0.013	0.004	0.000
MS-DRG 622	Matched	0.013	0.009	0.133
MS-DRG 623	Unmatched	0.030	0.015	0.000
MS-DRG 623	Matched	0.030	0.036	0.127
MS-DRG 624	Unmatched	0.001	0.002	0.236
MS-DRG 624	Matched	0.001	0.001	0.442
MS-DRG 901	Unmatched	0.003	0.003	0.636
MS-DRG 901	Matched	0.003	0.002	0.621
MS-DRG 902	Unmatched	0.004	0.005	0.734
MS-DRG 902	Matched	0.004	0.004	0.915
MS-DRG 903	Unmatched	0.001	0.002	0.096
MS-DRG 903	Matched	0.001	0.001	0.944
MS-DRG 927	Unmatched	0.002	0.002	0.257
MS-DRG 927	Matched	0.002	0.002	0.580
MS-DRG 928	Unmatched	0.004	0.005	0.338
MS-DRG 928	Matched	0.004	0.005	0.698
MS-DRG 929	Unmatched	0.001	0.002	0.328
MS-DRG 929	Matched	0.001	0.001	0.825
MS-DRG 933	Unmatched	0.000	0.000	0.974
MS-DRG 933	Matched	0.000	0.001	0.564
MS-DRG 934	Unmatched	0.005	0.003	0.064
MS-DRG 934	Matched	0.005	0.006	0.496
MS-DRG 935	Unmatched	0.008	0.009	0.350
MS-DRG 935	Matched	0.008	0.008	0.936
MS-DRG 329	Unmatched	0.342	0.314	0.000
MS-DRG 329	Matched	0.342	0.346	0.708
Log beds	Unmatched	5.564	5.469	0.000
Log beds	Matched	5.564	5.443	0.000

(continued)

Appendix Table D.3 (continued)
All covariates before and after matching: Aftercare, wound, and skin care group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Log resident ratio	Unmatched	0.068	0.082	0.000
Log resident ratio	Matched	0.068	0.074	0.060
Case mix index	Unmatched	1.542	1.509	0.000
Case mix index	Matched	1.542	1.504	0.000
Urban	Unmatched	0.916	0.844	0.000
Urban	Matched	0.916	0.829	0.000
Acute respiratory failure	Unmatched	0.174	0.111	0.000
Acute respiratory failure	Matched	0.174	0.169	0.531
Chronic respiratory failure	Unmatched	0.004	0.002	0.001
Chronic respiratory failure	Matched	0.004	0.002	0.126
Heart failure	Unmatched	0.193	0.161	0.000
Heart failure	Matched	0.193	0.197	0.641
Liver failure	Unmatched	0.003	0.002	0.151
Liver failure	Matched	0.003	0.002	0.818
Acute renal failure	Unmatched	0.162	0.099	0.000
Acute renal failure	Matched	0.162	0.159	0.736
Chronic renal failure	Unmatched	0.144	0.100	0.000
Chronic renal failure	Matched	0.144	0.146	0.796
Skin failure	Unmatched	0.346	0.162	0.000
Skin failure	Matched	0.346	0.359	0.262
Septic shock	Unmatched	0.028	0.015	0.000
Septic shock	Matched	0.028	0.030	0.728
Encephalopathy	Unmatched	0.004	0.002	0.011
Encephalopathy	Matched	0.004	0.005	0.862
Disseminated intravascular coagulopathy (DIC)	Unmatched	0.002	0.002	0.806
Disseminated intravascular coagulopathy (DIC)	Matched	0.002	0.002	0.721
Critical illness myopathy/polyneuropathy (CIM/CIP)	Unmatched	0.001	0.000	0.117
Critical illness myopathy/polyneuropathy (CIM/CIP)	Matched	0.001	0.000	0.380
Acute respiratory and heart failure	Unmatched	0.040	0.029	0.000
Acute respiratory and heart failure	Matched	0.040	0.041	0.915

(continued)

Appendix Table D.3 (continued)
All covariates before and after matching: Aftercare, wound, and skin care group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Acute respiratory failure and septic shock	Unmatched	0.020	0.010	0.000
Acute respiratory failure and septic shock	Matched	0.020	0.019	0.906
Acute respiratory failure and encephalopathy	Unmatched	0.001	0.001	0.472
Acute respiratory failure and encephalopathy	Matched	0.001	0.001	0.838
Heart and skin failure	Unmatched	0.059	0.027	0.000
Heart and skin failure	Matched	0.059	0.060	0.775
Heart failure and encephalopathy	Unmatched	0.000	0.000	0.858
Heart failure and encephalopathy	Matched	0.000	0.000	0.460
Heart failure and CIM/CIP	Unmatched	0.000	0.000	0.720
Heart failure and CIM/CIP	Matched	0.000	0.000	1.000
Liver and chronic renal failure	Unmatched	0.000	0.000	0.431
Liver and chronic renal failure	Matched	0.000	0.000	1.000
Liver failure and septic shock	Unmatched	0.000	0.000	0.782
Liver failure and septic shock	Matched	0.000	0.000	0.796
Liver failure and encephalopathy	Unmatched	0.000	0.000	0.770
Liver failure and encephalopathy	Matched	0.000	0.000	1.000
Liver failure and DIC	Unmatched	0.000	0.000	0.481
Liver failure and DIC	Matched	0.000	0.000	1.000
Acute and chronic renal failure	Unmatched	0.039	0.025	0.000
Acute and chronic renal failure	Matched	0.039	0.039	0.856
Renal and skin failure	Unmatched	0.057	0.025	0.000
Renal and skin failure	Matched	0.057	0.064	0.158
Renal failure and DIC	Unmatched	0.000	0.000	0.402
Renal failure and DIC	Matched	0.000	0.000	1.000
Renal failure and CIM/CIP	Unmatched	0.000	0.000	0.770
Renal failure and CIM/CIP	Matched	0.000	0.000	1.000
Septic shock and DIC	Unmatched	0.000	0.000	0.736
Septic shock and DIC	Matched	0.000	0.000	0.460
Septic shock and CIM/CIP	Unmatched	0.000	0.000	1.000
Septic shock and CIM/CIP	Matched	0.000	0.000	1.000

(continued)

Appendix Table D.3 (continued)
All covariates before and after matching: Aftercare, wound, and skin care group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Encephalopathy and DIC	Unmatched	0.000	0.000	0.830
Encephalopathy and DIC	Matched	0.000	0.000	1.000
Ventilator < 96 hours	Unmatched	0.054	0.045	0.011
Ventilator < 96 hours	Matched	0.054	0.052	0.755
Ventilator 96+ hours	Unmatched	0.039	0.023	0.000
Ventilator 96+ hours	Matched	0.039	0.040	0.904
Ventilator with tracheostomy	Unmatched	0.000	0.000	1.000
Ventilator with tracheostomy	Matched	0.000	0.000	1.000
Ulcers	Unmatched	0.456	0.211	0.000
Ulcers	Matched	0.456	0.454	0.855
Cellulitis	Unmatched	0.259	0.155	0.000
Cellulitis	Matched	0.259	0.280	0.040
Wound procedures	Unmatched	0.431	0.233	0.000
Wound procedures	Matched	0.431	0.453	0.057
2 organ failures	Unmatched	0.205	0.116	0.000
2 organ failures	Matched	0.205	0.204	0.968
3–5 organ failures	Unmatched	0.072	0.036	0.000
3–5 organ failures	Matched	0.072	0.075	0.660
Sepsis	Unmatched	0.137	0.065	0.000
Sepsis	Matched	0.137	0.135	0.817
Nosocomial pneumonia	Unmatched	0.008	0.006	0.110
Nosocomial pneumonia	Matched	0.008	0.010	0.487
Chronic obstructive pulmonary disease (COPD)	Unmatched	0.144	0.136	0.158
Chronic obstructive pulmonary disease (COPD)	Matched	0.144	0.147	0.730
Pleural effusion	Unmatched	0.038	0.035	0.385
Pleural effusion	Matched	0.038	0.042	0.416
Shock	Unmatched	0.037	0.021	0.000
Shock	Matched	0.037	0.038	0.712
Systemic inflammatory response syndrome (SIRS)	Unmatched	0.114	0.055	0.000
Systemic inflammatory response syndrome (SIRS)	Matched	0.114	0.108	0.400

(continued)

Appendix Table D.3 (continued)
All covariates before and after matching: Aftercare, wound, and skin care group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Malnutrition	Unmatched	0.194	0.095	0.000
Malnutrition	Matched	0.194	0.159	0.000
Thrombocytopenia	Unmatched	0.028	0.022	0.012
Thrombocytopenia	Matched	0.028	0.027	0.809
Cardiac dysrhythmias	Unmatched	0.193	0.203	0.138
Cardiac dysrhythmias	Matched	0.193	0.207	0.123
Endocarditis	Unmatched	0.001	0.000	0.132
Endocarditis	Matched	0.001	0.002	0.375
Acute myocardial infarction	Unmatched	0.026	0.020	0.014
Acute myocardial infarction	Matched	0.026	0.029	0.429
Acute coronary syndrome	Unmatched	0.001	0.002	0.269
Acute coronary syndrome	Matched	0.001	0.001	0.527
Other chronic ischemic disease	Unmatched	0.086	0.122	0.000
Other chronic ischemic disease	Matched	0.086	0.085	0.867
Other pulmonary disease	Unmatched	0.014	0.017	0.317
Other pulmonary disease	Matched	0.014	0.016	0.519
Cardiomyopathy	Unmatched	0.024	0.025	0.741
Cardiomyopathy	Matched	0.024	0.024	0.939
Other heart disease	Unmatched	0.015	0.028	0.000
Other heart disease	Matched	0.015	0.018	0.214
Osteomyelitis	Unmatched	0.113	0.037	0.000
Osteomyelitis	Matched	0.113	0.114	0.929
Other bacterial infection	Unmatched	0.180	0.102	0.000
Other bacterial infection	Matched	0.180	0.196	0.075
Percutaneous endoscopic gastrostomy (PEG)	Unmatched	0.035	0.020	0.000
Percutaneous endoscopic gastrostomy (PEG)	Matched	0.035	0.036	0.919
1–5 critical care days	Unmatched	0.156	0.230	0.000
1–5 critical care days	Matched	0.156	0.157	0.974
6–10 critical care days	Unmatched	0.124	0.116	0.136
6–10 critical care days	Matched	0.124	0.127	0.667

(continued)

Appendix Table D.3 (continued)
All covariates before and after matching: Aftercare, wound, and skin care group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
11–15 critical care days	Unmatched	0.090	0.057	0.000
11–15 critical care days	Matched	0.090	0.083	0.282
16–20 critical care days	Unmatched	0.054	0.025	0.000
16–20 critical care days	Matched	0.054	0.053	0.876
21+ critical care days	Unmatched	0.068	0.027	0.000
21+ critical care days	Matched	0.068	0.070	0.720
Critical care unit procedures	Unmatched	0.365	0.239	0.000
Critical care unit procedures	Matched	0.365	0.363	0.835
Dialysis	Unmatched	0.045	0.022	0.000
Dialysis	Matched	0.045	0.037	0.114
Dementia	Unmatched	0.010	0.009	0.325
Dementia	Matched	0.010	0.013	0.215

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table D.4
All covariates before and after matching: Complex rehabilitation group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Female	Unmatched	0.466	0.473	0.748
Female	Matched	0.466	0.460	0.799
Ages < 65	Unmatched	0.345	0.319	0.140
Ages < 65	Matched	0.345	0.315	0.221
Ages 75–84	Unmatched	0.229	0.257	0.092
Ages 75–84	Matched	0.229	0.235	0.802
Ages 85+	Unmatched	0.082	0.093	0.353
Ages 85+	Matched	0.082	0.098	0.294
MS-DRG 029	Unmatched	0.025	0.097	0.000
MS-DRG 029	Matched	0.025	0.029	0.649
MS-DRG 474	Unmatched	0.078	0.053	0.004
MS-DRG 474	Matched	0.078	0.069	0.518
MS-DRG 475	Unmatched	0.052	0.075	0.020
MS-DRG 475	Matched	0.052	0.060	0.476
MS-DRG 476	Unmatched	0.004	0.034	0.000
MS-DRG 476	Matched	0.004	0.006	0.654
MS-DRG 495	Unmatched	0.165	0.062	0.000
MS-DRG 495	Matched	0.165	0.124	0.027
MS-DRG 496	Unmatched	0.194	0.180	0.333
MS-DRG 496	Matched	0.194	0.204	0.643
MS-DRG 616	Unmatched	0.042	0.039	0.708
MS-DRG 616	Matched	0.042	0.048	0.558
MS-DRG 617	Unmatched	0.274	0.254	0.242
MS-DRG 617	Matched	0.274	0.292	0.439
MS-DRG 618	Unmatched	0.004	0.008	0.230
MS-DRG 618	Matched	0.004	0.007	0.441
MS-DRG 028	Unmatched	0.078	0.060	0.044
MS-DRG 028	Matched	0.078	0.070	0.545
Log beds	Unmatched	5.660	5.672	0.650
Log beds	Matched	5.660	5.460	0.000

(continued)

Appendix Table D.4 (continued)
All covariates before and after matching: Complex rehabilitation group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Log resident ratio	Unmatched	0.081	0.124	0.000
Log resident ratio	Matched	0.081	0.084	0.698
Case mix index	Unmatched	1.582	1.596	0.141
Case mix index	Matched	1.582	1.524	0.000
Urban	Unmatched	0.933	0.903	0.008
Urban	Matched	0.933	0.854	0.000
Acute respiratory failure	Unmatched	0.060	0.030	0.000
Acute respiratory failure	Matched	0.060	0.047	0.281
Chronic respiratory failure	Unmatched	0.000	0.001	0.394
Chronic respiratory failure	Matched	0.000	0.000	1.000
Heart failure	Unmatched	0.158	0.130	0.031
Heart failure	Matched	0.158	0.157	0.965
Liver failure	Unmatched	0.001	0.000	0.288
Liver failure	Matched	0.001	0.003	0.564
Acute renal failure	Unmatched	0.103	0.057	0.000
Acute renal failure	Matched	0.103	0.088	0.314
Chronic renal failure	Unmatched	0.203	0.159	0.002
Chronic renal failure	Matched	0.203	0.182	0.321
Skin failure	Unmatched	0.198	0.114	0.000
Skin failure	Matched	0.198	0.203	0.833
Septic shock	Unmatched	0.011	0.003	0.000
Septic shock	Matched	0.011	0.009	0.631
Encephalopathy	Unmatched	0.004	0.002	0.107
Encephalopathy	Matched	0.004	0.005	0.874
Disseminated intravascular coagulopathy (DIC)	Unmatched	0.001	0.001	0.705
Disseminated intravascular coagulopathy (DIC)	Matched	0.001	0.001	0.882
Critical illness myopathy/polyneuropathy (CIM/CIP)	Unmatched	0.000	0.000	0.756
Critical illness myopathy/polyneuropathy (CIM/CIP)	Matched	0.000	0.000	0.655
Acute respiratory failure and encephalopathy	Unmatched	0.000	0.000	0.820
Acute respiratory failure and encephalopathy	Matched	0.000	0.001	0.439

