COMPARISON OF QUALITY MEASURES FROM U.S. TEACHING HOSPITALS WITH CLINICALLY TRAINED AND NON-CLINICALLY TRAINED EXECUTIVES

By

Catherine Buren

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WHARTON RESEARCH SCHOLARS

Faculty Advisor:

Eileen T. Lake, Ph.D., RN, FAAN

Associate Director, Center for Health Outcomes and Policy Research, School of Nursing

THE WHARTON SCHOOL, UNIVERSITY OF PENNSYLVANIA

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i. Abstract

Background: With increasing emphasis on value-based care, nurses and physicians are being promoted to top administrative roles in US healthcare organizations.
Purpose: This study sought to examine whether clinician (nurse or physician) leadership was associated with improved Leapfrog Hospital Safety Grades (HSGs) and Magnet designation.
Methodology: Cross-sectional analysis of Leapfrog Hospital Safety Grade and Magnet status data on 257 U.S. teaching hospitals was performed.
Results: Hospitals in clinician-led hospitals performed better across several safety and performance measures than non-clinician-led hospitals. Magnet designation was independently associated with higher overall HSGs and better performance in several outcome, structure, and process measures.
Conclusions: This study suggests that hospital executives with a clinical background may possess skills, knowledge, or management strategies that positively impact patient outcomes.
Practice implications: Hospital quality and safety ratings impact patient decisions. Clinician executive leadership may improve hospital performance. Clinical education should prepare nurses and physicians to assume leadership positions in healthcare organizations.

Keywords: governance, hospital management, patient safety, clinical leadership, quality

1. Introduction

American health care organizations today are subject to immense pressure to provide high-quality, high-value care (Putera 2017). Current payment structures are directly linked to quality indicators; more than 50% of healthcare payments in 2022 were conducted through value-based reimbursement models and associated with varying degrees of financial risk (Health Care Payment Learning & Action Network 2023). Providers are expected to increase the 'value of care' they deliver, or "health outcomes achieved per dollar spent" (Catalyst 2017). While existing literature does discuss general strategies for promoting value in healthcare organizations, there has been a lesser emphasis on how value is achieved through organizational structure and leadership. The hospital Chief Executive Officer (CEO) is responsible for maintaining quality, overseeing day-to-day operations, and strategic planning to improve organizational performance (Creative Heath Care Management 2023). Lack of integration of clinical knowledge in management decisions inside hospitals has been associated with worse management (Harvard Business Review 2016). Increased emphasis on maximizing the value of care today is preparing healthcare providers for important leadership roles. CEOs with a clinical background are increasingly sought by hospital boards to improve the quality and value of care delivery, with increased focus on patient safety and experience (See et al 2022). The clinical knowledge integrated into executive leadership by clinician executives is thus likely to trickle down into changes in patient care, ultimately positively affecting the organization's health outcomes and patient experience ratings.

Hospital CEO performance has previously been evaluated by their organization's reported patient outcomes (Goodall 2011; Sarto 2016). Hospital executives face complex challenges that a clinician administrator may have the subject-matter expertise required to

address successfully. In 2019, only 5% of U.S. hospitals were operated by Chief Executive Officers (CEOs) with a medical background (Gupta 2019). A 2022 study by See et al. identified a positive relationship between physician CEOs and patient willingness to recommend the hospital, suggesting that physician executives implement institutional policies which prioritize patient care. However, present literature fails to include nurse CEOs as part of the cohort of hospital CEOs with a clinical background (likely due to the relatively newer trend of hiring nurse administrators). Nurses have the most patient contact among clinician professionals responsible for patient care and comprise nearly 60% of the healthcare workforce (World Health Organization 2020). Thus, a nursing background may be advantageous for a CEO given the predominance and centrality of nurses to patient care and hospital experience.

Studies are emerging in the literature (Comack 2012; Sanford 2020) highlighting the unique career paths of individual nurse CEOs. Evidence of the effect of clinical CEO leadership on measured hospital outcomes is limited, however few empirical studies have investigated the association between CEO educational background and hospital safety. Attention should be directed toward whether clinically trained leaders achieve higher quality patient care. The primary purpose of this study was to analyze the impact of clinician senior administrator leadership on hospital performance- specifically, the outcome, process and structural measures reported as part of the Leapfrog Hospital Safety Grade (HSG) as well as the prestigious 'Magnet' designation- of 257 U.S. teaching hospitals. The Leapfrog Hospital Safety Grade is cited as the gold standard, user-friendly measure of patient safety (The Leapfrog Group 2019). The Magnet Recognition Program recognizes organizations where nursing leaders effectively implement nursing strategic initiatives to improve patient outcomes (American Nurses Credentialing Center 2018). My hypothesis was that nurse and physician leadership translates to improved patient

outcomes and an enhanced patient experience. The end points in this study emphasize safety and quality—factors which patients rank most highly in their hospital selection process (Salampessy, Ikkersheim, Portrait et al 2022). This study analyzed measures publicly reported by the Leapfrog Group (several of which were adapted from the Centers for Medicare and Medicaid Services (CMS) Hospital Compare data) because of the thorough evaluation of safety and the patient experience across dimensions, and to allow for comparability with previous studies (See et al 2022).

1.1. Background and Literature Review

Previous evidence has demonstrated that the quality of a healthcare facility can be measured using established performance metrics including patient experience ratings and the occurrence of patient harm at the hospital. The Leapfrog Hospital Safety Grade (HSG) compiles 22 national patient safety measures, publicly reported from the Centers for Medicare & Medicaid Services (CMS) and the Leapfrog Hospital Survey, into a grade that reflects a facility's ability to avoid preventable harm to patients. Leapfrog HSGs are assigned to nearly 3,000 general acute-care hospitals across the nation twice annually and represent a facility's ability to avoid preventable harm to patients. Outcome measures include errors, accidents, and injuries that the hospital has publicly reported. Process and structural measures include the management structures and procedures a hospital has in place to protect patients from errors, accidents, and injuries.

