# AHA Commissioned Report Challenges Inappropriate Conclusions Regarding Long-term Care Hospitals

*Analysis reiterates unique role of these specialized hospitals, rejects paper's conclusions*

The American Hospital Association (AHA) released a new analysis conducted by the prominent health care economics and policy consulting firm Dobson DaVanzo & Associates, LLC (Dobson). The analysis critiques the findings of an academic paper that misconstrues the facts and draws faulty conclusions regarding the role of long-term care hospitals (LTCHs).[1] Specifically, in its comprehensive critique of the paper by Einav and colleagues (Einav paper), Dobson's economists and analysts rebut the findings and implications of the paper by analyzing the data, assumptions, econometric approach and methodologies. Ultimately, Dobson found that the conclusions reached by the study are not warranted and represent an overreach of the facts.

LTCHs play an important and unique role for Medicare and other beneficiaries by caring for the most severely ill patients who require extended hospitalization. As discussed in the Dobson analysis, LTCHs offer an intensive level of care that is not normally provided in other post-acute care settings. LTCH patients are typically very medically complex, with multiple organ failures, and stay in the LTCH on average at least 25 days. Many LTCH patients depend on ventilators due to respiratory failure or similar ailments, which require highly specialized care. In addition, LTCHs are critical partners for acute-care hospitals, alleviating capacity for overburdened intensive care units and other parts of the care continuum that would otherwise be further strained without access to LTCHs for these patients.

Dobson's report identified numerous shortcomings in the Einav paper. Some of the most problematic include:

- Use of data that is more than 10 years old, despite dramatic payment reforms and other changes in the field since that time.
- Weak assumptions about substitutability of LTCH care with non-hospital care provided in skilled-nursing facilities.
- Narrowly defined outcomes that do not include the totality of health spending or care outcomes for Medicare beneficiaries.

[1] Liran Einav, Amy Finkelstein & Neale Mahoney, July 2023. "Long-Term Care Hospitals: A Case Study in Waste," The Review of Economics and Statistics, MIT Press, vol. 105(4), pages 745-765.

 

- Econometric shortcomings involving sensitivity analysis, misspecification errors, variable bias and others.
- Research that contradicts the paper's findings and which supports the value and unique role that LTCHs fulfill in caring for beneficiaries.
- Bias and other weakness with the external and internal validity of the paper.
- Failure to consider alternative factors that contribute to the observed variations in spending.

Dobson's critique of these defects in the Einav paper underscores the importance of not using it to support policymaking or other decisions regarding the Medicare program. Instead, policymakers should consider the input of the doctors and other experts who support the LTCHs role in the care continuum for severely ill patients.

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The American Hospital Association (AHA) is a not-for-profit association of health care provider organizations and individuals committed to improving their communities' health. The AHA advocates on behalf of our nearly 5,000 member hospitals, health systems and other health care organizations, our clinician partners — including more than 270,000 affiliated physicians, 2 million nurses and other caregivers — and the 43,000 health care leaders who belong to our professional membership groups. Founded in 1898, the AHA provides insight and education for health care leaders and is a source of information on health care issues and trends. For more information, visit the AHA website at www.aha.org.

 

# A Critical Review of "*Long-Term Care Hospitals: A Case Study in Waste*"

## Introduction

Dobson DaVanzo & Associates, LLC (Dobson | DaVanzo) was commissioned by the American Hospital Association (AHA) to review the methodology and findings in the 2023 paper by Einav, Finklestein and Mahoney titled "*Long-Term Care Hospitals: A Case Study in Waste."*[1]

The authors use 100% Medicare Provider and Analysis Review (MedPAR) data from 1998–2014 to estimate the effect of Long-Term Care Hospitals (LTCHs) discharges on patient outcomes using variation in LTCH discharges caused by the entry of the first LTCH into a hospital market. The authors report that most LTCH patients would have counterfactually received care at Skilled Nursing Facilities (SNFs) and that substitution of care to LTCHs leaves patients unaffected or worse off on all measured outcomes. The study authors also contend that Medicare could save $4.6 billion per year with no harm to patients by not paying for discharges from LTCHs.