(continued)

Appendix Table D.4 (continued)
All covariates before and after matching: Complex rehabilitation group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Acute respiratory failure and DIC	Unmatched	0.001	0.000	0.101
Acute respiratory failure and DIC	Matched	0.001	0.001	0.882
Chronic respiratory and renal failure	Unmatched	0.000	0.000	0.820
Chronic respiratory and renal failure	Matched	0.000	0.000	1.000
Heart failure and septic shock	Unmatched	0.001	0.000	0.052
Heart failure and septic shock	Matched	0.001	0.001	0.882
Heart failure and encephalopathy	Unmatched	0.000	0.000	0.756
Heart failure and encephalopathy	Matched	0.000	0.001	0.527
Liver and acute renal failure	Unmatched	0.001	0.000	0.101
Liver and acute renal failure	Matched	0.001	0.003	0.564
Renal and skin failure	Unmatched	0.014	0.009	0.180
Renal and skin failure	Matched	0.014	0.013	0.818
Renal failure and DIC	Unmatched	0.000	0.000	0.623
Renal failure and DIC	Matched	0.000	0.000	0.655
Septic shock and skin failure	Unmatched	0.000	0.000	0.756
Septic shock and skin failure	Matched	0.000	0.000	1.000
Septic shock and encephalopathy	Unmatched	0.000	0.000	0.820
Septic shock and encephalopathy	Matched	0.000	0.000	1.000
Septic shock and DIC	Unmatched	0.001	0.000	0.000
Septic shock and DIC	Matched	0.001	0.000	0.317
Skin failure and DIC	Unmatched	0.000	0.000	0.820
Skin failure and DIC	Matched	0.000	0.000	1.000
Ventilator < 96 hours	Unmatched	0.014	0.010	0.302
Ventilator < 96 hours	Matched	0.014	0.013	0.928
Ventilator 96+ hours	Unmatched	0.010	0.005	0.090
Ventilator 96+ hours	Matched	0.010	0.010	0.957
Ulcers	Unmatched	0.359	0.285	0.000
Ulcers	Matched	0.359	0.370	0.677
Cellulitis	Unmatched	0.293	0.177	0.000
Cellulitis	Matched	0.293	0.271	0.342

(continued)

Appendix Table D.4 (continued)
All covariates before and after matching: Complex rehabilitation group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Wound procedures	Unmatched	0.099	0.055	0.000
Wound procedures	Matched	0.099	0.107	0.615
1–2 organ failures	Unmatched	0.501	0.354	0.000
1–2 organ failures	Matched	0.501	0.462	0.139
3–4 organ failures	Unmatched	0.031	0.018	0.011
3–4 organ failures	Matched	0.031	0.028	0.803
Sepsis	Unmatched	0.102	0.037	0.000
Sepsis	Matched	0.102	0.091	0.463
Nosocomial pneumonia	Unmatched	0.003	0.002	0.454
Nosocomial pneumonia	Matched	0.003	0.003	0.922
Chronic obstructive pulmonary disease (COPD)	Unmatched	0.123	0.107	0.194
Chronic obstructive pulmonary disease (COPD)	Matched	0.123	0.127	0.835
Pleural effusion	Unmatched	0.015	0.009	0.066
Pleural effusion	Matched	0.015	0.016	0.899
Shock	Unmatched	0.014	0.004	0.000
Shock	Matched	0.014	0.010	0.465
Systemic inflammatory response syndrome (SIRS)	Unmatched	0.092	0.032	0.000
Systemic inflammatory response syndrome (SIRS)	Matched	0.092	0.075	0.245
Malnutrition	Unmatched	0.089	0.029	0.000
Malnutrition	Matched	0.089	0.058	0.021
Thrombocytopenia	Unmatched	0.028	0.016	0.016
Thrombocytopenia	Matched	0.028	0.027	0.923
Cardiac dysrhythmias	Unmatched	0.145	0.135	0.436
Cardiac dysrhythmias	Matched	0.145	0.156	0.555
Endocarditis	Unmatched	0.003	0.002	0.625
Endocarditis	Matched	0.003	0.004	0.654
Acute myocardial infarction	Unmatched	0.011	0.010	0.687
Acute myocardial infarction	Matched	0.011	0.009	0.672
Acute coronary syndrome	Unmatched	0.001	0.001	0.974
Acute coronary syndrome	Matched	0.001	0.001	0.882

(continued)

Appendix Table D.4 (continued)
All covariates before and after matching: Complex rehabilitation group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Other chronic ischemic disease	Unmatched	0.101	0.142	0.002
Other chronic ischemic disease	Matched	0.101	0.104	0.848
Other pulmonary disease	Unmatched	0.014	0.010	0.321
Other pulmonary disease	Matched	0.014	0.018	0.582
Cardiomyopathy	Unmatched	0.038	0.025	0.038
Cardiomyopathy	Matched	0.038	0.030	0.449
Other heart disease	Unmatched	0.021	0.028	0.280
Other heart disease	Matched	0.021	0.020	0.941
Osteomyelitis	Unmatched	0.454	0.387	0.000
Osteomyelitis	Matched	0.454	0.481	0.300
Other bacterial infection	Unmatched	0.291	0.224	0.000
Other bacterial infection	Matched	0.291	0.305	0.548
Percutaneous endoscopic gastrostomy (PEG)	Unmatched	0.008	0.005	0.205
Percutaneous endoscopic gastrostomy (PEG)	Matched	0.008	0.007	0.811
11–25 critical care days	Unmatched	0.080	0.029	0.000
11–25 critical care days	Matched	0.080	0.065	0.270
26+ critical care days	Unmatched	0.013	0.003	0.000
26+ critical care days	Matched	0.013	0.010	0.653
Critical care unit procedures	Unmatched	0.461	0.289	0.000
Critical care unit procedures	Matched	0.461	0.456	0.840
Dialysis	Unmatched	0.106	0.059	0.000
Dialysis	Matched	0.106	0.070	0.014
Dementia	Unmatched	0.001	0.007	0.089
Dementia	Matched	0.001	0.003	0.633

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table D.5
All covariates before and after matching: Pneumonia group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Female	Unmatched	0.579	0.577	0.891
Female	Matched	0.579	0.569	0.664
Ages < 65	Unmatched	0.097	0.114	0.107
Ages < 65	Matched	0.097	0.088	0.488
Ages 75–84	Unmatched	0.378	0.343	0.025
Ages 75–84	Matched	0.378	0.394	0.502
Ages 85+	Unmatched	0.315	0.316	0.980
Ages 85+	Matched	0.315	0.340	0.265
MS-DRG 193	Unmatched	0.423	0.272	0.000
MS-DRG 193	Matched	0.423	0.434	0.631
Log beds	Unmatched	5.417	5.344	0.003
Log beds	Matched	5.417	5.344	0.040
Log resident ratio	Unmatched	0.026	0.060	0.000
Log resident ratio	Matched	0.026	0.046	0.000
Case mix index	Unmatched	1.460	1.457	0.730
Case mix index	Matched	1.460	1.453	0.533
Urban	Unmatched	0.892	0.810	0.000
Urban	Matched	0.892	0.857	0.024
Acute respiratory failure	Unmatched	0.152	0.061	0.000
Acute respiratory failure	Matched	0.152	0.150	0.907
Chronic respiratory failure	Unmatched	0.016	0.010	0.054
Chronic respiratory failure	Matched	0.016	0.017	0.971
Heart failure	Unmatched	0.380	0.300	0.000
Heart failure	Matched	0.380	0.387	0.737
Liver failure	Unmatched	0.000	0.001	0.488
Liver failure	Matched	0.000	0.000	1.000
Acute renal failure	Unmatched	0.131	0.093	0.000
Acute renal failure	Matched	0.131	0.139	0.613
Chronic renal failure	Unmatched	0.164	0.161	0.834
Chronic renal failure	Matched	0.164	0.171	0.653

(continued)

Appendix Table D.5 (continued)
All covariates before and after matching: Pneumonia group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Skin failure	Unmatched	0.027	0.010	0.000
Skin failure	Matched	0.027	0.029	0.779
Septic shock	Unmatched	0.002	0.002	0.675
Septic shock	Matched	0.002	0.002	0.918
Encephalopathy	Unmatched	0.008	0.004	0.077
Encephalopathy	Matched	0.008	0.013	0.249
Disseminated intravascular coagulopathy (DIC)	Unmatched	0.001	0.000	0.331
Disseminated intravascular coagulopathy (DIC)	Matched	0.001	0.002	0.710
Critical illness myopathy/polyneuropathy (CIM/CIP)	Unmatched	0.000	0.000	0.785
Critical illness myopathy/polyneuropathy (CIM/CIP)	Matched	0.000	0.000	1.000
Acute and chronic respiratory failure	Unmatched	0.000	0.000	0.847
Acute and chronic respiratory failure	Matched	0.000	0.000	1.000
Respiratory and acute renal failure	Unmatched	0.033	0.008	0.000
Respiratory and acute renal failure	Matched	0.033	0.031	0.853
Acute respiratory failure and encephalopathy	Unmatched	0.000	0.000	0.628
Acute respiratory failure and encephalopathy	Matched	0.000	0.000	1.000
Acute respiratory failure and DIC	Unmatched	0.000	0.000	0.847
Acute respiratory failure and DIC	Matched	0.000	0.000	1.000
Chronic respiratory failure and septic shock	Unmatched	0.000	0.000	0.918
Chronic respiratory failure and septic shock	Matched	0.000	0.000	0.527
Chronic respiratory and skin failure	Unmatched	0.002	0.000	0.000
Chronic respiratory and skin failure	Matched	0.002	0.002	1.000
Liver and acute renal failure	Unmatched	0.000	0.000	0.666
Liver and acute renal failure	Matched	0.000	0.000	1.000
Liver and chronic renal failure	Unmatched	0.000	0.000	0.726
Liver and chronic renal failure	Matched	0.000	0.000	1.000
Renal failure and septic shock	Unmatched	0.000	0.000	0.644
Renal failure and septic shock	Matched	0.000	0.000	1.000
Skin failure and septic shock	Unmatched	0.000	0.000	0.858
Skin failure and septic shock	Matched	0.000	0.000	0.527

(continued)

Appendix Table D.5 (continued)
All covariates before and after matching: Pneumonia group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Skin failure and encephalopathy	Unmatched	0.000	0.000	0.817
Skin failure and encephalopathy	Matched	0.000	0.000	0.655
Ulcers	Unmatched	0.077	0.041	0.000
Ulcers	Matched	0.077	0.069	0.496
Cellulitis	Unmatched	0.034	0.017	0.000
Cellulitis	Matched	0.034	0.036	0.761
Wound procedures	Unmatched	0.200	0.152	0.000
Wound procedures	Matched	0.200	0.215	0.407
1 organ failure	Unmatched	0.360	0.324	0.022
1 organ failure	Matched	0.360	0.351	0.697
2–3 organ failures	Unmatched	0.220	0.141	0.000
2–3 organ failures	Matched	0.220	0.235	0.443
4–5 organ failures	Unmatched	0.009	0.002	0.000
4–5 organ failures	Matched	0.009	0.009	0.921
Sepsis	Unmatched	0.037	0.020	0.000
Sepsis	Matched	0.037	0.037	1.000
Nosocomial pneumonia	Unmatched	0.016	0.012	0.267
Nosocomial pneumonia	Matched	0.016	0.024	0.271
Chronic obstructive pulmonary disease (COPD)	Unmatched	0.449	0.409	0.014
Chronic obstructive pulmonary disease (COPD)	Matched	0.449	0.475	0.269
Pleural effusion	Unmatched	0.089	0.087	0.837
Pleural effusion	Matched	0.089	0.093	0.783
Shock	Unmatched	0.007	0.003	0.031
Shock	Matched	0.007	0.009	0.592
Systemic inflammatory response syndrome (SIRS)	Unmatched	0.034	0.019	0.001
Systemic inflammatory response syndrome (SIRS)	Matched	0.034	0.038	0.651
Malnutrition	Unmatched	0.144	0.047	0.000
Malnutrition	Matched	0.144	0.125	0.223
Thrombocytopenia	Unmatched	0.028	0.029	0.955
Thrombocytopenia	Matched	0.028	0.033	0.535

(continued)

Appendix Table D.5 (continued)
All covariates before and after matching: Pneumonia group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Cardiac dysrhythmias	Unmatched	0.263	0.258	0.754
Cardiac dysrhythmias	Matched	0.263	0.286	0.263
Endocarditis	Unmatched	0.001	0.000	0.118
Endocarditis	Matched	0.001	0.001	1.000
Acute myocardial infarction	Unmatched	0.016	0.014	0.628
Acute myocardial infarction	Matched	0.016	0.022	0.343
Acute coronary syndrome	Unmatched	0.003	0.005	0.366
Acute coronary syndrome	Matched	0.003	0.002	0.584
Other chronic ischemic disease	Unmatched	0.181	0.213	0.017
Other chronic ischemic disease	Matched	0.181	0.163	0.305
Other pulmonary disease	Unmatched	0.034	0.035	0.817
Other pulmonary disease	Matched	0.034	0.056	0.021
Cardiomyopathy	Unmatched	0.035	0.044	0.172
Cardiomyopathy	Matched	0.035	0.031	0.638
Other heart disease	Unmatched	0.025	0.030	0.342
Other heart disease	Matched	0.025	0.025	0.976
Osteomyelitis	Unmatched	0.007	0.001	0.000
Osteomyelitis	Matched	0.007	0.005	0.762
Other bacterial infection	Unmatched	0.050	0.055	0.541
Other bacterial infection	Matched	0.050	0.058	0.482
Percutaneous endoscopic gastrostomy (PEG)	Unmatched	0.015	0.005	0.000
Percutaneous endoscopic gastrostomy (PEG)	Matched	0.015	0.012	0.575
1–5 critical care days	Unmatched	0.232	0.185	0.000
1–5 critical care days	Matched	0.232	0.246	0.504
6–10 critical care days	Unmatched	0.145	0.073	0.000
6–10 critical care days	Matched	0.145	0.132	0.418
11+ critical care days	Unmatched	0.046	0.017	0.000
11+ critical care days	Matched	0.046	0.042	0.699
Critical care unit procedures	Unmatched	0.140	0.045	0.000
Critical care unit procedures	Matched	0.140	0.137	0.860