Measures are linked to patient safety as they evaluate processes that lead to better health outcomes and directly quantify events of preventable harm and are identified by experts as important to patient safety. Safety measures can be divided into two domains: (1)

Process/Structural Measures and (2) Outcome Measures. Each domain comprises 50% of the Leapfrog HSG. Supplemental Table 1 lists the measures included in the grade, as well as the data source and reporting period for each measure. In some cases where a hospital's information is not available for a certain measure, Leapfrog uses a secondary data source (as indicated in Supplemental Table 1).

Physician executives tend to maintain greater credibility with clinicians than their peers without a medical background on clinical issues (Modern Healthcare 2008). To address the most common management shortfalls seen in hospitals run by professionals without a clinical background, this paper identified six recent studies which found that poor policies for staffing, job responsibilities, and other aspects of patient care (Aiken et al., 2022; Carayon, Alvarado, Brennan et al., 2008; Eaton, 2000; Jones, Lankshear, Kelly, 2016; Kachalia et al., 2016; Lundstrom et al., 2002), put in place by non-clinical executives, lead to harm for both patients and clinicians. While these studies address the need to include nurses in discussions involving important topics such as staffing policy changes, they fail to discuss how having an executive with clinical nursing experience would lend itself to enacting positive change in the system.

To better understand the career pathway for nurse CEOs and how they experience their roles differently than non-nurse executives, this study identified six articles (Anderson, 2014; Hess, 2004; Parisi, 2020; Patton, Zalon, Ludwick, 2015; Sanford, 2020; Weber, 2002). These studies illustrated that hospital CEOs with a clinical nursing background have strong collaboration with colleagues and uniquely understand the clinical implications of financial decisions. One article (Weber 2002), makes the argument that nurses are both well suited and professionally obligated to understand and participate in policy making. The literature also indicated that nurses in policy-making positions are supported by a program run by the American

Nurses Association that equips and enables nurses to take on leadership roles in health policy. Having strong support by a large professional organization empowers nurses to pursue executive leadership opportunities and excel in these roles.

Finally, to address the question of whether executive leadership actually has a clinically meaningful impact on the patient and nurse experience in the hospital, This study identified seven studies that speak to how hospital board and management practices are strongly related to hospital performance on clinical quality metrics (Akinleye et al., 2019; Blackman, 2021; Jiang, Lockee, Fraser, 2012; Parand et al., 2014; Spurgeon, Mazelan, Barwell, 2011; Spurgeon, Clark, Wathes, 2015; Tsai et al., 2015). All of these studies established that hospitals with more clinical evidence-based management practices provide higher quality care. Furthermore, the hospitals with good clinical outcomes had highly rated executive boards that paid greater attention to clinical quality by monitoring clinical outcomes and setting clinical-based organizational goals. This study utilized this knowledge to support my theory the idea that having a clinical background means nurse executives prioritize the quality of patient care as they make financial and policy decisions for the hospital they oversee. This study aimed to contribute more systematic evidence exploring the success of clinical executive leadership and explore why this may be the case.

1.2. Study Purpose

The purpose of this study was to investigate the association of the hospital CEO's clinical background on the quality of care delivered in U.S. teaching hospitals. This paper was limited to describing outcomes related to patient-reported experience and publicly reported hospital safety measures. The specific aims for this study were to 1) determine if the presence or absence of a

clinical background for a hospital CEO (either as a nurse or physician) is associated with patient experience scores, 2) determine if hospitals lead by clinically trained CEOs are more likely to achieve Magnet designation, and 3) understand whether Magnet status is correlated with patient experience and safety. My hypothesis for the first aim identified was that a hospital with a greater number of years under a clinician CEO would be associated with greater hospital experience scores. For the second aim, this study hypothesized that Magnet designation would be significantly associated with years of clinician CEO leadership. Finally, this study hypothesized that Magnet designation would translate to improved patient safety outcomes and higher patient experience scores as compared to non-Magnet institutions.

2. Methods

The 2018 to 2022 American Hospital Association (AHA) Annual Survey Data was scrutinized to identify 260 non-specialty teaching hospitals in the United States, all of which were included in the study to maximize statistical power. Performance metrics were studied between hospitals with CEOs of different educational backgrounds and varying Magnet status, as measured by outcome and process measures reported in the Leapfrog Safety survey for hospitals.

2.1 Data Sources

For this analysis, this study compiled data from three sources: (1) hospital characteristics from the 2018-2022 AHA Survey Database; (2) the ongoing list of hospitals with Magnet designation (ANA 2023); and (3) the 2023 Leapfrog Hospital Safety Grade (HSG) dataset, which includes hospital grades, Safe Practice Score (SPS) measures as reported in the 2023 Leapfrog Hospital Survey, and all other HSG components listed in Supplemental Table 1. The AHA

Annual Survey is an informative resource for demographic, operational, financial and IT-related data on U.S. hospitals. The survey data comprise hospital organizational structure, service workstreams, utilization, financials and employee status. Hospital executive credentials are not reported in the AHA Annual Hospital Survey or any publicly accessible database. Therefore, the CEO's educational background was identified using a keyword search in LinkedIn and Google. The executive's name and title were searched, and they were assigned as nurse, physician, or non-clinical CEO. This study aligned the 2018 to 2022 AHA Annual Survey data with the 2023 Magnet Designation data and 2023 Leapfrog survey data (representing the years 2019 to 2023) by manually cross matching the organization's name and location.