Our review of the paper and the literature suggests that the level of evidence presented does not support the far-reaching policy conclusion made by Einav and colleagues that "eliminating LTCHs could generate savings with no harm to patients." We identify seven broad concerns that weaken the level of evidence presented in the paper including: 1) weak assumptions about the substitutability of LTCH care; 2) use of data that is more than ten years old despite dramatic changes in the LTCH sector since that time; 3) issues with external and internal validity of the study; 4) narrowly defined study outcomes; 5) contradictory results in the literature; 6) methodological concerns with the chosen econometric approach; and 7) large geographic variation in Medicare spending that could be explained by non-patient factors.

## Summary of Findings

Below in brief (and later in detail) we describe the key concerns with Einav et al.'s paper. Given these concerns, we conclude that this study contains significant flaws that should be taken into consideration by stakeholders.

1) **Weak assumptions about substitutability of LTCH care.** In this study, the authors wrongly assume that most SNFs are comparable to LTCHs and can take care of all the complex types of patients that receive care in LTCHs. However, LTCHs are designed to be a different type of post-acute care (PAC) provider; if anything, they are an extension of Short-Term Acute Care Hospitals (STACH). This varies greatly from SNFs, which are sub-acute facilities. For the most

[1] Liran Einav & Amy Finkelstein & Neale Mahoney, 2023. "Long-Term Care Hospitals: A Case Study in Waste," The Review of Economics and Statistics, MIT Press, vol. 105(4), pages 745-765, July.

critically ill patients, LTCHs deliver the appropriate care using a multi-disciplinary team of specialized professionals. This value proposition is not well discussed or integrated into the analysis conducted by the authors.

2) **Use of data that is more than ten years old despite dramatic changes in the LTCH sector since that time.** The study uses out-of-date Medicare data from 1998 through 2014. However, there have been significant changes to the Medicare LTCH payment system, and the sector as a whole since 2014. For example, Congress introduced a dual payment-rate structure effective FY 2016 which pays differently for higher-intensity cases which the study does not take into account. This means that these data are inappropriate to use in drawing conclusions and making policy recommendations for the present day.

3) **Issues with external and internal validity of the study.** There is potential for selection treatment bias, as STACH discharges may be non-random and influenced by strategic discharge decisions due to patient health conditions or other factors. Additionally, the use of LTCH entry as an instrument for LTCH care could introduce endogeneity; for example, if LTCH entry is driven by market factors like local demand for specialized care, patient acuity, hospital characteristics, or patient-provider relationships, there could be unobserved confounding variables that influence both the likelihood of being discharged to an LTCH and the patient outcomes. The study may also not fully account for pre-existing hospital discharge policies that could bias the results. Regarding external validity, the study findings may not be applicable to all patient populations, for example, those with complex care needs or rare conditions that require the intensive services offered by LTCHs.

4) **Narrowly defined outcomes.** The authors do not assess the impact of LTCH entry on other outcomes such as hospital readmissions, emergency department (ED) admissions, and other quality of life metrics. Further, the authors' definition of total Medicare payments does not include the other care setting payments (e.g., Physician, Outpatient, and Durable Medical Equipment (DME)). This hinders the ability of the authors to make sound conclusions regarding the impact of LTCH entry. Specifically, the narrowly defined set of outcomes undermines the authors' ability to draw the conclusion that "excess spending on LTCHs provides unmeasured health benefits," as they do not explore a wide set of health measures.

5) **Contradictory results in the literature.** Other studies in the literature have found contradictory results. For example, a 2015 study by Koenig, et al.[2] found lower mortality and Medicare payments for LTCH patients compared to non-LTCH patients. A 2024 study by the same authors showed that LTCHs significantly decreased the time medically complex patients spent in a STACH and in

[2] Koenig L, Demiralp B, Saavoss J, Zhang Q. The Role of Long-term Acute Care Hospitals in Treating the Critically Ill and Medically Complex: An Analysis of Nonventilator Patients. Med Care. 2015 Jul;53(7):582-90. doi: 10.1097/MLR.0000000000000382. Erratum in: Med Care. 2015 Sep;53(9):835. PMID: 26067882; PMCID: PMC4470738.

an Intensive Care Unit (ICU).[3] An RTI analysis[4] found that cases that were most likely to be referred to LTCHs had lower Medicare payments, lower mortality and higher chances of being discharged to home relative to those who remained in acute care settings. An unpublished study conducted by Dobson | DaVanzo also showed that the mortality and readmission rates were lower for patients discharged to LTCHs compared to patients discharged to other post-acute care settings.