(continued)

Appendix Table D.5 (continued)
All covariates before and after matching: Pneumonia group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Dialysis	Unmatched	0.035	0.032	0.598
Dialysis	Matched	0.035	0.023	0.141
Dementia	Unmatched	0.011	0.018	0.096
Dementia	Matched	0.011	0.019	0.155

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table D.6
All covariates before and after matching: Heart failure group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Female	Unmatched	0.559	0.582	0.248
Female	Matched	0.558	0.541	0.542
Ages < 65	Unmatched	0.096	0.089	0.539
Ages < 65	Matched	0.096	0.075	0.172
Ages 75–84	Unmatched	0.365	0.339	0.157
Ages 75–84	Matched	0.366	0.378	0.667
Ages 85+	Unmatched	0.326	0.365	0.043
Ages 85+	Matched	0.327	0.346	0.461
MS-DRG 291	Unmatched	0.655	0.489	0.000
MS-DRG 291	Matched	0.655	0.645	0.724
Log beds	Unmatched	5.498	5.441	0.047
Log beds	Matched	5.498	5.459	0.355
Log resident ratio	Unmatched	0.033	0.071	0.000
Log resident ratio	Matched	0.033	0.061	0.000
Case mix index	Unmatched	1.469	1.486	0.068
Case mix index	Matched	1.468	1.502	0.005
Urban	Unmatched	0.893	0.850	0.002
Urban	Matched	0.893	0.879	0.438
Acute respiratory failure	Unmatched	0.157	0.068	0.000
Acute respiratory failure	Matched	0.156	0.153	0.889
Chronic respiratory failure	Unmatched	0.017	0.008	0.014
Chronic respiratory failure	Matched	0.017	0.016	0.896
Heart failure	Unmatched	0.948	0.961	0.106
Heart failure	Matched	0.948	0.943	0.711
Liver failure	Unmatched	0.002	0.002	0.976
Liver failure	Matched	0.002	0.002	1.000
Acute renal failure	Unmatched	0.252	0.187	0.000
Acute renal failure	Matched	0.252	0.264	0.626
Chronic renal failure	Unmatched	0.346	0.361	0.438
Chronic renal failure	Matched	0.345	0.333	0.644

(continued)

Appendix Table D.6 (continued)
All covariates before and after matching: Heart failure group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Skin failure	Unmatched	0.049	0.020	0.000
Skin failure	Matched	0.049	0.070	0.117
Septic shock	Unmatched	0.005	0.001	0.015
Septic shock	Matched	0.005	0.004	0.796
Encephalopathy	Unmatched	0.008	0.002	0.006
Encephalopathy	Matched	0.008	0.008	0.949
Disseminated intravascular coagulopathy (DIC)	Unmatched	0.000	0.000	0.617
Disseminated intravascular coagulopathy (DIC)	Matched	0.000	0.000	1.000
Critical illness myopathy/polyneuropathy (CIM/CIP)	Unmatched	0.000	0.000	0.763
Critical illness myopathy/polyneuropathy (CIM/CIP)	Matched	0.000	0.000	1.000
Respiratory and heart failure	Unmatched	0.151	0.065	0.000
Respiratory and heart failure	Matched	0.150	0.144	0.788
Respiratory and liver failure	Unmatched	0.000	0.000	0.606
Respiratory and liver failure	Matched	0.000	0.001	0.439
Respiratory failure and DIC	Unmatched	0.000	0.000	0.800
Respiratory failure and DIC	Matched	0.000	0.000	1.000
Heart failure and septic shock	Unmatched	0.005	0.001	0.013
Heart failure and septic shock	Matched	0.005	0.004	0.796
Liver and skin failure	Unmatched	0.000	0.000	0.880
Liver and skin failure	Matched	0.000	0.000	1.000
Renal failure and septic shock	Unmatched	0.005	0.001	0.000
Renal failure and septic shock	Matched	0.005	0.003	0.584
Septic shock and DIC	Unmatched	0.000	0.000	0.910
Septic shock and DIC	Matched	0.000	0.000	1.000
Skin failure and encephalopathy	Unmatched	0.000	0.000	0.850
Skin failure and encephalopathy	Matched	0.000	0.000	0.655
Ventilator < 96 hours	Unmatched	0.017	0.011	0.109
Ventilator < 96 hours	Matched	0.017	0.015	0.791
Ventilator 96+ hours	Unmatched	0.022	0.005	0.000
Ventilator 96+ hours	Matched	0.022	0.015	0.361

(continued)

Appendix Table D.6 (continued)
All covariates before and after matching: Heart failure group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Ulcers	Unmatched	0.113	0.055	0.000
Ulcers	Matched	0.112	0.144	0.084
Cellulitis	Unmatched	0.140	0.062	0.000
Cellulitis	Matched	0.140	0.158	0.370
Wound procedures	Unmatched	0.246	0.188	0.000
Wound procedures	Matched	0.246	0.241	0.834
4–6 organ failures	Unmatched	0.032	0.013	0.000
4–6 organ failures	Matched	0.032	0.035	0.708
Sepsis	Unmatched	0.050	0.010	0.000
Sepsis	Matched	0.049	0.032	0.116
Nosocomial pneumonia	Unmatched	0.003	0.002	0.628
Nosocomial pneumonia	Matched	0.003	0.001	0.473
Chronic obstructive pulmonary disease (COPD)	Unmatched	0.331	0.318	0.480
Chronic obstructive pulmonary disease (COPD)	Matched	0.331	0.324	0.783
Pleural effusion	Unmatched	0.094	0.078	0.118
Pleural effusion	Matched	0.095	0.086	0.597
Shock	Unmatched	0.016	0.006	0.001
Shock	Matched	0.016	0.013	0.635
Systemic inflammatory response syndrome (SIRS)	Unmatched	0.043	0.008	0.000
Systemic inflammatory response syndrome (SIRS)	Matched	0.041	0.028	0.196
Malnutrition	Unmatched	0.091	0.028	0.000
Malnutrition	Matched	0.090	0.054	0.012
Thrombocytopenia	Unmatched	0.038	0.031	0.287
Thrombocytopenia	Matched	0.038	0.038	0.976
Cardiac dysrhythmias	Unmatched	0.419	0.479	0.003
Cardiac dysrhythmias	Matched	0.420	0.480	0.030
Endocarditis	Unmatched	0.003	0.001	0.012
Endocarditis	Matched	0.003	0.002	0.745
Acute myocardial infarction	Unmatched	0.000	0.001	0.458
Acute myocardial infarction	Matched	0.000	0.000	1.000

(continued)

Appendix Table D.6 (continued)
All covariates before and after matching: Heart failure group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Acute coronary syndrome	Unmatched	0.017	0.017	0.958
Acute coronary syndrome	Matched	0.017	0.013	0.488
Other chronic ischemic disease	Unmatched	0.277	0.358	0.000
Other chronic ischemic disease	Matched	0.278	0.259	0.447
Other pulmonary disease	Unmatched	0.080	0.097	0.146
Other pulmonary disease	Matched	0.080	0.102	0.185
Cardiomyopathy	Unmatched	0.197	0.175	0.146
Cardiomyopathy	Matched	0.197	0.187	0.649
Other heart disease	Unmatched	0.000	0.002	0.329
Other heart disease	Matched	0.000	0.000	1.000
Osteomyelitis	Unmatched	0.006	0.001	0.001
Osteomyelitis	Matched	0.005	0.006	0.705
Other bacterial infection	Unmatched	0.030	0.039	0.242
Other bacterial infection	Matched	0.030	0.043	0.219
Percutaneous endoscopic gastrostomy (PEG)	Unmatched	0.009	0.003	0.001
Percutaneous endoscopic gastrostomy (PEG)	Matched	0.009	0.007	0.619
6–10 critical care days	Unmatched	0.214	0.148	0.000
6–10 critical care days	Matched	0.215	0.210	0.837
11–20 critical care days	Unmatched	0.091	0.037	0.000
11–20 critical care days	Matched	0.090	0.080	0.506
21–25 critical care days	Unmatched	0.013	0.002	0.000
21–25 critical care days	Matched	0.013	0.009	0.513
26+ critical care days	Unmatched	0.000	0.002	0.324
26+ critical care days	Matched	0.000	0.000	1.000
Critical care unit procedures	Unmatched	0.167	0.058	0.000
Critical care unit procedures	Matched	0.166	0.150	0.432
Dialysis	Unmatched	0.069	0.059	0.250
Dialysis	Matched	0.069	0.048	0.110
Dementia	Unmatched	0.008	0.010	0.599
Dementia	Matched	0.008	0.013	0.403

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table D.7
All covariates before and after matching: Chronic obstructive pulmonary disease/other respiratory failure group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Female	Unmatched	0.584	0.610	0.062
Female	Matched	0.584	0.579	0.806
Ages < 65	Unmatched	0.146	0.156	0.372
Ages < 65	Matched	0.146	0.138	0.572
Ages 75–84	Unmatched	0.360	0.352	0.599
Ages 75–84	Matched	0.360	0.369	0.615
Ages 85+	Unmatched	0.146	0.181	0.002
Ages 85+	Matched	0.146	0.135	0.424
MS-DRG 189	Unmatched	0.515	0.356	0.000
MS-DRG 189	Matched	0.515	0.533	0.374
MS-DRG 190	Unmatched	0.255	0.251	0.736
MS-DRG 190	Matched	0.255	0.233	0.202
Log beds	Unmatched	5.427	5.395	0.106
Log beds	Matched	5.427	5.406	0.467
Log resident ratio	Unmatched	0.049	0.054	0.135
Log resident ratio	Matched	0.049	0.055	0.159
Case mix index	Unmatched	1.489	1.468	0.001
Case mix index	Matched	1.489	1.473	0.072
Urban	Unmatched	0.943	0.827	0.000
Urban	Matched	0.943	0.857	0.000
Acute respiratory failure	Unmatched	0.613	0.409	0.000
Acute respiratory failure	Matched	0.613	0.615	0.921
Chronic respiratory failure	Unmatched	0.042	0.034	0.132
Chronic respiratory failure	Matched	0.042	0.043	0.888
Heart failure	Unmatched	0.430	0.363	0.000
Heart failure	Matched	0.430	0.398	0.100
Liver failure	Unmatched	0.002	0.001	0.082
Liver failure	Matched	0.002	0.001	0.745

(continued)

Appendix Table D.7 (continued)
All covariates before and after matching: Chronic obstructive pulmonary disease/other respiratory failure group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Acute renal failure	Unmatched	0.120	0.086	0.000
Acute renal failure	Matched	0.120	0.103	0.167
Chronic renal failure	Unmatched	0.123	0.137	0.159
Chronic renal failure	Matched	0.123	0.114	0.500
Skin failure	Unmatched	0.015	0.008	0.017
Skin failure	Matched	0.015	0.014	0.865
Septic shock	Unmatched	0.003	0.001	0.001
Septic shock	Matched	0.003	0.002	0.705
Encephalopathy	Unmatched	0.002	0.003	0.902
Encephalopathy	Matched	0.002	0.001	0.380
Disseminated intravascular coagulopathy (DIC)	Unmatched	0.002	0.000	0.000
Disseminated intravascular coagulopathy (DIC)	Matched	0.002	0.003	0.705
Critical illness myopathy/polyneuropathy (CIM/CIP)	Unmatched	0.000	0.000	0.644
Critical illness myopathy/polyneuropathy (CIM/CIP)	Matched	0.000	0.000	0.655
Acute and chronic respiratory failure	Unmatched	0.000	0.001	0.370
Acute and chronic respiratory failure	Matched	0.000	0.000	1.000
Skin and chronic respiratory failure	Unmatched	0.000	0.000	0.605
Skin and chronic respiratory failure	Matched	0.000	0.000	1.000
Liver failure and septic shock	Unmatched	0.000	0.000	0.870
Liver failure and septic shock	Matched	0.000	0.000	1.000
Liver and skin failure	Unmatched	0.001	0.000	0.000
Liver and skin failure	Matched	0.001	0.000	0.317
Liver failure and DIC	Unmatched	0.000	0.000	0.870
Liver failure and DIC	Matched	0.000	0.000	1.000
Septic shock and skin failure	Unmatched	0.000	0.000	0.890
Septic shock and skin failure	Matched	0.000	0.000	0.655
Ulcers	Unmatched	0.034	0.025	0.039
Ulcers	Matched	0.034	0.036	0.776

(continued)