Leapfrog data describing hospital performance were compiled for U.S. teaching hospitals to compare outcomes according to CEO background and Magnet status. The most recent data available for each measure was utilized. Due to delays with reporting during the COVID-19 pandemic, the 2023 Leapfrog Hospital Results represent performance data spanning from 2020 to 2023. Computerized Physician Order Entry (CPOE), Bar Code Medication Administration (BCMA), Intensive Care Unit Physician Staffing (IPS), and the two National Quality Forum (NQF) Safe Practices (SPs), Total Nursing Care Hours per Patient Day and Hand Hygiene, were reported in the Leapfrog Survey from 2023. Bloodstream infection (CLABSI), urinary tract infection (CAUTI), MRSA, C. Diff, and SSI Colon data were collected over the following period of time: 07/01/2022 - 06/30/2023. Five of the seven patient experience measures and five infection measures (for hospitals that did not report via the Leapfrog Hospital Survey) represent data from 04/01/2022 to 03/31/2023. Three Hospital-Acquired Condition (HAC) measures, as well as Patient Safety Indicators (PSIs) 4 and 90, represent data collected between July 2020 and July 2022.

2.3 Study Population

The sample consisted of U.S. teaching hospitals that are members of the Council of Teaching Hospitals of the Association of American Medical Colleges. This designation was indicated by the 'MAPP8' indicator within the AHA Survey data. Data from the AHA and Leapfrog Safety surveys reported annually and biannually, respectively, for each of the five years between 2018 and 2022 were collected, analyzed and interpreted. Hospitals that did not submit data to the Leapfrog Group within this designated time period or those that were not required to participate in the CMS annual survey were excluded from this study. Hospitals which were not responsible for submitting data to CMS include those designated as Critical Access Hospitals, Rural Referral Centers, and those of small size (less than 25 beds). To eliminate additional confounding, other exclusions included hospitals located in territories outside the 50 U.S. states, hospitals operated by the federal government, as well as children's and other specialty hospitals.

2.3 Variables

Hospital performance metrics including both outcome and process measures from Leapfrog safety data published online were analyzed. The independent variable was the educational background of the hospital's CEO: nurse, physician, and non-clinician. AHA Annual Hospital Survey data from 2018 to 2022 were utilized to determine the name of each hospital's chief administrator in each of those five years. An executive was assigned to the "nurse CEO" group if they were identified as holding a Bachelor of Science in Nursing (BSN) degree,

Registered Nurse (RN) license or other nursing degree. An executive was assigned to the "physician CEO" group if they held a Medical Degree (MD) or Doctor of Osteopathy (DO) degree. An executive was assigned to the "non-clinician CEO" group if they held none of the aforementioned nursing or medical degrees.

Magnet designation is an exclusive status awarded to select health care organizations that meet certain high standards for hospital performance by way of leaders aligning nursing strategic policies to improve patient care. Hospitals may apply for Magnet status with an extensive application and are scored by appraisers from the American Nurses Credentialing Center. High-scoring hospitals are visited by appraisers and observed over a three-day period, during which staff and patients are interviewed about how their needs are being met and interprofessional collaboration. Magnet Recognition is awarded based on the following criteria: patient and nurse satisfaction, adherence to patient care standards, interprofessional collaboration, leadership of the chief nurse executive in supporting professional practice, nurse competency and continuing education, and nurse impact on patient outcomes. The mission of the Magnet Recognition Program is to encourage hospital environments that cultivate collaboration between nurses and the interprofessional team and set standards for quality of care through leadership, scientific discovery and continued pursuit of new clinical knowledge and skills. Therefore, it was included as both an independent and a dependent variable to describe the dataset and understand the level of care delivered by these hospitals.

Although there are some similarities between the outcome measures used by the Magnet Recognition process and the Leapfrog Group, the CMS outcomes represent the most comprehensive outcome measures available. The Leapfrog Group classifies each outcome and process measure under five subcategories: 'Infections'; 'Problems with Surgery'; 'Safety

Problems'; 'Practices to Prevent Errors'; and 'Doctors, Nurses & Hospital Staff'. Twenty-nine of the thirty-two performance measures, representing all five subcategories, were analyzed for each hospital in the dataset; 17 were outcome measures and 12 were structural or process measures. Three measures were excluded due to lack of evidence supporting relevance to CEO performance. Of the 29 measures selected, 7 were selected (MRSA infection ('MRSA'); C. diff infection ('C. diff'); infection in the blood ('CLABSI'); infection in the urinary tract ('CAUTI'), death from serious treatable complications ('preventable deaths'), total nursing care hours per patient day ('nurse staffing'), and communication with nurses) due to their status as nursing-sensitive outcomes, based on evidence from a 2021 study (Oner et al 2020). Nursing-sensitive indicators are the criteria for patient health status that nursing care can directly impact. It is important to note that several infection measures were considered nursing-sensitive as infection prevention largely falls among the nurse's responsibilities due to the importance of maintaining cleanliness, close patient monitoring, and other nursing-related procedures. Several physician-sensitive indicators were also included in my analysis of the 29 measures, including: computerized physician order entry (CPOE), harmful events, communication about medicines, and communication with doctors. These metrics were selected based on evidence from the AHRQ that identified them as being strongly associated with physician care due to their association with typical physician responsibilities in the hospital. The remaining performance measures were included in the analysis due to their hypothesized relationship with hospital organizational structure and processes.

1. Infections

There are six outcome measures associated with the 'Infections' subcategory. All six of these measures (MRSA; C. diff; CAUTI; CLABSI; surgical site infection after colon surgery

('SSI colon'); and sepsis infection after surgery ('sepsis')) were determined to be relevant to the study and included in the analysis:

MRSA Infection and C. diff Infection

Methicillin-resistant Staphylococcus aureus (MRSA) is a staph bacterium resistant to many antibiotics which can cause life-threatening bloodstream infections, pneumonia and surgical site infections. Clostridium difficile (C. diff) is another bacterium that can cause severe gastrointestinal symptoms and fever and can be very difficult to treat. According to the Leapfrog Group, hospitals who score well in 'MRSA infection' as well as in 'C. diff infection' tend to isolate infected patients appropriately, provide thorough and frequent disinfection of contaminated rooms and equipment, enforce personal protective equipment utilization and promote proper handwashing by providers and staff. The scores a hospital receives for MRSA and C. diff infections represent a comparison of the number of infections that occurred at the hospital to the number of infections expected for this hospital, based on the number of patients they treat per day and the rate of infection in the community. A number less than one means fewer infections than expected; a number greater than one means more infections than expected.