6) **Methodological concerns with the econometric approach.** There are several methodological limitations to the study including: a) no sensitivity analysis conducted when choosing the instrumental variable; b) potential misspecification errors from choice of linear functional form; c) potential overfitting of regression tree models used for prediction of LTCH discharges; and d) omitted variable bias.

7) **Conclusion about large geographic variation in Medicare spending could be explained by non-patient factors.** Finally, while the authors contend that the significant geographic variation in Medicare spending could be attributed to "wasteful" LTCH discharges, it could be explained by other factors. The variation could be due to non-patient factors, including payment policies, regulations, and provider practice patterns.

[3] https://cdn.ymaws.com/nalth.site-ym.com/resource/resmgr/members/congressionalcontacts/ltach_roundtabley_01162024.pdf

[4] Gage, B., N. Pilkauskas, K. Dalton, et al. 2007. Long-term care hospital (LTCH) payment system monitoring and evaluation: Phase II report. Prepared under contract to the Centers for Medicare & Medicaid Services. Waltham, MA: RTI International.

## Findings in Detail

### 1. Weak assumptions about LTCH substitutability

In this study, the authors assume that most SNFs are comparable to LTCHs and can take care of all the complex types of patients that receive care in LTCHs. However, this conclusion is clearly inaccurate – LTCHs and SNFs have distinct clinical capabilities, patient populations and regulatory requirements and should not be considered substitutes.

LTCHs are certified as acute care hospitals, but focus on patients who, on average, stay more than 25 days. Many of the LTCH patients are transferred from an intensive or critical care unit.[5] LTCHs provide services and care to patients with complex medical issues, including ventilator weaning, wound care, head trauma treatment, comprehensive rehabilitation, or pain management. Care in LTCHs is directed by physicians who typically see patients at least once per day, with multiple subspecialists available for consultation. Respiratory and other therapies and interventions are available 24/7 and is often provided by pulmonologists, respiratory therapists, and rehabilitation specialists. Additionally, LTCHs maintain nurse to patient ratios similar to acute care hospitals and high-acuity care is provided by Basic Life Support (BLS) and Advanced Cardiac Life Support (ACLS) certified nurses with advanced critical care training. Services such as telemetry, radiology, pharmacy, lab, and dialysis are available on site.[6] Indeed, unlike SNFs, LTCHs must be certified by Medicare as a hospital and meet all applicable licensing and participation requirements for hospitals, including those for nursing, emergency response, medical staff, and numerous others.[7]

The acuity of patients seen in LTCHs matches the high-level of care provided. Within the top conditions seen in LTCHs, more than 20% of cases require ventilator support, 40% are characterized by the top two pulmonary DRGs and 16 of the top 20 conditions include at least one major complication or comorbidity.[8] An analysis by KNG Health Consulting found that patients discharged to LTCHs were on average, more severely ill, with the higher severity of illness reflecting greater rates of multiple organ failure, greater rates of ventilator use, and higher number of comorbidities and complications (CCs) and major CCs (MCCs) compared to patients discharged to other care settings.[9]

In contrast SNFs are licensed as sub-acute facilities with differing and less intensive requirements than hospitals.[10] Under these rules, onsite physician visits are only required to occur once every 30 days for the first 90 days. Unlike hospitals, in SNFs subspecialists are

[5] U.S. Centers for Medicare & Medicaid Services, What Are Long-Term Care Hospitals? (Baltimore, MD: CMS Product No. 11347, 2022), https://www.medicare.gov/publications/11347-What-are-long-term-care-hospitals.pdf.

[6] https://www.kindredhospitals.com/content/dam/Home/ScionHealth/web-assets/specialty-hospitals/kindredhospitals-com/file/ltachs-vs-snfs-media-piece-q2-2024-update-kindred-managedcare.pdf

[7] 42 C.F.R. § 412.23(e)(1) requires LTCHs to have a provider agreement with Medicare to participate as a hospital. 42 C.F.R. Part 482 details the extensive Conditions of Participation for hospitals.