Appendix Table D.7 (continued)
All covariates before and after matching: Chronic obstructive pulmonary disease/other respiratory failure group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Cellulitis	Unmatched	0.024	0.020	0.328
Cellulitis	Matched	0.024	0.023	0.832
Wound procedures	Unmatched	0.332	0.195	0.000
Wound procedures	Matched	0.332	0.282	0.007
1–6 organ failures	Unmatched	0.819	0.668	0.000
1–6 organ failures	Matched	0.819	0.812	0.685
Sepsis	Unmatched	0.038	0.010	0.000
Sepsis	Matched	0.038	0.028	0.149
Nosocomial pneumonia	Unmatched	0.008	0.004	0.013
Nosocomial pneumonia	Matched	0.008	0.007	0.672
Chronic obstructive pulmonary disease (COPD)	Unmatched	0.745	0.752	0.542
Chronic obstructive pulmonary disease (COPD)	Matched	0.745	0.769	0.150
Pleural effusion	Unmatched	0.040	0.037	0.631
Pleural effusion	Matched	0.040	0.055	0.075
Shock	Unmatched	0.006	0.003	0.038
Shock	Matched	0.006	0.006	1.000
Systemic inflammatory response syndrome (SIRS)	Unmatched	0.033	0.009	0.000
Systemic inflammatory response syndrome (SIRS)	Matched	0.033	0.022	0.076
Malnutrition	Unmatched	0.088	0.038	0.000
Malnutrition	Matched	0.088	0.078	0.380
Thrombocytopenia	Unmatched	0.027	0.021	0.121
Thrombocytopenia	Matched	0.027	0.026	0.860
Cardiac dysrhythmias	Unmatched	0.282	0.256	0.041
Cardiac dysrhythmias	Matched	0.282	0.280	0.943
Endocarditis	Unmatched	0.000	0.000	0.624
Endocarditis	Matched	0.000	0.000	0.527
Acute myocardial infarction	Unmatched	0.020	0.017	0.432
Acute myocardial infarction	Matched	0.020	0.025	0.353

(continued)

Appendix Table D.7 (continued)
All covariates before and after matching: Chronic obstructive pulmonary disease/other respiratory failure group

Variable	Sample	LTCH group	Control group	$p > \|t\|$
Acute coronary syndrome	Unmatched	0.004	0.010	0.041
Acute coronary syndrome	Matched	0.004	0.004	0.845
Other chronic ischemic disease	Unmatched	0.194	0.235	0.001
Other chronic ischemic disease	Matched	0.194	0.181	0.391
Other pulmonary disease	Unmatched	0.106	0.091	0.074
Other pulmonary disease	Matched	0.106	0.143	0.005
Cardiomyopathy	Unmatched	0.063	0.061	0.786
Cardiomyopathy	Matched	0.063	0.056	0.517
Other heart disease	Unmatched	0.015	0.028	0.009
Other heart disease	Matched	0.015	0.018	0.681
Osteomyelitis	Unmatched	0.000	0.001	0.352
Osteomyelitis	Matched	0.000	0.000	1.000
Other bacterial infection	Unmatched	0.035	0.046	0.067
Other bacterial infection	Matched	0.035	0.039	0.579
Percutaneous endoscopic gastrostomy (PEG)	Unmatched	0.008	0.003	0.003
Percutaneous endoscopic gastrostomy (PEG)	Matched	0.008	0.007	0.745
1–5 critical care days	Unmatched	0.342	0.283	0.000
1–5 critical care days	Matched	0.342	0.352	0.605
6–10 critical care days	Unmatched	0.185	0.108	0.000
6–10 critical care days	Matched	0.185	0.177	0.637
11–25 critical care days	Unmatched	0.055	0.027	0.000
11–25 critical care days	Matched	0.055	0.063	0.412
26+ critical care days	Unmatched	0.002	0.001	0.108
26+ critical care days	Matched	0.002	0.004	0.519
Critical care unit procedures	Unmatched	0.125	0.053	0.000
Critical care unit procedures	Matched	0.125	0.109	0.201
Dialysis	Unmatched	0.015	0.018	0.561
Dialysis	Matched	0.015	0.009	0.153
Dementia	Unmatched	0.003	0.010	0.017
Dementia	Matched	0.003	0.005	0.456

SOURCE: Analysis of RTI 2007 Episode Margins file.

APPENDIX E:
TABLES OF RESULTS FROM OUTCOME REGRESSIONS

LIST OF TABLES IN APPENDIX E

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Appendix Table E.1
Ventilator group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
No LTCH referral group 2	0.533***	0.523***	0.01	0.490***	0.425***	0.065***	10.244***	7.471***
	[0.019]	[0.020]	[0.015]	[0.020]	[0.019]	[0.014]	[1.039]	[0.702]
No LTCH referral group 3	0.860***	0.749***	0.110***	0.797***	0.622***	0.175***	18.153***	12.295***
	[0.018]	[0.021]	[0.015]	[0.018]	[0.020]	[0.014]	[1.224]	[0.826]
No LTCH referral group 4	0.825***	0.748***	0.077***	0.729***	0.581***	0.148***	14.972***	10.117***
	[0.020]	[0.023]	[0.016]	[0.020]	[0.021]	[0.014]	[1.303]	[0.927]
No LTCH referral group 5	0.860***	0.781***	0.079***	0.756***	0.612***	0.144***	17.088***	10.963***
	[0.022]	[0.025]	[0.018]	[0.022]	[0.024]	[0.016]	[1.484]	[1.040]
No LTCH referral group 6	0.938***	0.837***	0.101***	0.788***	0.626***	0.162***	14.898***	9.500***
	[0.030]	[0.034]	[0.027]	[0.030]	[0.033]	[0.024]	[2.215]	[1.402]
LTCH referral group 1	−0.098***	−0.074***	−0.024	0.678***	0.553***	0.125***	25.222***	21.836***
	[0.015]	[0.022]	[0.018]	[0.019]	[0.019]	[0.014]	[1.032]	[0.704]
LTCH referral group 2	0.398***	0.444***	−0.045***	0.903***	0.813***	0.090***	35.146***	31.281***
	[0.023]	[0.024]	[0.017]	[0.020]	[0.021]	[0.014]	[1.291]	[0.928]
LTCH referral group 3	0.591***	0.580***	0.011	1.022***	0.899***	0.122***	39.706***	35.169***
	[0.021]	[0.024]	[0.016]	[0.020]	[0.021]	[0.014]	[1.315]	[0.991]
LTCH referral group 4	0.541***	0.536***	0.005	1.023***	0.895***	0.129***	37.739***	33.098***
	[0.020]	[0.024]	[0.017]	[0.020]	[0.022]	[0.014]	[1.360]	[0.995]
LTCH referral group 5	0.554***	0.544***	0.01	1.055***	0.925***	0.130***	37.045***	32.620***
	[0.022]	[0.025]	[0.018]	[0.021]	[0.023]	[0.016]	[1.446]	[1.051]
LTCH referral group 6	0.628***	0.618***	0.01	1.139***	0.999***	0.140***	38.566***	34.093***
	[0.028]	[0.032]	[0.024]	[0.027]	[0.030]	[0.020]	[2.146]	[1.608]
14 or fewer days to death	−0.058***	−0.366***	0.308***	−0.296***	−0.592***	0.296***	−27.579***	−20.117***
	[0.017]	[0.021]	[0.020]	[0.021]	[0.021]	[0.021]	[0.732]	[0.515]
15–21 days to death	−0.025**	−0.201***	0.177***	−0.167***	−0.338***	0.170***	−29.667***	−19.874***
	[0.012]	[0.013]	[0.013]	[0.014]	[0.013]	[0.013]	[0.599]	[0.441]
22–28 days to death	−0.001	−0.061***	0.060***	−0.119***	−0.170***	0.051***	−28.482***	−17.475***
	[0.012]	[0.013]	[0.011]	[0.012]	[0.013]	[0.011]	[0.646]	[0.465]

(continued)

Appendix Table E.1 (continued)
Ventilator group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
Survived at least 29 days	0.109***	0.133***	−0.024***	0.171***	0.221***	−0.050***	−7.578***	6.718***
	[0.006]	[0.007]	[0.006]	[0.006]	[0.007]	[0.005]	[0.546]	[0.382]
Acute referral without LTCH	−0.077***	−0.027*	−0.049***	0.210***	0.230***	−0.02	8.421***	13.736***
	[0.013]	[0.015]	[0.011]	[0.014]	[0.016]	[0.013]	[0.961]	[0.771]
Acute referral with LTCH	−0.257***	−0.209***	−0.048*	0.582***	0.654***	−0.072***	40.410***	40.175***
	[0.037]	[0.044]	[0.027]	[0.034]	[0.035]	[0.023]	[3.097]	[2.261]
SNF first PAC	−0.075***	−0.032**	−0.043***	−0.186***	−0.152***	−0.034***	−16.164***	−9.683***
	[0.011]	[0.013]	[0.010]	[0.012]	[0.014]	[0.010]	[1.086]	[0.715]
IRF first PAC	−0.033	0.029	−0.062**	0.240***	0.293***	−0.053***	14.675***	18.633***
	[0.022]	[0.028]	[0.024]	[0.019]	[0.023]	[0.020]	[1.589]	[1.150]
Any SNF claims	0.018**	−0.006	0.024***	0.241***	0.247***	−0.006	74.546***	19.718***
	[0.007]	[0.009]	[0.006]	[0.007]	[0.008]	[0.005]	[0.679]	[0.500]
Log beds	0.160***	0.140***	0.021	0.106***	0.087***	0.019*	3.898***	2.908***
	[0.013]	[0.016]	[0.013]	[0.010]	[0.013]	[0.011]	[0.631]	[0.487]
Case mix index	0.256***	0.372***	−0.116***	0.181***	0.275***	−0.093***	−1.576	−1.698
	[0.033]	[0.045]	[0.036]	[0.026]	[0.036]	[0.030]	[1.514]	[1.191]
Urban	−0.008	0.007	−0.015	−0.014	−0.003	−0.011	−0.643	1.136
	[0.014]	[0.023]	[0.020]	[0.013]	[0.020]	[0.017]	[0.908]	[0.713]
Medicare outlier status	0.364***	0.708***	−0.344***	0.247***	0.530***	−0.283***	16.595***	16.612***
	[0.009]	[0.011]	[0.008]	[0.008]	[0.010]	[0.007]	[0.676]	[0.546]
Wage index	0.925***	0.940***	−0.015	0.869***	0.860***	0.009	18.921***	9.570***
	[0.035]	[0.051]	[0.050]	[0.032]	[0.044]	[0.044]	[2.067]	[1.497]
Skin failure	−0.016	−0.021	0.005	0.042*	0.062**	−0.019	5.528***	5.397***
	[0.024]	[0.026]	[0.022]	[0.024]	[0.025]	[0.019]	[1.917]	[1.390]
Ventilator <96 hours	−0.663***	−0.383***	−0.280***	−0.418***	−0.255***	−0.163***	−7.069***	−6.357***
	[0.012]	[0.016]	[0.013]	[0.016]	[0.015]	[0.011]	[1.025]	[0.648]
Ulcers	0.077***	0.039***	0.038***	0.063***	0.033**	0.031***	5.592***	3.740***
	[0.011]	[0.014]	[0.011]	[0.011]	[0.013]	[0.010]	[1.058]	[0.736]

(continued)

Appendix Table E.1 (continued)
Ventilator group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
Wound procedures	−0.239***	−0.128***	−0.111***	−0.196***	−0.116***	−0.079***	−5.809***	−4.540***
	[0.017]	[0.017]	[0.010]	[0.015]	[0.015]	[0.009]	[0.926]	[0.699]
Systemic inflammatory response syndrome (SIRS)	0.123***	0.130***	−0.007	0.088***	0.093***	−0.004	3.738***	2.838***
	[0.006]	[0.008]	[0.006]	[0.006]	[0.007]	[0.005]	[0.547]	[0.392]
Malnutrition	−0.008	0.004	−0.012	−0.014*	−0.004	−0.01	0.431	−0.023
	[0.008]	[0.010]	[0.009]	[0.007]	[0.009]	[0.007]	[0.626]	[0.433]
Other chronic ischemic disease	−0.032***	−0.059***	0.027***	−0.012	−0.032***	0.020***	−3.596***	−2.242***
	[0.010]	[0.012]	[0.008]	[0.009]	[0.011]	[0.008]	[0.798]	[0.572]
Percutaneous endoscopic gastrostomy (PEG)	−0.125***	−0.123***	−0.001	−0.089***	−0.093***	0.003	3.216***	0.148
	[0.008]	[0.009]	[0.008]	[0.007]	[0.008]	[0.007]	[0.607]	[0.442]
Critical care unit procedures	−0.148***	−0.085***	−0.062***	−0.107***	−0.059***	−0.047***	−1.764***	−1.619***
	[0.006]	[0.007]	[0.006]	[0.006]	[0.007]	[0.005]	[0.474]	[0.325]
Constant	8.347***	8.086***	0.261***	8.978***	8.858***	0.120*	−9.245**	0.991
	[0.070]	[0.089]	[0.079]	[0.061]	[0.076]	[0.068]	[4.040]	[3.144]
Observations	38,120	38,120	38,120	38,120	38,120	38,120	38,120	38,120
R-squared	0.636	0.562	0.226	0.581	0.555	0.194	0.604	0.453