Infection in the blood and Infection in the urinary tract

Some patients require a central line (a tube inserted into a blood vessel) to receive medications and food if they are medically compromised in some way. Patients with a central line are at high risk for developing a dangerous infection in the blood which can extend recovery time and often lead to death. Similarly, many hospitalized patients require a urinary catheter to facilitate proper excretion, which creates a risk for infection in the urinary tract. The Leapfrog Group indicates that hospitals with better infection scores enforce strict procedural guidelines for associated- device insertion, maintenance, and removal. A hospital's score for each of these two

categories represents a comparison of the number of infections that actually happened to the number of infections expected for this hospital, given the number of devices used and other factors like facility type and size. A number lower than one means fewer infections than expected; a number more than one means more infections than expected.

Sepsis infection after surgery and Surgical site infection after colon surgery

Sepsis is an extreme systemic reaction to an infection that can cause organ failure and even be fatal if not managed immediately. Surgery puts patients at risk of infection that can develop into sepsis. The Leapfrog Group indicates that safer hospitals tend to have effective post-surgical monitoring of patients. The number for this outcome measure represents the number of surgical patients that experienced a sepsis infection for every 1,000 people who had surgery at that facility.

Surgical site infection after colon surgery often results in long stays in the hospital's intensive care unit. The Leapfrog Group states that hospitals who perform well with this metric enforce special cleaning, appropriate antibiotic therapy, and close patient monitoring. This datapoint represents a comparison of the number of infections after colon surgery that actually happened at this hospital to the number of infections expected for this hospital, given the types of patients they care for and other factors like a patient's age and type of surgery. A number lower than one means fewer infections than expected; a number more than one means more infections than expected.

2. Problems with Surgery

There are seven outcome measures associated with the 'Problems with Surgery' subcategory. Four of these measures (surgical wound splits open, death from serious treatable

complications, kidney injury after surgery, and serious breathing problem) were determined to be relevant to the study and included in the analysis:

Surgical wound splits open

After major surgery, surgical wounds may split open and create immense pain as well as risk for infection. The Leapfrog Group indicates that in safer hospitals, doctors and nurses closely monitor incisions and provide appropriate patient education for incision care after surgery. This number represents the number of times surgical wounds split open for every 1,000 people who had surgery on their abdomen.

Death from serious treatable complications

Patients may develop serious complications after surgery such as infection, heart attack, or loss of function in certain organs, and require strict monitoring and follow-up care. The Leapfrog Group states that safe hospital practices include staff communication after surgery and adherence to patient safety guidelines to limit preventable patient deaths. This datapoint represents the number of surgical patients that died for every 1,000 people who had a serious treatable complication after surgery.

Kidney injury after surgery

Some patients may experience kidney failure after major surgery. Hospitals who earn high scores for this category regularly monitor blood by collecting labs and urine output. Close monitoring leads to early intervention, which is key to preventing irreversible damage. This datapoint describes the incidence of kidney failure for every 1,000 surgical patients.

Serious breathing problem

After surgery some patients can develop a serious breathing problem, so their respiratory status must be monitored in the hospital. This datapoint describes the incidence of respiratory emergencies for every 1,000 surgeries.

3. Safety Problems

There are seven outcome measures associated with the 'Safety Problems' subcategory. All seven of these measures (harmful events; dangerous bed sores; patient falls and injuries; falls causing broken hips; collapsed lung; dangerous blood clot; air or gas bubble in the blood) were determined to be relevant to the study and included in the analysis:

Harmful events

Preventing medical errors in the hospital setting presents opportunities for improving patient care. Facilities that perform well with this metric practice proper error documentation, conduct debrief sessions after an error occurs, and create a plan to prevent it. The 'harmful events' datapoint represents the number of times patients experienced dangerous safety-related adverse events for every 1,000 discharges.

Dangerous bed sores

Bed sores form when a patient lays or sits in one position for too long without being moved. Advanced sores (known as 'pressure ulcers') can cause pain and infection if unmanaged, and lead to longer hospital stays, amputation, or even death. The Leapfrog Group indicates that staff in high-performing hospitals move patients regularly, frequently check for sores, and provide preventative care as needed. This datapoint represents the number of times patients experienced dangerous bed sores for every 1,000 discharges.

Patient falls and injuries and Falls causing broken hips

Falls often happen in the hospital when patients who cannot walk on their own try getting out of bed or moving around. Patient falls extend hospital stays, exacerbate medical problems, and may cause permanent disability or loss of mobility that can lead to depression. Older patients or those with weaker bones are also at risk of breaking their hip if they fall. The Leapfrog Group suggests that hospitals who score well in this category educate patients about their restrictions and follow facility fall prevention guidelines. The number of 'patient falls and injuries' describes the number of falls or other types of trauma for every 1,000 people discharged. The number of 'falls causing broken hips' describes the incidence of hip fractures for every 1,000 people discharged.

Collapsed lung, Dangerous Blood Clot, and Air or gas bubble in the blood

A collapsed lung can occur when a doctor or nurse is inserting a catheter, a feeding tube, or other medical device. Hospitals that score well in this category train staff on appropriate device insertion and management. This datapoint represents the incidence of collapsed lungs for every 1,000 discharges.

A blood clot can be caused by damage to tissue during surgery or lack of mobility and can be fatal if not detected or managed effectively. Providers in high-performing hospitals use compression devices, prescribe blood thinners, monitor at-risk patients, and help patients ambulate as soon as possible after surgery. This datapoint describes the incidence of dangerous blood clots for every 1,000 surgical patients.