[8] https://www.kindredhospitals.com/news-stories/research-and-insights/ltachs-vs-snfs

[9] https://cdn.ymaws.com/nalth.site-ym.com/resource/resmgr/members/congressionalcontacts/ltach_roundtabley_01052024.pdf

[10] 42 C.F.R. Part 483 Subpart B generally provides the regulatory requirements for care in SNFs as well as Long-term Care Facilities.

often seen off-site and these facilities maintain a staffing ratio of approximately 10-40 patients per nurse, with limited respiratory therapy in select locations. Ancillary services such as radiology, lab, and dialysis services are often only accessible off-site. This is a markedly different experience than that provided in LTCHs.

In summary, LTCHs provide physician-led acute care for critically ill patients with multiple serious conditions and specialize in treating complex pulmonary diagnoses while SNFs treat patients with a wide range of conditions that can be managed by nursing staff.

Einav et al. imply that a SNF can become LTCH-like, and provide such levels of complex care, yet most SNFs cannot provide the intensive level of therapy or management LTCH patients require. In some instances, a "Super SNF" which "combines medically complex care with high-end hospitality" could provide care to LTCH level patients.[11] However, only a small percentage of SNFs fit this designation.

### 2. Use of data that is more than ten years old despite dramatic changes in the LTCH sector

Another limitation in the study by Einav and colleagues is that it relies on data that is more than ten years old and does not reflect recent trends in the healthcare system, changes in LTCH payment, or economic shifts, making it less applicable to the present-day context. The study uses MedPAR and other datasets from 1998 through 2014, yet there have since been significant changes to the LTCH payment system including new reimbursement rules as well as changes in healthcare practices that have altered LTCH utilization since that time. As such, the use of these data to draw conclusions and make policy recommendations for the present day are inappropriate.

For instance, beginning in 2016, LTCHs are paid under a "dual payment-rate structure," depending on whether or not the patient meets certain clinical criteria. LTCH discharges meeting the LTCH payment system criteria are paid at standard rates, while those that do not are paid lower "IPPS-equivalent" rates. In order to receive payment at the standard LTCH PPS amount, an LTCH patient must either; 1) have been admitted directly from an inpatient hospital during which at least three days were spent in an Intensive Care Unit (ICU) or Coronary Care Unit (CCU), but the discharge must not be assigned to a psychiatric or rehabilitation LTCH diagnosis related group (DRG); or 2) have been admitted directly from an inpatient hospital and the LTCH discharge includes the procedure code 5A1955Z for ventilator services of at least 96 hours and cannot be assigned to a psychiatric or rehabilitation LTCH DRG.

This policy has resulted in significant changes in the types of patients receiving care in LTCHs as well as overall financial impacts for LTCHs. Specifically, the policy has resulted in multiple LTCH closures, decreased patient volumes, and lower Medicare revenues for

[11] https://skillednursingnews.com/2017/06/symphony-shares-secrets-super-snf/

LTCHs. From 2015 through 2023, the number of LTCH discharges dropped by 55 percent, with the largest decline among IPPS-equivalent discharges. Over the same period, the number of LTCH providers decreased by 22 percent and LTCH payments declined by 46 percent, as shown in **Exhibit 1** below. These marked decreases further underscore the fact that the authors have not considered updating their results and addressing these trends with newer data.

**Exhibit 1: Trends in the number of providers, volume of LTCH discharges, and total Medicare payments to LTCHs, 2015-2023**

| Type of Discharge | Number of Providers | | Number of LTCH Discharges | | Total Payment | | Percent Change from 2015-2023 | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 2023 | 2015 | 2023 | 2015 | 2023 | Providers | Discharges | Total Payment |
| Total | 422 | 331 | 131,616 | 59,432 | $5.4 B | $2.9 B | -22% | -55% | -46% |
| IPPS-equivalent Rate | | | 58,684 | 17,130 | $2.0 B | $622.1 M | | -71% | -69% |
| Standard Rate | | | 72,932 | 42,302 | $3.4 B | $2.3 B | | -42% | -33% |

Sources: AHA Analysis of FY 2015 and FY 2023 LTCH MedPAR files (March updates); FY 2017 and FY 2025 LTCH PPS impact files.