NOTES: LTCH = long-term care hospital; SNF = skilled nursing facility; PAC = post-acute care. Statistically significant at *$p < .10$; **$p < .05$; ***$p < .01$. Robust standard errors in brackets.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table E.2
Infection group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
No LTCH referral group 2	0.004	0.200***	−0.196***	0.066***	0.233***	−0.167***	0.712	0.997***
	[0.006]	[0.012]	[0.011]	[0.011]	[0.014]	[0.010]	[0.677]	[0.343]
No LTCH referral group 3	−0.005	0.264***	−0.269***	0.118***	0.328***	−0.211***	1.291	0.854*
	[0.008]	[0.014]	[0.013]	[0.014]	[0.016]	[0.011]	[0.852]	[0.469]
No LTCH referral group 4	−0.008	0.313***	−0.321***	0.120***	0.353***	−0.234***	2.232**	0.886
	[0.011]	[0.018]	[0.017]	[0.017]	[0.020]	[0.014]	[1.102]	[0.667]
No LTCH referral group 5	−0.004	0.387***	−0.391***	0.064**	0.324***	−0.260***	2.205	0.418
	[0.016]	[0.026]	[0.025]	[0.028]	[0.032]	[0.022]	[1.807]	[1.066]
LTCH referral group 1	−0.005	0.029	−0.034	0.955***	0.943***	0.013	26.280***	22.148***
	[0.020]	[0.028]	[0.023]	[0.017]	[0.020]	[0.014]	[0.991]	[0.631]
LTCH referral group 2	−0.02	0.172***	−0.192***	0.882***	0.948***	−0.066***	25.226***	22.292***
	[0.015]	[0.025]	[0.022]	[0.018]	[0.021]	[0.015]	[1.066]	[0.749]
LTCH referral group 3	−0.056***	0.198***	−0.254***	0.858***	0.974***	−0.116***	26.473***	24.035***
	[0.013]	[0.023]	[0.022]	[0.019]	[0.023]	[0.015]	[1.159]	[0.839]
LTCH referral group 4	−0.057***	0.224***	−0.281***	0.858***	1.019***	−0.161***	26.638***	25.312***
	[0.014]	[0.025]	[0.022]	[0.022]	[0.025]	[0.017]	[1.499]	[1.032]
LTCH referral group 5	−0.075***	0.298***	−0.373***	0.852***	1.057***	−0.205***	28.048***	26.459***
	[0.021]	[0.037]	[0.032]	[0.034]	[0.038]	[0.024]	[2.699]	[1.738]
14 or fewer days to death	0.009	−0.072***	0.081***	−0.359***	−0.397***	0.039***	−18.081***	−11.480***
	[0.009]	[0.016]	[0.014]	[0.028]	[0.025]	[0.015]	[0.918]	[0.776]
15–21 days to death	−0.025**	0.044**	−0.069***	−0.280***	−0.130***	−0.150***	−21.227***	−11.316***
	[0.012]	[0.020]	[0.019]	[0.022]	[0.022]	[0.015]	[0.800]	[0.669]
22–28 days to death	0.002	0.062***	−0.060***	−0.195***	−0.078***	−0.117***	−21.191***	−10.380***
	[0.012]	[0.019]	[0.020]	[0.019]	[0.019]	[0.015]	[0.800]	[0.579]
Survived at least 29 days	0.019***	0.066***	−0.046***	0.369***	0.418***	−0.049***	0.237	10.483***
	[0.006]	[0.011]	[0.011]	[0.013]	[0.013]	[0.007]	[0.850]	[0.563]
Ages <65	0.018***	0.008	0.01	0.056***	0.063***	−0.007	1.661**	1.907***
	[0.007]	[0.011]	[0.010]	[0.011]	[0.013]	[0.008]	[0.763]	[0.514]

(continued)

Appendix Table E.2 (continued)
Infection group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
Ages 75–84	−0.011**	−0.046***	0.035***	−0.060***	−0.086***	0.026***	−1.244*	−1.578***
	[0.005]	[0.011]	[0.010]	[0.010]	[0.011]	[0.007]	[0.682]	[0.451]
Ages 85+	−0.016**	−0.111***	0.095***	−0.134***	−0.203***	0.070***	−5.158***	−4.108***
	[0.007]	[0.011]	[0.011]	[0.012]	[0.014]	[0.008]	[0.868]	[0.534]
MS-DRG 95	0.575***	0.518***	0.057	0.334***	0.258***	0.076	5.436	2.043
	[0.045]	[0.126]	[0.127]	[0.082]	[0.088]	[0.066]	[6.163]	[3.505]
MS-DRG 96	0.630***	0.202	0.428**	0.255**	0.036	0.219***	−7.332	−4.076
	[0.034]	[0.157]	[0.181]	[0.112]	[0.130]	[0.078]	[10.264]	[4.073]
MS-DRG 97	0.425***	0.427***	−0.002	0.343***	0.318***	0.025	8.651***	6.573***
	[0.028]	[0.052]	[0.054]	[0.044]	[0.046]	[0.034]	[3.279]	[1.961]
MS-DRG 98	0.443***	0.470***	−0.027	0.323***	0.258***	0.066	6.718	4.309
	[0.056]	[0.080]	[0.065]	[0.073]	[0.084]	[0.059]	[6.166]	[2.989]
MS-DRG 99	0.263***	0.149	0.114	0.082	0.042	0.04	−0.888	−1.695
	[0.049]	[0.129]	[0.154]	[0.111]	[0.143]	[0.108]	[4.140]	[2.451]
MS-DRG 288	0.530***	0.269***	0.261***	0.439***	0.292***	0.147***	8.731***	7.583***
	[0.018]	[0.035]	[0.033]	[0.033]	[0.039]	[0.024]	[2.450]	[1.556]
MS-DRG 289	0.412***	−0.007	0.419***	0.362***	0.144***	0.218***	−1.738	3.386*
	[0.026]	[0.043]	[0.037]	[0.046]	[0.055]	[0.033]	[2.918]	[1.952]
MS-DRG 290	0.258***	−0.181**	0.439***	0.381***	0.230***	0.151***	4.184	4.606**
	[0.054]	[0.081]	[0.054]	[0.069]	[0.088]	[0.057]	[3.714]	[2.341]
MS-DRG 485	0.583***	0.442***	0.142***	0.426***	0.374***	0.052*	7.371**	6.740***
	[0.024]	[0.038]	[0.036]	[0.042]	[0.046]	[0.027]	[3.238]	[2.190]
MS-DRG 486	0.398***	0.336***	0.062*	0.360***	0.371***	−0.011	7.519***	4.676***
	[0.021]	[0.039]	[0.038]	[0.039]	[0.048]	[0.028]	[2.624]	[1.708]
MS-DRG 487	0.284***	0.144**	0.140***	0.239***	0.189***	0.05	3.629	2.248
	[0.036]	[0.064]	[0.050]	[0.049]	[0.066]	[0.040]	[3.563]	[1.856]
MS-DRG 539	−0.018	0.033	−0.05	0.130***	0.162***	−0.032	7.739***	5.825***
	[0.019]	[0.038]	[0.035]	[0.036]	[0.040]	[0.026]	[2.517]	[1.638]

(continued)

Appendix Table E.2 (continued)
Infection group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
MS-DRG 540	−0.140***	−0.266***	0.126***	−0.002	−0.082**	0.079***	0.64	0.35
	[0.022]	[0.035]	[0.034]	[0.033]	[0.038]	[0.023]	[2.417]	[1.338]
MS-DRG 541	−0.220***	−0.495***	0.274***	−0.141**	−0.264***	0.123***	−2.576	−0.421
	[0.032]	[0.054]	[0.045]	[0.057]	[0.067]	[0.034]	[3.158]	[1.977]
MS-DRG 853	1.019***	0.599***	0.421***	0.650***	0.390***	0.261***	9.823***	7.441***
	[0.011]	[0.020]	[0.019]	[0.019]	[0.019]	[0.014]	[1.277]	[0.808]
MS-DRG 854	0.938***	0.492***	0.446***	0.558***	0.310***	0.248***	2.925	4.451***
	[0.018]	[0.029]	[0.024]	[0.023]	[0.027]	[0.020]	[1.879]	[1.169]
MS-DRG 856	0.692***	0.483***	0.209***	0.488***	0.390***	0.098***	10.327***	9.511***
	[0.031]	[0.042]	[0.037]	[0.038]	[0.047]	[0.028]	[2.881]	[2.154]
MS-DRG 857	0.459***	0.201***	0.258***	0.267***	0.106**	0.161***	−0.636	2.566
	[0.022]	[0.043]	[0.037]	[0.037]	[0.046]	[0.028]	[2.699]	[1.821]
MS-DRG 858	0.349***	0.009	0.340***	0.258***	0.026	0.233***	4.22	4.87
	[0.043]	[0.069]	[0.048]	[0.084]	[0.120]	[0.060]	[5.006]	[3.795]
MS-DRG 870	1.088***	0.539***	0.548***	0.724***	0.370***	0.354***	8.664***	6.380***
	[0.020]	[0.028]	[0.026]	[0.029]	[0.030]	[0.020]	[2.130]	[1.411]
MS-DRG 871	0.067***	0.182***	−0.115***	0.093***	0.126***	−0.033***	3.774***	2.143***
	[0.008]	[0.017]	[0.016]	[0.015]	[0.016]	[0.010]	[0.960]	[0.626]
MS-DRG 94	0.685***	0.377***	0.308***	0.515***	0.310***	0.205***	12.254***	8.920***
	[0.021]	[0.044]	[0.043]	[0.046]	[0.049]	[0.029]	[3.531]	[2.171]
Acute referral without LTCH	−0.065***	−0.030*	−0.035**	0.487***	0.453***	0.034**	5.894***	7.601***
	[0.011]	[0.015]	[0.014]	[0.016]	[0.020]	[0.014]	[0.877]	[0.567]
Acute referral with LTCH	−0.154***	−0.112**	−0.043	1.204***	1.241***	−0.038	48.076***	43.672***
	[0.034]	[0.048]	[0.040]	[0.054]	[0.057]	[0.028]	[3.910]	[2.791]
SNF first PAC	−0.016**	0.016	−0.033**	−0.325***	−0.320***	−0.005	−24.677***	−15.065***
	[0.007]	[0.013]	[0.013]	[0.015]	[0.016]	[0.010]	[1.222]	[0.636]
IRF first PAC	−0.006	0.094***	−0.099***	0.592***	0.543***	0.049**	14.599***	15.211***
	[0.018]	[0.033]	[0.031]	[0.025]	[0.030]	[0.021]	[1.887]	[1.158]

(continued)

Appendix Table E.2 (continued)
Infection group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
Any SNF claims	−0.009	−0.004	−0.005	0.347***	0.369***	−0.022***	74.915***	17.475***
	[0.006]	[0.011]	[0.011]	[0.013]	[0.013]	[0.007]	[1.093]	[0.568]
Log beds	0.029*	0.056***	−0.027*	0.055***	0.070***	−0.015*	2.136***	1.635***
	[0.017]	[0.019]	[0.016]	[0.011]	[0.013]	[0.009]	[0.442]	[0.306]
Case mix index	0.052	0.228***	−0.176***	−0.021	0.105***	−0.126***	−3.799**	−2.927***
	[0.033]	[0.057]	[0.050]	[0.033]	[0.037]	[0.031]	[1.708]	[1.043]
Urban	−0.027**	−0.025	−0.003	0.040***	0.045**	−0.005	−0.4	0.738
	[0.011]	[0.025]	[0.025]	[0.015]	[0.021]	[0.017]	[0.806]	[0.497]
Medicare outlier status	0.417***	0.680***	−0.263***	0.247***	0.455***	−0.208***	8.576***	9.450***
	[0.013]	[0.015]	[0.014]	[0.017]	[0.017]	[0.011]	[1.072]	[0.781]
Wage index	0.821***	0.887***	−0.066	0.837***	0.830***	0.007	10.696***	6.437***
	[0.030]	[0.060]	[0.059]	[0.036]	[0.044]	[0.042]	[2.077]	[1.272]
Acute renal failure	0.015***	0.034***	−0.020**	−0.007	−0.001	−0.006	−0.457	−0.153
	[0.005]	[0.009]	[0.009]	[0.009]	[0.009]	[0.006]	[0.651]	[0.418]
Ventilator 96+ hours	0.047***	−0.001	0.048***	0.111***	0.051**	0.060***	0.256	−0.471
	[0.016]	[0.022]	[0.018]	[0.023]	[0.024]	[0.015]	[1.756]	[1.152]
Ulcers	0	−0.171***	0.171***	0.072***	−0.034**	0.106***	7.498***	3.369***
	[0.006]	[0.011]	[0.010]	[0.013]	[0.015]	[0.008]	[0.782]	[0.610]
1–4 organ failures	0.007	0.077***	−0.070***	0.006	0.066***	−0.060***	0.34	0.115
	[0.006]	[0.012]	[0.011]	[0.010]	[0.012]	[0.008]	[0.738]	[0.441]
5–7 organ failures	0.036	0.107***	−0.071**	−0.039	0.01	−0.049*	−4.393*	−4.640***
	[0.034]	[0.032]	[0.036]	[0.038]	[0.037]	[0.028]	[2.479]	[1.409]
Sepsis	0.005	0.031	−0.025	0.043**	0.067***	−0.024*	3.193**	2.106**
	[0.011]	[0.021]	[0.019]	[0.018]	[0.021]	[0.013]	[1.444]	[0.907]
Nosocomial pneumonia	0.021*	0.022	−0.001	0.044**	0.018	0.026**	0.097	0.279
	[0.011]	[0.018]	[0.016]	[0.020]	[0.021]	[0.013]	[1.589]	[0.974]
Systemic inflammatory response syndrome (SIRS)	−0.029***	−0.103***	0.074***	−0.033***	−0.075***	0.041***	−2.846***	−1.835***
	[0.006]	[0.012]	[0.010]	[0.010]	[0.010]	[0.007]	[0.694]	[0.434]

(continued)

Appendix Table E.2 (continued)
Infection group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
Malnutrition	0.006	−0.005	0.011	−0.008	−0.013	0.005	1.348*	−0.335
	[0.006]	[0.012]	[0.011]	[0.012]	[0.013]	[0.008]	[0.786]	[0.523]
Cardiac dysrhythmias	−0.014***	0.038***	−0.052***	−0.01	0.024**	−0.034***	−0.103	−0.453
	[0.005]	[0.010]	[0.009]	[0.009]	[0.010]	[0.006]	[0.627]	[0.393]
Other bacterial infection	−0.01	−0.075***	0.065***	−0.019	−0.064***	0.045***	0.268	−0.213
	[0.006]	[0.014]	[0.012]	[0.012]	[0.014]	[0.008]	[0.797]	[0.526]
Percutaneous endoscopic gastrostomy (PEG)	0.064***	0.182***	−0.118***	0.015	0.064***	−0.050***	9.968***	3.177***
	[0.011]	[0.019]	[0.019]	[0.021]	[0.021]	[0.013]	[1.513]	[1.038]
6–10 critical care days	0.082***	0.405***	−0.323***	0.025**	0.207***	−0.182***	0.371	0.501
	[0.008]	[0.013]	[0.012]	[0.011]	[0.012]	[0.009]	[0.821]	[0.513]
11–15 critical care days	0.165***	0.678***	−0.512***	0.039**	0.339***	−0.300***	4.131***	2.561***
	[0.012]	[0.018]	[0.017]	[0.017]	[0.017]	[0.013]	[1.137]	[0.701]
16–20 critical care days	0.210***	0.765***	−0.555***	0.029	0.358***	−0.329***	4.648***	5.187***
	[0.015]	[0.022]	[0.021]	[0.021]	[0.020]	[0.015]	[1.472]	[0.935]
21+ critical care days	0.371***	0.814***	−0.442***	0.088***	0.385***	−0.297***	11.228***	10.675***
	[0.021]	[0.024]	[0.026]	[0.026]	[0.025]	[0.018]	[1.813]	[1.206]
Dialysis	0.021**	0.130***	−0.108***	0.051***	0.127***	−0.075***	3.055***	2.449***
	[0.010]	[0.015]	[0.015]	[0.015]	[0.015]	[0.010]	[1.055]	[0.693]
Constant	8.091***	7.420***	0.671***	8.358***	7.955***	0.403***	−7.590**	−1.187
	[0.072]	[0.099]	[0.087]	[0.057]	[0.070]	[0.059]	[3.459]	[2.169]
Observations	29,763	29,763	29,763	29,763	29,763	29,763	29,763	29,763
R-squared	0.818	0.665	0.365	0.642	0.599	0.248	0.57	0.487