An air or gas bubble (air embolism) impedes blood flow and can happen during surgery or other procedures, like getting an injection. The Leapfrog Group indicates that in safer hospitals, staff are trained on how to safely insert or remove catheters and other tubes and

monitor patients for changes. This datapoint represents the number of air embolisms in the blood for every 1,000 discharges.

4. Practices to Prevent Errors

There are six outcome measures associated with the 'Practices to Prevent Errors' subcategory. All of these measures (doctors order medications through a computer; safe medication administration; handwashing; communication about medicines; communication about discharge; staff work together to prevent errors) were identified as relevant to this study and included in the analysis:

Doctors order medications through a computer

Hospitals who score well in this category use Computerized Physician Order Entry (CPOE) systems to order medications for patients in the hospital, which reduces medication errors. These systems alert the doctor if they try to order a medication that could cause harm, such as an incorrect dose or one that could cause an allergic reaction. Hospitals may earn up to 100 points for using a well-functioning CPOE system in most parts of the hospital.

Safe medication administration

Using bar code medication administration (BCMA), nurses can scan the medication and the patient's ID band to administer the correct dose to the correct patient. If the bar codes do not match, this signals there is an error, giving nurses and doctors the chance to confirm they have the right patient, right medication, and right dose. Hospitals earn up to 100 points for using a well-functioning bar-coding system for all medication orders, and making sure it is used properly to prevent medication errors.

Handwashing

Healthcare workers can help stop infection and illness by washing their hands to prevent the spread of bacteria between patients. Hospitals that score high in this metric provide training and institute policies to encourage frequent handwashing and can earn up to 100 points for having a handwashing policy and evaluating how hospital workers follow it.

Communication about Medicines

This measure reflects patients' feedback on how often hospital staff provided education for any new medicine they are given. Hospitals that score well on this measure speak with every patient as effective communication about medicine prevents misunderstandings that could lead to medical emergencies. Based on a scale of zero-100, this number describes a comparison of patients' perspectives of how effectively this hospital communicated about their medications as compared to patients in other hospitals.

Communication about Discharge

This measure describes how well the hospital staff communicated with patients about discharge and whether they were provided with resources to take home. Thorough discharge education on at-home recovery reduces readmission rates. Hospitals that score well take time with every patient to answer their questions and cover all relevant topics related to discharge. This number represents a comparison of patients' perspectives of how effectively this hospital communicated with patients about the help they would need after discharge relative to patients in other hospitals, on a scale of zero-100.

Staff work together to prevent errors

Collaboration among hospital staff reduces the likelihood of medical errors. Hospitals that perform well in this category routinely assess their physicians, nurses, and other personnel regarding safety culture and share feedback with leaders and staff in order to devise focused

strategies for improvement. Hospitals are graded on a scale of 120 points on safety culture, providing staff feedback, and error prevention strategies.

5. Doctors, Nurses & Hospital Staff

There are six outcome measures associated with the 'Doctors, Nurses & Hospital Staff' subcategory. All six of these measures (effective leadership to prevent errors; nursing and bedside care for patients; specially trained doctors care for ICU patients; communication with doctors; communication with nurses; responsiveness of hospital staff) were identified as relevant to this study and included in the analysis:

Effective leadership to prevent errors

Errors become more prevalent when hospital leaders fail to prioritize patient safety. In hospitals that score well, leaders collaborate with staff to address safety challenges and share their initiatives with the community. Additionally, good leaders prioritize implementing the most effective error-prevention methods and are accountable for identifying and mitigating unsafe practices. Hospitals earn up to 120 points for having leaders that actively make improvements to target identified patient safety issues.

Nursing and Bedside Care for Patients

Improved staffing strategies significantly enhance the quality and safety of patient care. Hospitals with increased numbers of nurses and support staff tend to offer patients better experiences and achieve improved health outcomes. Insufficient nurse staffing can lead to complications, prolonged hospitalizations, and even death. It's imperative for hospitals to maintain adequate numbers of trained nurses capable of delivering direct patient care, including monitoring and assessing patients and administering medications. Hospitals are scored on a scale

of 100 based on a comparison of staff-to-patient ratios of nurses (RNs), licensed practical nurses (LPNs), and unlicensed assistive personnel (UAPs).

Specially trained doctors care for ICU patients

A critical care unit or Intensive Care Unit (ICU) provides care for extremely ill patients. Hospitals should have experienced doctors working in the ICU to manage problems and reduce errors. There are higher death rates in hospitals where ICU patients are treated by inexperienced providers. High-performing hospitals staff ICUs with physicians who have critical care training. Hospitals can earn up to 100 points based on the quantity of experienced acute care specialists employed in their ICUs.

Communication with Doctors

This metric assesses patients' feelings toward interactions with their doctors. Strong communication between doctors and patients not only provides comfort but also plays a role in preventing errors such as medication mix-ups or misdiagnoses. Hospitals that perform well in this measure effectively promote communication practices among doctors. Based on a scale of zero-100, this datapoint describes a comparison of patients' perspectives of how effectively physicians at this hospital communicated with patients relative to other hospitals.

Communication with Nurses

This metric evaluates how patients perceive the education, attentiveness, and respect provided by nurses. Strong communication between nurses and patients not only provides reassurance but also reduces the likelihood of medication errors or misdiagnoses. Hospitals with high scores in this area promote thorough communication practices among nurses, including active listening, courteous behavior, clear education in patient-friendly language, and addressing patient inquiries effectively. Based on a scale of zero-100, this datapoint describes a comparison

of patients' perspectives of how effectively nurses at this hospital communicated with patients relative to other hospitals.

Responsiveness of Hospital Staff

This measure records patient feedback on how long it takes for a staff member to respond to the call bell. If a patient is in pain, experiencing new symptoms, or needs to use the bathroom, hospital staff must respond quickly, therefore high-scoring hospitals are often well-staffed and allocate call bell response effectively. Based on a scale of zero-100, this number represents a comparison of patients' perspectives of how quickly the staff at this hospital typically responds to patients' requests for help relative to other hospitals. Higher scores indicate a faster response time than lower scores.