Einav and colleagues conducted a sensitivity analysis to examine whether study results differed for patients that would have met the criteria for a standard payment under the dual payment rate structure. The authors did not find statistically significant differences in the spending effects or other outcomes for the patients who would have qualified for the standard LTCH reimbursement under the new policy. The use of data from the period prior to 2016 when the "dual payment" policy went into effect in the sensitivity analysis does not directly analyze the impact of dual payment structure policy. The pre-2016 data does not fully account for the dual payment structure's broader effects, for example, changes in provider behavior and changes in the volume and composition of patients paid under the Standard or IPPS-equivalent rates.

## 3. Issues with external and internal validity of the study

There are also several issues with the internal and external validity of the study that undermine the credibility of the paper's conclusions.

Regarding internal validity, there is potential for selection treatment bias. STACH discharges to LTCHs could be due to strategic discharge decisions based on patient health conditions or other factors. As such, STACH discharges to LTCHs may be non-random, thereby introducing bias to the study results.

Second, the use of LTCH entry[12] as an instrument for LTCH use assumes that LTCH entry is not correlated with factors that affect patient outcomes. However, if LTCH entry is driven by market factors like local demand for specialized care, patient clinical acuity, hospital characteristics, or patient-provider relationships, this introduces endogeneity.[13] While study authors tested for endogeneity and found that LTCH entry is not related to the likelihood of

[12] Entry of the first LTCH into a hospital market

[13] Statistically, endogeneity means that the model's errors are not truly *random*, since they are partially predictable from information contained in the explanatory variables. Practically, endogeneity means that a regression is misspecified in a way that makes identifying a causal effect between two economic variables difficult, if not impossible.

discharge to an LTCH based on demographics and health conditions, unobservable factors may still introduce endogeneity. For example, LTCHs may enter markets where they are better positioned to serve patients with severe health conditions. These underlying market dynamics could independently influence patient outcomes, making it difficult to fully isolate the impact of LTCH entry.

Finally, there could be unobserved confounding variables that influence both the likelihood of being discharged to an LTCH and patient outcomes. For example, hospitals with better intensive care management or resources might have higher LTCH discharge rates and better patient outcomes.

Additionally, several factors may limit the external validity of the study, particularly regarding the generalizability of the paper's findings beyond the specific context, or the final sample studied. Patient populations are diverse, and there may be subgroups of patients with specific conditions or needs who benefit more from LTCH-level care than SNF care. The findings might not be applicable to all patient populations, particularly those with complex care needs or rare conditions that require the intensive services offered by LTCHs. This issue is further corroborated by research in the literature that shows that certain subgroups (for example patients who spend more than 3 days in the ICU) are likely to benefit from LTCH care compared to others. [14, 15]

Further, the use of LTCH market entry as an instrument assumes that entry is exogenous. However, if LTCHs enter markets with specific healthcare dynamics such as high demand for higher-intensity care, the findings might be less applicable to other markets where LTCH entry is less common or driven by different factors.

### 4. Contradictory results from studies in the literature

The results from the Einav, et al. study contradict findings from other studies in the literature where researchers have reported lower mortality rates and lower Medicare payments for patients receiving LTCH care.

Koenig and colleagues[16] conducted a retrospective cohort study to compare mortality and Medicare payments for high-acuity Medicare patients transferred to an LTCH immediately after a STACH stay and those receiving care in other settings. The authors found favorable results for LTCH care in terms of patient mortality and Medicare payments for two (circulatory and digestive systems) out of the five major diagnostic categories[17] for non-

[14] Koenig L, Demiralp B, Saavoss J, Zhang Q. The Role of Long-term Acute Care Hospitals in Treating the Critically Ill and Medically Complex: An Analysis of Nonventilator Patients. Med Care. 2015 Jul;53(7):582-90. doi: 10.1097/MLR.0000000000000382. Erratum in: Med Care. 2015 Sep;53(9):835. PMID: 26067882; PMCID: PMC4470738.

[15] https://cdn.ymaws.com/nalth.site-ym.com/resource/resmgr/members/congressionalcontacts/ltach_roundtabley_01162024.pdf

[16] Koenig L, Demiralp B, Saavoss J, Zhang Q. The Role of Long-term Acute Care Hospitals in Treating the Critically Ill and Medically Complex: An Analysis of Nonventilator Patients. Med Care. 2015 Jul;53(7):582-90. doi: 10.1097/MLR.0000000000000382. Erratum in: Med Care. 2015 Sep;53(9):835. PMID: 26067882; PMCID: PMC4470738.