NOTES: LTCH = long-term care hospital; MS-DRG = Medicare severity diagnosis related group; SNF = skilled nursing facility; PAC = post-acute care. Statistically significant at *$p < .10$; **$p < .05$; ***$p < .01$. Robust standard errors in brackets.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table E.3
Aftercare, wound, and skin care group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
No LTCH referral group 2	−0.291***	−0.270***	−0.021*	−0.138***	−0.108***	−0.030***	6.027***	2.013***
	[0.014]	[0.018]	[0.012]	[0.015]	[0.019]	[0.011]	[0.697]	[0.383]
No LTCH referral group 3	−0.271***	−0.239***	−0.032**	−0.101***	−0.065***	−0.036***	9.148***	3.443***
	[0.014]	[0.019]	[0.013]	[0.017]	[0.020]	[0.012]	[0.801]	[0.438]
No LTCH referral group 4	−0.212***	−0.114***	−0.098***	−0.002	0.085***	−0.087***	13.964***	6.324***
	[0.016]	[0.020]	[0.015]	[0.019]	[0.021]	[0.014]	[0.958]	[0.566]
No LTCH referral group 5	−0.199***	0.047	−0.246***	0.029	0.244***	−0.216***	21.167***	9.665***
	[0.026]	[0.030]	[0.025]	[0.031]	[0.032]	[0.022]	[1.814]	[1.111]
LTCH referral group 1	0.031	0.157***	−0.126***	0.750***	0.788***	−0.038**	28.296***	24.057***
	[0.021]	[0.029]	[0.020]	[0.020]	[0.023]	[0.015]	[1.174]	[0.785]
LTCH referral group 2	−0.313***	−0.220***	−0.092***	0.715***	0.746***	−0.031**	34.657***	26.070***
	[0.026]	[0.036]	[0.022]	[0.021]	[0.025]	[0.015]	[1.348]	[0.927]
LTCH referral group 3	−0.376***	−0.288***	−0.088***	0.736***	0.764***	−0.028*	34.517***	28.457***
	[0.026]	[0.034]	[0.021]	[0.022]	[0.027]	[0.015]	[1.266]	[0.901]
LTCH referral group 4	−0.303***	−0.209***	−0.094***	0.808***	0.828***	−0.02	39.270***	32.345***
	[0.025]	[0.034]	[0.024]	[0.024]	[0.029]	[0.016]	[1.420]	[1.032]
LTCH referral group 5	−0.266***	−0.066	−0.200***	0.752***	0.803***	−0.051**	40.240***	32.521***
	[0.039]	[0.046]	[0.042]	[0.042]	[0.048]	[0.024]	[2.851]	[2.285]
14 or fewer days to death	0.104***	0.152***	−0.048**	−0.219***	−0.157***	−0.062***	−17.964***	−13.320***
	[0.034]	[0.044]	[0.024]	[0.040]	[0.043]	[0.023]	[1.101]	[0.856]
15–21 days to death	0.094***	0.164***	−0.070***	−0.191***	−0.062	−0.128***	−20.520***	−13.764***
	[0.034]	[0.044]	[0.027]	[0.036]	[0.039]	[0.023]	[1.039]	[0.811]
22–28 days to death	0.036	0.178***	−0.143***	−0.169***	0.009	−0.179***	−20.435***	−13.112***
	[0.036]	[0.042]	[0.031]	[0.031]	[0.033]	[0.021]	[0.871]	[0.738]
Survived at least 29 days	0.075***	0.102***	−0.026*	0.307***	0.364***	−0.058***	−1.213	8.151***
	[0.016]	[0.021]	[0.014]	[0.016]	[0.017]	[0.009]	[1.069]	[0.712]
Acute referral without LTCH	0.065***	0.152***	−0.088***	0.467***	0.452***	0.015	7.464***	9.925***
	[0.021]	[0.028]	[0.019]	[0.025]	[0.029]	[0.018]	[1.317]	[0.993]

(continued)

Appendix Table E.3 (continued)
Aftercare, wound, and skin care group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
Acute referral with LTCH	−0.046	0.001	−0.046	1.175***	1.241***	−0.065	41.956***	39.227***
	[0.090]	[0.111]	[0.085]	[0.101]	[0.109]	[0.050]	[4.563]	[3.609]
SNF first PAC	0.006	0.063***	−0.057***	−0.304***	−0.275***	−0.029**	−21.965***	−14.305***
	[0.019]	[0.024]	[0.016]	[0.020]	[0.023]	[0.012]	[1.382]	[0.822]
IRF first PAC	0.232***	0.355***	−0.123***	0.681***	0.662***	0.018	15.628***	16.472***
	[0.040]	[0.042]	[0.030]	[0.033]	[0.037]	[0.021]	[1.966]	[1.425]
Any SNF claims	−0.043**	−0.047**	0.004	0.335***	0.343***	−0.008	74.450***	16.784***
	[0.017]	[0.022]	[0.013]	[0.016]	[0.017]	[0.008]	[1.274]	[0.786]
Log beds	0.042***	0.034	0.008	0.047***	0.049***	−0.002	2.104***	1.730***
	[0.016]	[0.021]	[0.014]	[0.012]	[0.014]	[0.010]	[0.631]	[0.445]
Case mix index	0.139***	0.347***	−0.208***	0.072*	0.222***	−0.150***	−4.612**	−1.313
	[0.043]	[0.062]	[0.049]	[0.039]	[0.051]	[0.033]	[1.855]	[1.413]
Urban	−0.002	0.029	−0.031	−0.011	0.001	−0.012	2.246**	0.88
	[0.020]	[0.031]	[0.024]	[0.021]	[0.032]	[0.020]	[1.048]	[0.652]
Medicare outlier status	1.064***	1.485***	−0.421***	0.585***	0.897***	−0.313***	16.464***	17.607***
	[0.017]	[0.017]	[0.011]	[0.015]	[0.016]	[0.008]	[0.956]	[0.665]
Wage index	0.879***	1.056***	−0.177***	0.788***	0.881***	−0.093**	5.212**	3.750**
	[0.046]	[0.067]	[0.052]	[0.045]	[0.059]	[0.040]	[2.291]	[1.531]
Cellulitis	−0.250***	−0.316***	0.066***	−0.184***	−0.225***	0.040***	−3.889***	−2.917***
	[0.013]	[0.019]	[0.012]	[0.013]	[0.015]	[0.008]	[0.837]	[0.538]
Malnutrition	0.087***	0.119***	−0.031**	0.01	0.033**	−0.023***	0.224	−0.522
	[0.015]	[0.020]	[0.013]	[0.013]	[0.015]	[0.009]	[0.865]	[0.574]
Constant	8.447***	7.928***	0.518***	8.832***	8.460***	0.372***	0.197	2.818
	[0.072]	[0.107]	[0.080]	[0.064]	[0.086]	[0.057]	[3.496]	[2.373]
Observations	18,480	18,480	18,480	18,480	18,480	18,480	18,480	18,480
R-squared	0.458	0.479	0.147	0.511	0.5	0.135	0.559	0.458

NOTES: LTCH = long-term care hospital; SNF = skilled nursing facility; PAC = post-acute care. Statistically significant at *$p < .10$; **$p < .05$; ***$p < .01$. Robust standard errors in brackets.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table E.4
Complex rehabilitation group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
No LTCH referral group 2	0.025	0.087***	−0.062**	0.074**	0.122***	−0.048*	4.615***	1.990***
	[0.019]	[0.029]	[0.028]	[0.033]	[0.041]	[0.027]	[1.586]	[0.761]
No LTCH referral group 3	0.106***	0.234***	−0.128***	0.135***	0.235***	−0.099***	7.836***	4.465***
	[0.020]	[0.030]	[0.028]	[0.032]	[0.039]	[0.027]	[1.775]	[0.893]
No LTCH referral group 4	0.096***	0.296***	−0.200***	0.174***	0.344***	−0.170***	9.849***	6.611***
	[0.023]	[0.036]	[0.033]	[0.039]	[0.048]	[0.031]	[2.025]	[1.031]
No LTCH referral group 5	0.182***	0.556***	−0.375***	0.233***	0.544***	−0.311***	14.255***	10.643***
	[0.046]	[0.058]	[0.048]	[0.061]	[0.068]	[0.041]	[3.349]	[1.861]
LTCH referral group 1	0.046	0.221***	−0.175***	1.175***	1.305***	−0.130***	35.242***	32.141***
	[0.034]	[0.053]	[0.045]	[0.044]	[0.052]	[0.030]	[2.717]	[1.775]
LTCH referral group 2	0.053**	0.349***	−0.296***	1.231***	1.444***	−0.213***	38.163***	37.126***
	[0.026]	[0.050]	[0.044]	[0.041]	[0.048]	[0.029]	[2.447]	[1.740]
LTCH referral group 3	0.076***	0.368***	−0.292***	1.194***	1.365***	−0.171***	38.713***	35.051***
	[0.028]	[0.045]	[0.042]	[0.043]	[0.048]	[0.030]	[2.471]	[1.716]
LTCH referral group 4	0.154***	0.425***	−0.271***	1.248***	1.373***	−0.125***	41.417***	35.618***
	[0.033]	[0.052]	[0.044]	[0.048]	[0.055]	[0.032]	[3.064]	[1.903]
LTCH referral group 5	0.133*	0.629***	−0.496***	1.209***	1.483***	−0.274***	44.456***	42.200***
	[0.069]	[0.087]	[0.087]	[0.098]	[0.114]	[0.060]	[6.731]	[4.969]
14 or fewer days to death	0.198***	0.255***	−0.057	−0.305**	−0.195	−0.11	−14.682***	−12.954***
	[0.050]	[0.097]	[0.088]	[0.124]	[0.157]	[0.082]	[3.417]	[3.008]
15–21 days to death	0.055	0.229*	−0.174*	−0.259**	−0.062	−0.198**	−23.569***	−14.701***
	[0.086]	[0.132]	[0.102]	[0.106]	[0.114]	[0.089]	[3.236]	[2.893]
22–28 days to death	0.014	0.322***	−0.309***	−0.258**	0.084	−0.342***	−19.628***	−9.856***
	[0.073]	[0.069]	[0.059]	[0.102]	[0.120]	[0.062]	[3.286]	[2.381]
Survived at least 29 days	0.111***	0.145***	−0.034	0.381***	0.422***	−0.041*	9.363***	14.012***
	[0.031]	[0.043]	[0.034]	[0.043]	[0.046]	[0.024]	[3.136]	[2.267]
Acute referral without LTCH	0.120***	0.318***	−0.197***	0.795***	0.731***	0.064*	19.564***	15.945***
	[0.027]	[0.042]	[0.035]	[0.039]	[0.049]	[0.035]	[2.594]	[1.565]

(continued)

Appendix Table E.4 (continued)
Complex rehabilitation group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
Acute referral with LTCH	0.018	0.343***	−0.325***	1.364***	1.502***	−0.138	60.881***	52.159***
	[0.079]	[0.128]	[0.109]	[0.093]	[0.102]	[0.090]	[8.511]	[6.172]
SNF first PAC	−0.035	0.072*	−0.107***	−0.099**	0.02	−0.119***	−16.024***	−9.260***
	[0.024]	[0.041]	[0.036]	[0.039]	[0.047]	[0.027]	[2.855]	[1.580]
IRF first PAC	0.083*	0.334***	−0.252***	0.884***	0.905***	−0.021	17.296***	18.470***
	[0.045]	[0.058]	[0.052]	[0.045]	[0.058]	[0.038]	[3.144]	[2.047]
Any SNF claims	0.059***	0.119***	−0.060**	0.328***	0.368***	−0.040**	71.729***	14.017***
	[0.020]	[0.034]	[0.030]	[0.030]	[0.035]	[0.019]	[2.554]	[1.545]
Case mix index	0.248***	0.456***	−0.208***	0.267***	0.406***	−0.139***	8.575**	5.560***
	[0.039]	[0.065]	[0.057]	[0.052]	[0.062]	[0.039]	[3.535]	[2.012]
Urban	0.022	0.101***	−0.080**	−0.013	0.047	−0.060**	−0.613	0.57
	[0.022]	[0.039]	[0.037]	[0.041]	[0.047]	[0.029]	[1.978]	[1.330]
Medicare outlier status	0.810***	1.244***	−0.434***	0.458***	0.760***	−0.302***	21.979***	17.895***
	[0.040]	[0.035]	[0.032]	[0.040]	[0.044]	[0.022]	[3.004]	[2.019]
Wage index	0.943***	1.154***	−0.211***	0.765***	0.910***	−0.145**	5.279	0.986
	[0.064]	[0.089]	[0.075]	[0.075]	[0.091]	[0.063]	[5.101]	[2.958]
Malnutrition	0.090***	0.104**	−0.013	0.002	0.012	−0.01	1.939	−1.946
	[0.026]	[0.043]	[0.044]	[0.043]	[0.047]	[0.028]	[3.222]	[1.760]
Dialysis	0.022	0.117***	−0.095***	0.091*	0.176***	−0.085***	2.672	2.797
	[0.026]	[0.043]	[0.036]	[0.047]	[0.050]	[0.023]	[2.976]	[2.138]
Constant	7.932***	7.177***	0.754***	8.328***	7.780***	0.549***	−12.668*	−2.095
	[0.088]	[0.132]	[0.112]	[0.119]	[0.137]	[0.084]	[7.513]	[4.380]
Observations	3,616	3,616	3,616	3,616	3,616	3,616	3,616	3,616
R-squared	0.456	0.476	0.174	0.608	0.577	0.14	0.615	0.551