2.4 Procedure

The data were derived from the 2018 to 2022 American Hospital Association (AHA) Annual Survey database. Chief administrator data were combined with publicly available data provided in the 2023 Leapfrog Safety Report. Hospitals in the AHA database were matched by facility name and location to their respective quality metrics reported by the Leapfrog Group.

2.5 Data Analysis

Linear Regression analysis was performed to determine whether the presence of a clinical background for a CEO affects hospital performance for each of the performance metrics being analyzed. T-test and Chi-square analyses were utilized to provide additional support for the results of the linear regression analysis, with respect to Magnet Designation as an independent variable. In comparative research studies, researchers measure discrepancies between groups on

a continuously scaled variable. Measures of effect for the study were p, F, and R-squared. P is the probability of error, F is the ratio between and within data groups, and R-squared is the effect size. A p-value of <.05 was enforced, meaning the probability of error from testing the hypotheses had to be fewer than 5% to be considered statistically significant.

The outcome variables of interest were outcome, structure, and process measures (categorical) and Magnet designation (binary). Separate hospital-level multivariate logistic regression models were estimated to examine the association between each of the outcome variables and (1) CEO background and (2) Magnet designation. This study controlled for hospital characteristics: size, hospital ownership and specialization, by selecting a small sample with many exclusion criteria, as described earlier.

All statistical analyses were performed using R Statistical Software (v4.3.3; R Core Team 2024). The performance of the linear regression models was assessed using measures of linear relationship (correlation coefficient) and significance (p-value).

3. Results

Hospital performance data was voluntarily reported via submission of the Leapfrog Survey by 257 of the 260 hospitals from 2018 to 2022. The remaining three hospitals either declined to report data to the Leapfrog Group, shut down within the time period in which data was collected, or were not included in the survey for other unspecified reasons. Some hospitals' displayed outcome measures for which data is ‘Not Available’; such a result was not indicative that the hospital declined to report certain statistics to the public. ‘Not Available’ indicated that the hospital did not have data for this measure because it relates to a service the hospital does not

provide, or because the hospital had too few patients or cases to report data for a particular condition or procedure.

A hospital was considered to have a 'nurse CEO' if they had at least one year of nurse leadership within the five-year period described by 2018 to 2022; a hospital with a 'physician CEO' had at least one year of physician leadership within that five-year period; a hospital with a 'clinician CEO' had at least one year of either nurse or physician leadership in that time period. Among the hospitals in the sample, the average number of years there was a nurse CEO between 2018 and 2022 was 0.62 out of the five years. More specifically, among nurse CEO-led hospitals, the average number of years of leadership for that nurse CEO within the five-year data period was 2.79 years. Among the 257 hospitals that reported data, nurse CEOs led these hospitals 12.4% of the time during the five-year data collection period. Among the 260 hospitals in the sample, the average number of years there was a physician CEO was 1.47 out of five years. More specifically, among physician CEO-led hospitals, the average number of years of leadership within the five years for that CEO was 3.53 years. Among of the 257 hospitals that reported data, physician CEOs led these hospitals 29.4% of the time during the five-year data collection period. Among the hospitals in the sample, the average number of years there was a clinician CEO (either a nurse or physician) was 2.09 years. More specifically, among clinician CEO-led hospitals, the average number of years of leadership for that CEO was 3.63 years. And, of the 257 hospitals that reported data, nurse or physician CEOs led these hospitals 41.8% of the time during the five-year data collection period.

Of the 260 hospitals from the 2018-2022 AHA sourced hospital list selected for inclusion in the sample, 257 (99%) received a Leapfrog summary grade. This study identified 58 hospitals (22%) led by nurse CEOs, of which 57 were assigned Leapfrog HSGs. This study identified 107

hospitals (41%) led by physician CEOs, all of which were assigned HSGs. 16 hospitals had both a physician and a nurse CEO within the five years of data collection. This study also identified 149 hospitals led by either a nurse or physician CEO, 148 of which were assigned HSGs.

As of March 2024, 581 (9.7%) US hospitals are Magnet institutions (ANA 2023). In this subset of 260 US teaching hospitals, 141 (54%) upheld Magnet designation (and hospitals are reevaluated every four years); that is, 24% of the total US Magnet hospital population is represented by approximately half of this dataset. 109 of the 260 hospitals (42%) had at least one year between 2018 and 2020 with a physician CEO. One hospital CEO held both a BSN, RN nursing background as well as a medical degree (MD) and was included in both subgroups. Among the 260 hospitals within the sample between the years 2018 and 2022, 57 had nurse CEOs, 107 had physician CEOs, 148 had either, 112 had neither. Among the identified 141 Magnet hospitals within this sample between the years 2018 and 2022, 35 had nurse CEOs, 57 had physician CEOs, 84 had either and 57 had neither. Nurse CEOs represented 22% of the total sample, but 25% (n=35) of the Magnet hospitals within the sample. Physician CEOs represented 42% of the total sample, but 40% of the Magnet hospitals within the sample. Clinician CEOs represented 57% of the total sample, but 60% of the Magnet hospitals within the sample. Finally, non-clinician CEOs represented 43% of the total sample, but 40% of the Magnet hospitals within the sample.

Of the 58 hospitals in the sample with at least one year between 2018 and 2022 of a nurse CEO, 35 (60%) were Magnet recognized in 2024. Of the 109 hospitals with at least one year with a physician CEO, 58 (53%) received Magnet recognition. Of the remaining 109 hospitals that had zero years of nurse or physician CEO leadership, 57 (52%) received Magnet recognition. Chi square significance tests were performed for each CEO variable however no

statistically significant relationships with Magnet status were found. It is possible that the sample size lacked statistical power in one or more comparison groups to generate statistically significant endpoint. Therefore, the effect size of the sample should be considered when interpreting the results presented in this paper.