[17] The five major diagnostic categories included in the study were based on the MS-DRG for the index STACH stay: respiratory (MDC 4), circulatory (MDC 5), digestive (MDC 6), musculoskeletal and connective tissue (MDC 8), and infectious and parasitic diseases and disorders (DDs) (MDC 18).

ventilator Medicare patients. Additionally, findings showed that LTCH care was associated with lower mortality for patients with ≥ 3 days in the ICU[18] in the prior STACH stay, in four of the major diagnostic categories (respiratory, circulatory, musculoskeletal, and infectious and parasitic diseases and disorders), and lower payments in three major diagnostic categories (circulatory, digestive, and musculoskeletal and connective tissue) for patients with ≥ 3 days in the ICU in the prior STACH stay.

Separately, in a 2024 analysis using 2016-2019 Medicare fee-for-service inpatient claims data, Koenig and colleagues conducted regression analyses to examine the effects of LTACH use on STACH length of stay and ICU days for patients who spent 3 or more days in an ICU and had a condition frequently treated in LTCHs.[19] Results showed that LTCHs significantly decreased the time medically complex patients spent in a STACH and in an ICU.

An RTI analysis[20] found that for discharges that were most likely to be referred to LTCHs (almost exclusively episodes with long-term ventilator dependency and tracheotomy in the acute care hospital), Medicare payments were the same or lower, mortality was lower, and the chance of being discharged home was higher for those referred to LTCHs relative to those who remained in acute care settings for the duration of their episode.[21]

Further, in an unpublished research study, Dobson | DaVanzo used an instrumental variable (IV) approach (with two stage residual inclusion criteria)[22] and claims data from 2015 to 2016 to estimate the differences in utilization (90-day episode payments, 90-day episode costs, mortality and readmission) for patients transferred to an LTCH versus those discharged to other settings. We found lower mortality and readmission rates and generally increased Medicare payments for patients who were transferred to LTCHs versus those who were not.

## 5. Methodological Concerns with the Econometric Approach

We also identified several methodological limitations to the econometric approach used by Einav and colleagues. This again suggests that this paper is inappropriate to use in drawing conclusions and making policy recommendations for the present day. These limitations are described below.

[18] The analysis also included patients who spent ≥ 3 days in the Cardiac Care Unit (CCU).

[19] https://cdn.ymaws.com/nalth.site-ym.com/resource/resmgr/members/congressionalcontacts/ltach_roundtabley_01162024.pdf

[20] Gage, B., N. Pilkauskas, K. Dalton, et al. 2007. Long-term care hospital (LTCH) payment system monitoring and evaluation: Phase II report. Prepared under contract to the Centers for Medicare & Medicaid Services. Waltham, MA: RTI International.

[21] RTI used the same ventilator-related episodes to examine episode-level differences in outcomes (rather than average area-level differences) only for beneficiaries in Texas, Louisiana, and Oklahoma—states with a history of high LTCH use.

[22] In the first stage of the IV model, we estimated probability of LTCH transfer on instruments (driving distance from Acute Care Hospitals to the nearest LTCH and number of LTCHs in hospital referral region ), patient demographic characteristics (age, gender, race), Medicare eligibility status (dually eligible or not) , clinical characteristics (number of CC, number of MCC, ICU days [more than three or not]), other risk factors (HCC indicators, MS-DRG groups), geographic location factor (census regions), and provider characteristics (IRB). In the second stage of the IV model, we regressed the outcome variable on patient demographic characteristics (age, gender, race), Medicare eligibility status (dually eligible or not) , clinical characteristics (number of CC, number of MCC, ICU days [more than three or not]), other risk factors (HCC indicators, MS-DRG groups), geographic location factor (census regions), provider characteristics (IRB), and residual (obtained from the first stage of the model).

### Choice of instrumental variables

The authors did not conduct any sensitivity analysis using other instruments to evaluate whether it would produce different results. The use of a weak study instrument can lead to biased estimates. In this case, if the study authors had chosen a different instrument (e.g., distance from Acute Care Hospitals to the nearest LTCH), the results could be different. In the literature, other authors have used different instruments and generated different findings—which highlights the fact that without a true sensitivity analysis, results from a study based on a single instrument are not conclusive and further casts doubt on the validity of the study.