NOTES: LTCH = long-term care hospital; SNF = skilled nursing facility; PAC = post-acute care. Statistically significant at *$p < .10$; **$p < .05$; ***$p < .01$. Robust standard errors in brackets.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table E.5
Pneumonia group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
No LTCH referral group 2	0.014*	0.181***	−0.167***	0.048**	0.183***	−0.135***	1.385	1.301***
	[0.008]	[0.023]	[0.023]	[0.024]	[0.032]	[0.022]	[1.059]	[0.498]
No LTCH referral group 3	0.047***	0.310***	−0.263***	0.092***	0.305***	−0.213***	2.100**	2.468***
	[0.009]	[0.024]	[0.023]	[0.025]	[0.032]	[0.022]	[1.038]	[0.517]
No LTCH referral group 4	0.079***	0.572***	−0.494***	0.157***	0.567***	−0.410***	5.180***	4.588***
	[0.011]	[0.026]	[0.026]	[0.027]	[0.034]	[0.025]	[1.159]	[0.570]
No LTCH referral group 5	0.139***	0.842***	−0.703***	0.208***	0.818***	−0.610***	10.386***	7.452***
	[0.021]	[0.041]	[0.042]	[0.048]	[0.052]	[0.041]	[2.215]	[1.083]
LTCH referral group 1	0.02	0.137***	−0.118***	1.315***	1.287***	0.029	24.855***	21.763***
	[0.020]	[0.042]	[0.042]	[0.049]	[0.052]	[0.031]	[2.282]	[1.447]
LTCH referral group 2	0.055***	0.332***	−0.277***	1.391***	1.417***	−0.026	30.193***	25.362***
	[0.016]	[0.044]	[0.042]	[0.039]	[0.044]	[0.027]	[2.222]	[1.321]
LTCH referral group 3	0.050***	0.476***	−0.426***	1.312***	1.390***	−0.078***	25.394***	22.103***
	[0.019]	[0.050]	[0.046]	[0.041]	[0.040]	[0.029]	[1.812]	[1.113]
LTCH referral group 4	0.111***	0.597***	−0.486***	1.524***	1.543***	−0.02	32.709***	28.855***
	[0.019]	[0.050]	[0.047]	[0.046]	[0.048]	[0.030]	[2.579]	[1.809]
LTCH referral group 5	0.093***	0.686***	−0.593***	1.356***	1.444***	−0.087*	27.121***	26.649***
	[0.035]	[0.073]	[0.075]	[0.099]	[0.088]	[0.053]	[4.891]	[2.992]
14 or fewer days to death	−0.031*	−0.088*	0.057	−0.399***	−0.354***	−0.045	−12.581***	−8.066***
	[0.018]	[0.046]	[0.040]	[0.040]	[0.041]	[0.032]	[1.174]	[0.959]
15–21 days to death	0.03	0.171***	−0.142**	−0.387***	−0.134***	−0.252***	−15.963***	−9.635***
	[0.023]	[0.062]	[0.056]	[0.043]	[0.050]	[0.043]	[1.172]	[1.020]
22–28 days to death	−0.007	−0.032	0.024	−0.095**	0.016	−0.111**	−13.886***	−5.637***
	[0.023]	[0.078]	[0.078]	[0.042]	[0.044]	[0.047]	[1.125]	[0.857]
Survived at least 29 days	0.007	0.090***	−0.083***	0.562***	0.595***	−0.033*	4.097**	13.365***
	[0.011]	[0.028]	[0.028]	[0.027]	[0.029]	[0.018]	[1.756]	[1.127]
Acute referral without LTCH	−0.008	0.07	−0.078*	0.741***	0.622***	0.120***	5.517***	6.498***
	[0.019]	[0.044]	[0.044]	[0.047]	[0.052]	[0.039]	[1.986]	[1.192]

(continued)

Appendix Table E.5 (continued)
Pneumonia group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
Acute referral with LTCH	−0.074	−0.074	−0.001	1.863***	1.589***	0.274*	44.053***	46.748***
	[0.100]	[0.188]	[0.197]	[0.209]	[0.220]	[0.159]	[11.678]	[11.240]
SNF first PAC	−0.003	0.152***	−0.156***	−0.318***	−0.206***	−0.111***	−19.912***	−11.917***
	[0.014]	[0.036]	[0.034]	[0.043]	[0.045]	[0.026]	[2.391]	[1.277]
IRF first PAC	−0.019	0.352***	−0.371***	1.157***	0.999***	0.157**	16.380***	17.613***
	[0.028]	[0.113]	[0.106]	[0.096]	[0.112]	[0.061]	[5.055]	[3.717]
Any SNF claims	−0.004	−0.068**	0.064**	0.407***	0.362***	0.044**	64.119***	13.412***
	[0.013]	[0.033]	[0.030]	[0.039]	[0.038]	[0.021]	[2.308]	[1.257]
Log beds	0.007	−0.007	0.014	0.023	0.037**	−0.014	0.798	−0.084
	[0.012]	[0.027]	[0.024]	[0.019]	[0.017]	[0.014]	[1.034]	[0.594]
Log resident ratio	0.627***	0.367**	0.261*	0.265	0.03	0.235	−0.112	0.162
	[0.057]	[0.149]	[0.157]	[0.176]	[0.127]	[0.148]	[6.280]	[4.363]
Urban	−0.047***	−0.032	−0.015	−0.023	−0.054	0.031	1.537	0.26
	[0.017]	[0.050]	[0.054]	[0.032]	[0.040]	[0.028]	[1.582]	[0.929]
Medicare outlier status	0.560***	1.101***	−0.541***	0.277***	0.628***	−0.351***	12.217***	12.038***
	[0.048]	[0.039]	[0.054]	[0.075]	[0.063]	[0.042]	[3.320]	[3.104]
Wage index	0.747***	0.716***	0.031	0.802***	0.763***	0.038	4.177	5.149*
	[0.048]	[0.104]	[0.105]	[0.088]	[0.096]	[0.074]	[4.619]	[2.770]
Other pulmonary disease	0.014	0.034	−0.021	0.083**	0.090**	−0.007	−1.723	−0.508
	[0.013]	[0.042]	[0.039]	[0.038]	[0.041]	[0.027]	[1.893]	[1.055]
Constant	7.939***	8.052***	−0.113	8.035***	8.044***	−0.009	−1.782	2.74
	[0.074]	[0.164]	[0.138]	[0.123]	[0.128]	[0.092]	[6.275]	[3.518]
Observations	5,323	5,323	5,323	5,323	5,323	5,323	5,323	5,323
R-squared	0.4	0.266	0.161	0.705	0.604	0.168	0.586	0.508

NOTES: LTCH = long-term care hospital; SNF = skilled nursing facility; PAC = post-acute care. Statistically significant at *$p < .10$; **$p < .05$; ***$p < .01$. Robust standard errors in brackets.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table E.6
Heart failure group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
No LTCH referral group 2	0.017	0.126***	−0.109***	−0.029	0.078*	−0.107***	1.245	1.420*
	[0.011]	[0.030]	[0.030]	[0.033]	[0.040]	[0.027]	[1.306]	[0.726]
No LTCH referral group 3	0.023**	0.289***	−0.266***	0.073**	0.295***	−0.221***	5.615***	4.922***
	[0.010]	[0.032]	[0.032]	[0.036]	[0.043]	[0.027]	[1.524]	[0.873]
No LTCH referral group 4	0.044***	0.495***	−0.451***	0.056	0.422***	−0.366***	5.674***	5.688***
	[0.013]	[0.038]	[0.037]	[0.039]	[0.047]	[0.032]	[1.697]	[0.947]
No LTCH referral group 5	0.062**	0.774***	−0.712***	0.169***	0.738***	−0.569***	8.954***	9.959***
	[0.025]	[0.054]	[0.059]	[0.065]	[0.068]	[0.054]	[2.937]	[1.624]
LTCH referral group 1	0.055***	0.241***	−0.186***	1.180***	1.184***	−0.004	24.368***	23.360***
	[0.019]	[0.056]	[0.059]	[0.048]	[0.063]	[0.038]	[3.573]	[2.054]
LTCH referral group 2	0.048**	0.276***	−0.228***	1.157***	1.148***	0.009	23.455***	22.347***
	[0.020]	[0.068]	[0.065]	[0.055]	[0.057]	[0.039]	[3.297]	[1.805]
LTCH referral group 3	0.049***	0.409***	−0.360***	1.251***	1.264***	−0.013	33.863***	27.450***
	[0.018]	[0.054]	[0.050]	[0.058]	[0.063]	[0.036]	[3.415]	[2.382]
LTCH referral group 4	0.060***	0.686***	−0.626***	1.233***	1.384***	−0.150***	32.644***	29.481***
	[0.023]	[0.058]	[0.059]	[0.066]	[0.064]	[0.036]	[3.557]	[2.431]
LTCH referral group 5	0.202***	0.935***	−0.733***	1.168***	1.418***	−0.250***	46.262***	30.387***
	[0.067]	[0.115]	[0.130]	[0.125]	[0.107]	[0.078]	[8.548]	[4.203]
14 or fewer days to death	0.002	−0.059	0.061	−0.490***	−0.414***	−0.076*	−15.807***	−11.909***
	[0.020]	[0.055]	[0.052]	[0.051]	[0.064]	[0.041]	[1.954]	[1.432]
15–21 days to death	−0.004	0.086	−0.091	−0.514***	−0.249***	−0.265***	−17.536***	−11.555***
	[0.023]	[0.069]	[0.076]	[0.051]	[0.064]	[0.052]	[1.731]	[1.250]
22–28 days to death	−0.045	0.144*	−0.189**	−0.192***	0.044	−0.236***	−16.562***	−7.586***
	[0.028]	[0.076]	[0.075]	[0.074]	[0.047]	[0.062]	[1.797]	[1.265]
Survived at least 29 days	0.023*	0.074**	−0.051	0.521***	0.549***	−0.028	4.740**	11.681***
	[0.012]	[0.035]	[0.034]	[0.038]	[0.041]	[0.021]	[2.286]	[1.513]
MS-DRG 291	0.071***	0.173***	−0.102***	0.051*	0.085***	−0.033**	1.614	−0.02
	[0.008]	[0.027]	[0.028]	[0.028]	[0.029]	[0.017]	[1.386]	[0.919]

(continued)

Appendix Table E.6 (continued)
Heart failure group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
Acute referral without LTCH	−0.008	0.077	−0.086*	0.759***	0.607***	0.152***	4.693**	6.042***
	[0.019]	[0.049]	[0.048]	[0.054]	[0.065]	[0.045]	[2.322]	[1.434]
Acute referral with LTCH	0.041	0.365**	−0.324***	1.980***	1.894***	0.086	41.563***	48.160***
	[0.119]	[0.155]	[0.124]	[0.224]	[0.295]	[0.148]	[13.208]	[8.261]
SNF first PAC	0.018	0.178***	−0.160***	−0.385***	−0.305***	−0.080***	−22.996***	−15.376***
	[0.015]	[0.044]	[0.041]	[0.045]	[0.051]	[0.029]	[3.212]	[1.861]
IRF first PAC	−0.048	0.158	−0.207*	0.809***	0.601***	0.208***	4.789	8.777***
	[0.035]	[0.119]	[0.112]	[0.102]	[0.122]	[0.062]	[5.556]	[3.178]
Any SNF claims	−0.023*	−0.065*	0.043	0.441***	0.439***	0.001	68.956***	17.180***
	[0.013]	[0.038]	[0.036]	[0.040]	[0.044]	[0.021]	[3.069]	[1.856]
Log resident ratio	0.556***	−0.033	0.589***	0.486***	0.09	0.396***	8.272	5.603
	[0.051]	[0.150]	[0.164]	[0.139]	[0.174]	[0.099]	[5.050]	[3.569]
Case mix index	0.003	0.180***	−0.177**	0.137*	0.231**	−0.094*	4.008	2.259
	[0.029]	[0.069]	[0.069]	[0.072]	[0.090]	[0.050]	[3.182]	[2.658]
Medicare outlier status	0.635***	1.038***	−0.402***	0.300***	0.636***	−0.336***	11.170**	9.643***
	[0.055]	[0.053]	[0.076]	[0.085]	[0.071]	[0.046]	[4.848]	[2.764]
Wage index	0.735***	0.841***	−0.106	0.562***	0.638***	−0.076	−7.311	−6.131*
	[0.053]	[0.116]	[0.134]	[0.098]	[0.131]	[0.091]	[5.159]	[3.292]
Malnutrition	0.005	−0.078	0.083	−0.038	−0.07	0.032	−1.249	−3.584
	[0.021]	[0.058]	[0.055]	[0.052]	[0.060]	[0.035]	[3.843]	[2.560]
Cardiac dysrhythmias	−0.019**	0.074***	−0.093***	−0.082***	−0.028	−0.054***	−3.810***	−2.092**
	[0.008]	[0.025]	[0.026]	[0.022]	[0.025]	[0.017]	[1.452]	[0.884]
Constant	7.954***	7.549***	0.404**	8.363***	8.150***	0.213*	9.96	11.816**
	[0.070]	[0.177]	[0.188]	[0.136]	[0.172]	[0.121]	[7.163]	[4.793]
Observations	3741	3741	3741	3741	3741	3741	3741	3741
R-squared	0.468	0.335	0.198	0.634	0.541	0.18	0.547	0.458