Leapfrog Hospital Safety Grades A-F (A, B, C, D and F) were assigned to every hospital that reported data to the Leapfrog Group. For the purpose of statistical analysis, these letter grades were converted into numerical values with 5 representing a grade of 'A', 4 representing a 'B', 3 representing a 'C', 2 representing a 'D', and 1 representing an 'F'. After the average values of these safety scores were calculated, they were converted back to the letter grade which most accurately depicted the average value for interpretation. In order to accurately depict the five years of leadership summarized by the dataset (2018 to 2022), the average Leapfrog grades from the fall and spring of each year from 2020 to 2022 were used to determine the average safety score over a three-year period, which represents the years represented by the individual outcome, process, and structure measures that make up the grade.

The average Leapfrog safety score (as a statistic) for the 257 hospitals that reported data was a 3.72, or a 'B'. The 140 Magnet hospitals had an average Leapfrog safety score of 3.98 out of 5, as compared to the 113 non-Magnet hospitals who reported data, which had a combined average Leapfrog grade of 3.41 out of 5. The mean Leapfrog score for all hospitals that chose to report data in 2023 was 2.99 out of 5, or a 'C'. The average safety score for hospitals with only non-clinician CEOs was 3.83, the average score for nurse CEO hospitals was 3.71, the average score for physician CEO hospitals was 3.63 and the average score for clinician CEOs was 3.64, refuting my initial hypothesis. However, statistical significance was not found to explain the differences in safety scores.

Multivariable analysis results are recorded in Table 1 below. Linear regression analysis determined that there was no statistically significant relationship between a hospital's overall Leapfrog grade and number of years of CEO leadership with a nursing, physician, clinical, or nonclinical background. A positive correlation was discovered between number of years of a nurse CEO, number of years of a physician CEO, and number of years of a clinician CEO and Magnet status; however, these results were nullified in the linear regression analysis for all outcome categories (statistical significance was not found in any of the three relationships). However, the same analysis did identify a highly statistically significant positive correlation between hospital Magnet status and overall safety score (0.59126, p<1.16E-07). A t-test and Chi-square test were also conducted for magnet hospitals and a statistically significant correlation was confirmed by both (X^2= 19.857, p<8.35E-06; t= -5.3882, p<1.77E-07, df= 228.38, 95% CI= (-0.8074787, -0.3750445)).

Table 1. Multivariate analysis of Magnet designation, CEO Background and Leapfrog HSG

Correlation with Hospital Safety Grade (HSG):	**Chi-Square value**	**p-value**	**t-test (95% CI)**	**p-value**	**Global F-test value**	**Global F-test p-value**
Magnet Designation	45.63	**0.004903****	-5.3392 (-0.7979, -0.3677)	**2.229e-07 *****	1.2917	0.1484
Nurse CEO Hospitals	30.43	0.4626	0.88691 (-0.1388, 0.3634)	0.3772	1.2996	**0.2494**
Physician CEO Hospitals	23.26	0.4986	1.5223 (-0.0511, 0.3987)	0.1293	1.0252	0.8982
Clinician CEO Hospitals	31.04	0.1528	1.4816 (-0.0562, 0.3966)	0.1398	1.0929	0.6136

Note. *p < .05, **p < .01, ***p < .001.

Statistical significance was then identified between Magnet status and four outcome measures: incidence of MRSA infection (-0.13338, $p<0.04677$); incidence of harmful events (-6.018, $p<0.0198$); incidence of collapsed lung (-0.01198, $p<0.0309$); and incidence of broken hips due to falls (-0.015594, $p<0.0004175$). Linear regression analysis identified statistically significant relationships between Magnet status and four of the seven structural measures: CPOE medication orders (3.234, $p<0.0392$); medication administration (2.6299, $p<0.048$); leadership quality (2.293, $p<0.00426$); and nursing care hours (8.145, $p<0.0386$). Notably, regression analysis also identified statistical significance between Magnet status and all five process measures: nurse communication (1.7448, $p<2.63E-10$); doctor communication (1.2795, $p<1.84E-08$); staff response (2.046, $p<7.68E-06$); medication communication (1.993, $p<1.46E-06$); and discharge plan (1.9486, $p<4.89E-07$). Although statistical significance was not identified between nurse CEO status and Hospital Safety Grade, it is important to note that a Global F-test indicated that the null hypothesis can be rejected, and the data demonstrates significant evidence to determine that the two population variances are definitively not equal. All linear regression results for Leapfrog performance measures are reported in Tables 2-5.

Further, statistical significance was identified between the number of years of a physician CEO and one outcome measure, incidence of broken hips due to falls (-0.0027, $p<0.01373$), however there was no significant relationship found between this endpoint and nurse CEO or clinician CEO background. Additionally, statistical significance was identified between the number of years of a clinician CEO and incidence of sepsis (-0.08425, $p<0.0282$); as well as one process measure: nurse communication (0.13418, $p<0.0426$). These results indicate that hospitals led by CEOs with a clinical background may place more emphasis on infection control and

patient monitoring. This also may indicate that hospitals with clinician CEOs promote better communication practices among staff nurses and encourage providers to address patient inquiries effectively. However, statistical significance was not found independently for nurse CEO status nor physician CEO status and either of these measures. No other statistical significance was found relating CEO background and performance measures.