### Functional form misspecification

The choice of a linear functional form in estimating the impact of LTCHs on outcomes could also introduce misspecification errors. If the true relationship between LTCH use and patient outcomes is nonlinear or involves interaction effects between different covariates, a linear model may oversimplify the analysis and, once again, challenge the study's validity.

### Potential for overfitting from regression trees

The authors used the regression tree machine learning technique to determine the likelihood of LTCH discharge using demographics and predetermined health conditions of patients with STACH stays.[23] One of the major limitations of regression tree methodology is that it is prone to overfitting the training data, thereby weakening the accuracy of the predictions. Regression trees are also unstable to the changes in the data—a slight change in the data, for example, can result in a major change in the structure of the decision tree. Given that the authors did not specify whether sensitivity analyses or tests were conducted to check for overfitting, we cannot evaluate the accuracy of the predictions.

### Potential for omitted variable bias

While the study authors adjusted for some baseline demographics and health conditions, there could be omitted variable bias in the regression estimates as the authors did not adjust for other important provider-level characteristics (provider experience, ratio of interns to beds, bed size, provider ownership characteristics) and patient-level characteristics (whether the patient required ventilator support on admission, patients' functional status prior to LTCH admission, patients' communication status at admission, HCC scores to determine patient's health severity) that might influence the LTCH admission and the outcome. Comparing staffing levels, nurse-to-patient ratios, and access to specialized care in LTCHs vs. SNFs could provide insight into whether differences in resource availability can lead to better or worse patient outcomes.

[23] Regression trees are a type of decision tree used in machine learning to predict output values based on multiple input variables.

### 6. Narrow definition of study outcomes

Einav and colleagues inappropriately draw far-reaching conclusions from a study that only considers a narrow set of outcomes. As noted by the authors, the study measures patient outcomes based on easily observable dimensions (e.g., survival rates, cost), however, other measures such as the quality of care, patient satisfaction, and long-term functional recovery are not captured. In addition, other easily observable measures of utilization such as readmission rates and ED admissions are not considered. That aside, the definition of total Medicare payments is too narrow, as the study authors do not include payments made to the other care settings (e.g., Physician, Outpatient, DME) and payments made post-discharge. A comprehensive assessment of total healthcare expenditures incurred after discharge would provide a fuller and more accurate picture of the long-term economic impact. For example, if patients receiving care in SNFs incur additional costs post-discharge due to follow-up care, the immediate savings from avoiding LTCHs may be potentially overestimated. Therefore, study outcomes should not just focus on PAC settings but on how the shift affects total healthcare spending for each patient over a defined follow up period (e.g., 3 or 6 months). Overall, the narrowly defined set of outcomes undermines the authors' ability to draw the conclusion that "excess spending on LTCHs provides unmeasured health benefits," as they do not explore a wide set of health measures.

### 7. Conclusion about large geographic variation in Medicare spending could be explained by non-patient factors

Lastly, the conclusion that significant geographic variation in Medicare spending could be attributed to "wasteful" LTCH discharges is not the sole explanation. This variation may also stem from non-patient factors, including payment policies, regulations, and provider practice patterns, which were not considered by the authors. A geographic variation in LTCH availability or hospital practice patterns could weaken the strength of this conclusion. LTCH entry might not be uniformly influential across all regions or patient groups, raising concerns about how generalizable the correlation is across different settings and across geographic locations.

## Conclusion

In conclusion, there are a variety of theoretical and practical reasons why the paper's "black and white" fimndings and policy recomendations may represent an overreach not warranted by the study. The choice of the specific instrument under the instrumental variable approach may be problematic as other authors using different instruments have come to different conclusions—especially as they relate to some patient subgroups. Further, the notion that LTCHs provide no value undermines the continued role that LTCHs play in treating critically ill and medically complex patients using a multi-disciplinary physician team approach. As described, some studies have reported decreased mortality for LTCH patients—indicating that LTCH care may result in prolonged life expectancy. Finally, SNFs are not adequate substitutes for LTCHs, because they are operationally not set up to provide

the level of care that LTCH patients need at current SNF payment rates. These shortcomings in this study should give policy makers some pause as they consider the finding that LTCHs are entirely wasteful, particularly as thousands of patients are cared for by LTCHs annually.