NOTES: LTCH = long-term care hospital; MS-DRG = Medicare severity diagnosis related group; SNF = skilled nursing facility; PAC = post-acute care. Statistically significant at *$p < .10$; **$p < .05$; ***$p < .01$. Robust standard errors in brackets.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table E.7
Chronic obstructive pulmonary disease/other respiratory failure group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
No LTCH referral group 2	0.177***	0.198***	−0.021	0.165***	0.180***	−0.015	1.023	1.149**
	[0.010]	[0.021]	[0.022]	[0.024]	[0.029]	[0.020]	[0.897]	[0.503]
No LTCH referral group 3	0.273***	0.414***	−0.141***	0.270***	0.388***	−0.118***	2.257**	2.713***
	[0.011]	[0.023]	[0.025]	[0.024]	[0.029]	[0.021]	[0.981]	[0.569]
No LTCH referral group 4	0.298***	0.691***	−0.393***	0.303***	0.623***	−0.320***	5.165***	5.255***
	[0.013]	[0.027]	[0.031]	[0.027]	[0.032]	[0.024]	[1.162]	[0.658]
No LTCH referral group 5	0.422***	1.003***	−0.581***	0.415***	0.876***	−0.461***	7.363***	7.814***
	[0.041]	[0.043]	[0.047]	[0.051]	[0.046]	[0.041]	[2.084]	[1.147]
LTCH referral group 1	0.031*	0.141***	−0.110**	1.238***	1.146***	0.092***	23.439***	19.918***
	[0.017]	[0.041]	[0.044]	[0.035]	[0.038]	[0.024]	[1.682]	[0.995]
LTCH referral group 2	0.186***	0.213***	−0.028	1.336***	1.222***	0.114***	22.344***	20.764***
	[0.018]	[0.052]	[0.056]	[0.039]	[0.041]	[0.028]	[1.853]	[1.168]
LTCH referral group 3	0.283***	0.441***	−0.158***	1.376***	1.306***	0.070**	23.061***	22.049***
	[0.020]	[0.047]	[0.055]	[0.035]	[0.039]	[0.027]	[1.759]	[1.248]
LTCH referral group 4	0.278***	0.698***	−0.419***	1.360***	1.399***	−0.039	26.865***	24.370***
	[0.020]	[0.052]	[0.059]	[0.041]	[0.044]	[0.030]	[1.803]	[1.438]
LTCH referral group 5	0.333***	0.899***	−0.566***	1.311***	1.432***	−0.122*	27.426***	20.771***
	[0.042]	[0.120]	[0.144]	[0.077]	[0.071]	[0.073]	[3.530]	[2.363]
14 or fewer days to death	0.034**	−0.073**	0.107***	−0.444***	−0.425***	−0.019	−13.166***	−9.861***
	[0.015]	[0.032]	[0.036]	[0.031]	[0.031]	[0.027]	[0.873]	[0.781]
15–21 days to death	0.009	0.082	−0.074	−0.342***	−0.114***	−0.227***	−13.703***	−8.198***
	[0.025]	[0.063]	[0.063]	[0.045]	[0.038]	[0.041]	[1.341]	[0.817]
22–28 days to death	0.049*	0.191**	−0.142*	0.033	0.147***	−0.115**	−12.066***	−4.118***
	[0.029]	[0.075]	[0.081]	[0.049]	[0.045]	[0.045]	[1.724]	[0.837]
Survived at least 29 days	0.008	0.156***	−0.148***	0.577***	0.641***	−0.064***	8.143***	15.929***
	[0.014]	[0.028]	[0.032]	[0.027]	[0.028]	[0.018]	[1.966]	[1.100]

(continued)

Appendix Table E.7 (continued)
Chronic obstructive pulmonary disease/other respiratory failure group: Results from outcome regressions on LTCH user groups and matched control groups

Variable	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
Acute referral without LTCH	−0.009	−0.017	0.008	0.646***	0.460***	0.186***	4.638***	4.161***
	[0.022]	[0.036]	[0.038]	[0.042]	[0.048]	[0.032]	[1.749]	[1.068]
Acute referral with LTCH	−0.169***	−0.002	−0.167	1.646***	1.436***	0.21	61.033***	43.134***
	[0.045]	[0.121]	[0.125]	[0.178]	[0.291]	[0.162]	[19.836]	[11.780]
SNF first PAC	−0.008	0.141***	−0.149***	−0.311***	−0.247***	−0.064***	−22.520***	−13.892***
	[0.016]	[0.035]	[0.039]	[0.035]	[0.038]	[0.024]	[2.027]	[1.130]
IRF first PAC	0.011	0.254***	−0.243**	0.946***	0.753***	0.192***	13.392***	15.601***
	[0.041]	[0.080]	[0.100]	[0.092]	[0.100]	[0.055]	[4.339]	[3.623]
Any SNF claims	0.021*	−0.024	0.046	0.496***	0.493***	0.003	66.712***	17.391***
	[0.012]	[0.031]	[0.035]	[0.027]	[0.030]	[0.017]	[1.897]	[1.030]
Urban	−0.006	0.092**	−0.099**	0.021	0.075**	−0.054**	0.579	1.592**
	[0.019]	[0.038]	[0.050]	[0.026]	[0.029]	[0.028]	[1.129]	[0.665]
Medicare outlier status	0.530***	1.100***	−0.570***	0.193***	0.615***	−0.422***	10.834***	10.367***
	[0.049]	[0.049]	[0.057]	[0.067]	[0.057]	[0.036]	[3.358]	[2.227]
Wage index	0.781***	0.439***	0.341*	0.523***	0.403***	0.119	−7.272*	−5.862**
	[0.066]	[0.165]	[0.207]	[0.082]	[0.099]	[0.089]	[4.226]	[2.604]
Wound procedures	0.02	−0.041	0.061	−0.026	−0.049**	0.023	−2.467**	−2.490***
	[0.017]	[0.043]	[0.056]	[0.019]	[0.024]	[0.021]	[0.980]	[0.704]
Other pulmonary disease	−0.043***	−0.061**	0.017	−0.064***	−0.065***	0.002	−1.793	−1.319
	[0.011]	[0.027]	[0.032]	[0.024]	[0.025]	[0.019]	[1.229]	[0.844]
Constant	7.880***	8.226***	−0.346*	8.459***	8.608***	−0.148*	16.231***	13.198***
	[0.063]	[0.156]	[0.199]	[0.077]	[0.094]	[0.084]	[3.851]	[2.432]
Observations	7,070	7,070	7,070	7,070	7,070	7,070	7,070	7,070
R-squared	0.357	0.303	0.13	0.642	0.569	0.146	0.577	0.487

NOTES: LTCH = long-term care hospital; SNF = skilled nursing facility; PAC = post-acute care. Statistically significant at *$p < .10$; **$p < .05$; ***$p < .01$. Robust standard errors in brackets.

SOURCE: Analysis of RTI 2007 Episode Margins file.

APPENDIX F:
MEANS TABLES FOR LTCH USER GROUPS AND MATCHED CONTROL GROUPS

LIST OF TABLES IN APPENDIX F

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Appendix Table F.1
Ventilator group: Outcome means for LTCH user group and matched control group

Episode type	Percentage of total	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
LTCH referral	100.0	$62,542	$60,755	1.03	$136,052	$126,144	1.08	71.0	97.1
No LTCH referral	100.0	76,388	68,775	1.11	91,486	83,142	1.10	43.2	63.0
Index only	44.8	84,668	73,840	1.15	84,733	73,905	1.15	32.8	32.8
Acute referral without LTCH	11.3	72,536	69,268	1.05	113,466	106,021	1.07	58.2	75.3
Acute referral with LTCH	1.1	60,667	58,536	1.04	175,898	176,485	1.00	91.1	123.7
First PAC SNF	29.6	75,265	69,634	1.08	93,286	88,239	1.06	49.2	102.7
First PAC IRF	3.4	84,922	79,597	1.07	128,213	120,237	1.07	65.2	88.3
All other	9.8	42,458	36,708	1.16	70,349	65,415	1.08	41.2	49.2

NOTES: SNF = skilled nursing facility; LTCH = long-term care hospital; PAC = post-acute care; IRF = inpatient rehabilitation facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table F.2
Infection group: Outcome means for LTCH user group and matched control group

Episode type	Percentage of total	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
LTCH referral	100.0	$14,390	$15,759	0.91	$56,102	$57,340	0.98	49.5	73.8
No LTCH referral	100.0	14,303	15,235	0.94	21,308	22,598	0.94	19.8	42.3
Index only	34.2	15,749	16,843	0.94	15,768	16,858	0.94	12.3	12.4
Acute referral without LTCH	6.8	13,775	15,018	0.92	36,549	37,607	0.97	30.8	47.1
Acute referral with LTCH	0.6	13,663	15,424	0.89	93,523	105,701	0.88	73.7	100.2
First PAC SNF	40.8	13,765	14,941	0.92	20,504	22,036	0.93	20.1	68.0
First PAC IRF	1.2	18,146	22,195	0.82	46,465	48,600	0.96	41.0	58.9
All other	16.5	12,886	12,703	1.01	31,742	32,376	0.98	26.6	35.0

NOTES: SNF = skilled nursing facility; LTCH = long-term care hospital; PAC = post-acute care; IRF = inpatient rehabilitation facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table F.3
Aftercare, wound, and skin care group: Outcome means for LTCH user group and matched control group

Episode type	Percentage of total	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
LTCH referral	100.0	$15,312	$17,474	0.88	$56,519	$60,673	0.93	52.6	76.5
No LTCH referral	100.0	16,152	17,707	0.91	23,223	25,325	0.92	22.6	46.1
Index only	35.7	17,667	19,463	0.91	17,680	19,474	0.91	14.9	15.0
Acute referral without LTCH	5.6	18,870	22,557	0.84	40,557	43,866	0.92	37.1	52.6
Acute referral with LTCH	0.3	13,596	14,427	0.94	77,001	85,675	0.90	66.9	92.2
First PAC SNF	40.4	15,591	17,524	0.89	22,868	25,469	0.90	23.3	73.5
First PAC IRF	1.5	24,055	31,319	0.77	52,440	58,536	0.90	45.1	60.4
All other	16.6	13,344	12,994	1.03	32,640	33,047	0.99	29.4	39.9

NOTES: SNF = skilled nursing facility; LTCH = long-term care hospital; PAC = post-acute care; IRF = inpatient rehabilitation facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table F.4
Complex rehabilitation group: Outcome means for LTCH user group and matched control group

Episode type	Percentage of total	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
LTCH referral	100.0	$12,671	$15,482	0.82	$53,973	$59,250	0.91	52.1	74.4
No LTCH referral	100.0	12,549	13,675	0.92	18,903	19,694	0.96	18.0	40.4
Index only	39.2	11,817	11,290	1.05	11,821	11,293	1.05	8.5	8.7
Acute referral without LTCH	8.0	14,722	18,880	0.78	39,343	37,765	1.04	35.7	60.0
Acute referral with LTCH	0.7	13,343	19,267	0.69	72,600	84,428	0.86	74.3	105.5
First PAC SNF	35.6	12,862	15,347	0.84	20,096	23,432	0.86	18.9	69.7
First PAC IRF	3.3	15,845	22,703	0.70	47,006	50,985	0.92	41.1	59.8
All other	13.3	11,994	12,597	0.95	31,203	31,975	0.98	24.7	34.4

NOTES: SNF = skilled nursing facility; LTCH = long-term care hospital; PAC = post-acute care; IRF = inpatient rehabilitation facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table F.5
Pneumonia group: Outcome means for LTCH user group and matched control group

Episode type	Percentage of total	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
LTCH referral	100.0	$6,389	$9,147	0.70	$39,290	$41,676	0.94	39.6	59.4
No LTCH referral	100.0	6,345	8,540	0.74	9,320	11,897	0.78	12.2	26.5
Index only	49.2	6,316	8,055	0.78	6,322	8,062	0.78	7.1	7.2
Acute referral without LTCH	4.2	6,187	8,921	0.69	21,067	23,882	0.88	23.1	38.0
Acute referral with LTCH	0.2	5,349	7,594	0.70	63,775	65,763	0.97	63.6	71.0
First PAC SNF	29.7	6,428	9,506	0.68	10,019	13,789	0.73	13.5	54.7
First PAC IRF	0.4	6,800	13,440	0.51	34,218	37,815	0.90	34.6	44.8
All other	16.4	6,329	8,226	0.77	20,415	23,640	0.86	21.3	29.9

NOTES: SNF = skilled nursing facility; LTCH = long-term care hospital; PAC = post-acute care; IRF = inpatient rehabilitation facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table F.6
Heart failure group: Outcome means for LTCH user group and matched control group

Episode type	Percentage of total	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
LTCH referral	100.0	$6,701	$10,160	0.66	$39,402	$44,173	0.89	42.0	60.7
No LTCH referral	100.0	6,642	9,100	0.73	11,029	14,222	0.78	14.3	28.6
Index only	43.9	6,664	8,740	0.76	6,676	8,748	0.76	7.3	7.4
Acute referral without LTCH	5.0	6,648	9,628	0.69	24,896	27,662	0.90	24.0	37.2
Acute referral with LTCH	0.2	6,449	10,285	0.63	119,145	126,167	0.94	75.6	84.4
First PAC SNF	26.9	6,774	10,470	0.65	11,583	16,329	0.71	15.9	58.2
First PAC IRF	0.8	6,169	10,869	0.57	26,669	29,686	0.90	29.3	42.2
All other	23.3	6,471	8,195	0.79	21,530	25,252	0.85	22.7	31.7

NOTES: SNF = skilled nursing facility; LTCH = long-term care hospital; PAC = post-acute care; IRF = inpatient rehabilitation facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.

Appendix Table F.7
Chronic obstructive pulmonary disease/other respiratory group:
Outcome means for LTCH user group and matched control group

Episode type	Percentage of total	Medicare index payment	Index costs	Index payment-to-cost ratio	Medicare episode payment	Episode cost	Episode ratio	Episode days without SNF days	Episode days with SNF days
LTCH referral	100.0	$7,247	$9,754	0.74	$39,217	$41,368	0.95	37.7	52.5
No LTCH referral	100.0	7,028	9,205	0.76	10,983	13,687	0.80	13.6	24.7
Index only	51.8	7,011	8,763	0.80	7,022	8,772	0.80	7.0	7.0
Acute referral without LTCH	4.1	7,057	9,226	0.76	22,916	24,219	0.95	22.4	36.8
Acute referral with LTCH	0.2	6,579	11,444	0.57	81,185	91,009	0.89	68.0	104.6
First PAC SNF	21.0	7,364	10,945	0.67	13,030	17,704	0.74	16.9	56.1
First PAC IRF	0.7	7,320	13,107	0.56	32,699	35,751	0.91	35.0	46.1
All other	22.1	6,750	8,624	0.78	21,938	25,931	0.85	23.1	32.2

NOTES: SNF = skilled nursing facility; LTCH = long-term care hospital; PAC = post-acute care; IRF = inpatient rehabilitation facility.

SOURCE: Analysis of RTI 2007 Episode Margins file.