Table 2. Hospital Characteristics and CMS Hospital Compare Outcome Measures

Hospital Characteristics & Outcome Measures	**Constant**	**Coefficient of Hospital**	**Standard Error**	**F-statistic**	**p-value**	**R-squared**	**t-score**
Magnet							
air embolism	0.002207	0.001347	0.00214	0.3961	0.5297	0.001563	0.629
falls and injuries	0.54299	-0.05435	0.03883	1.9590	0.1630	0.007745	-1.400
CLABSI	0.85444	0.04520	0.05431	0.6926	0.4060	0.002741	0.8320
CAUTI	0.77078	-0.08941	0.04823	3.4360	0.0650	0.01345	-1.854
SSI Colon	0.99758	0.03955	0.07116	0.3089	0.5788	1.24E-03	0.556
MRSA	0.99849	-0.13338	0.06675	3.993	**0.04677***	0.01566	-1.998
C. diff	0.49072	0.04691	0.02852	2.705	0.101	0.01058	1.645
CEO Background							
Nurse							
air embolism	0.0028499	0.0001482	0.0007938	0.03487	0.852	0.0001378	0.187
falls and injuries	0.508426	0.007932	0.014391	0.3038	0.582	0.001209	0.551
CLABSI	0.882696	-0.005694	0.020112	0.08014	0.777	0.0003179	-0.283
CAUTI	0.715881	0.009664	0.017953	0.2898	0.5909	0.001148	0.538
SSI Colon	1.014728	0.007506	0.026137	0.08248	0.7742	3.33E-04	0.287
MRSA	0.94292	-0.02872	0.02476	1.345	0.2472	0.005331	-1.16
C. diff	0.521148	-0.007884	0.010614	0.5517	0.458	0.002176	-0.743
Physician							

air embolism	0.0037728	-0.0005685	0.0005266	1.166	0.28134	0.004586	-1.08
falls and injuries	0.500125	0.009091	0.009617	0.8936	0.3450	0.003548	0.945
CLABSI	0.871877	0.005039	0.013446	0.1404	0.708	0.0005569	0.375
CAUTI	0.729224	-0.005087	0.012006	0.1795	0.6722	0.3851	-0.424
SSI Colon	1.006695	0.008758	0.017538	0.2494	0.6180	0.001010	0.499
MRSA	0.8883	0.02565	0.01657	2.396	0.123	0.009454	1.548
C. diff	0.505454	0.007411	0.007049	1.105	0.294	0.004349	1.051
Clinician							
air embolism	0.0038635	-0.0004438	0.000495	0.8038	0.37081	0.003167	-0.897
falls and injuries	0.49028	0.011117	0.009007	1.523	0.2183	0.006032	1.234
CLABSI	0.874653	0.002189	0.012602	0.03017	0.8620	0.0001197	0.174
CAUTI	0.7232451	-0.0006729	0.0112537	0.003575	0.9524	1.42E-05	-0.06
SSI Colon	0.99717	0.01071	0.01647	0.4231	0.516	1.70E-03	0.65
MRSA	0.90221	0.01119	0.0156	0.5149	0.474	0.002047	0.718
C. diff	0.509096	0.003463	0.006632	0.2727	0.602	0.001077	0.522

Note. *p < .05, **p < .01, ***p < .001.

Table 3. Hospital CEO Characteristics and CMS AHRQ Patient safety and adverse events outcome measures

Hospital Characteristics & Outcome Measures	**Constant**	**Coefficient of Hospital**	**Standard Deviation**	**T-statistic**	**p-value**	**R-squared**	**t-score**
Magnet Status							
Magnet							
Preventable deaths	146.075	-6.018	2.566	5.499	**0.0198***	0.0224	-2.345
Harmful events	1.03819	-0.05905	0.0276	4.579	**0.0333***	0.01778	-2.14
Bed sores	0.84043	-0.13604	0.09324	2.129	0.146	8.34E-03	-1.459
Collapsed lung	0.193707	-0.01198	0.00552	4.71	**0.0309***	0.01828	-2.17
Broken hips	0.0725	-0.015594	0.00436	12.79	**0.0004175*****	0.04812	-3.576
Kidney injury	0.94698	0.02784	0.04575	0.3702	0.543	0.001461	0.6008

Breathing problem	6.8041	-0.452	0.3446	1.721	0.191	0.006755	-1.312
Blood clot	3.66948	0.17059	0.1318	1.675	0.197	0.006578	1.294
Sepsis	4.465	-0.2686	0.1657	2.628	0.106	0.01028	-1.621
Surgical wounds	0.81914	0.02597	0.03519	0.5446	0.461	0.002148	0.738
CEO Background							
Nurse							
Preventable deaths	142.9097	-0.3397	0.9399	0.1307	0.718	0.0005441	-0.361
Harmful events	1.009627	-0.005891	0.010314	0.3263	0.568	0.001288	-0.571
Bed sores	0.76794	-0.002705	0.034703	0.006075	0.9379	2.40E-05	-0.078
Collapsed lung	0.188215	-0.001687	0.002062	0.6695	0.414	2.64E-03	-0.818
Broken hips	0.062499	0.002437	0.001649	2.184	0.1407	0.008559	1.478
Kidney injury	0.97033	-0.01327	0.01695	0.6131	0.4344	0.002417	-0.783
Breathing problem	6.57817	-0.03327	0.12812	0.06745	0.795	0.0002665	-0.26
Blood clot	3.75348	0.0146	0.049	0.08881	0.7659	0.0003509	0.298
Sepsis	4.38694	-0.11102	0.06133	3.277	0.07143	0.01279	-1.81
Surgical wounds	0.8263	0.01137	0.01304	0.7603	0.3480	0.002996	0.872
Physician							
Preventable deaths	142.9425	-0.1683	0.632	0.07093	0.79	0.0002955	-0.266
Harmful events	1.002106	0.002662	0.006859	0.1506	0.698	0.0005948	0.388
Bed sores	0.73103	0.02409	0.02302	1.095	0.296	4.31E-03	1.046
Collapsed lung	0.184728	0.001674	0.001369	1.495	0.223	5.88E-03	1.223
Broken hips	0.06795	-0.0027	0.01088	6.159	**0.01373***	0.02376	-2.482
Kidney injury	0.94386	0.01251	0.01125	1.235	0.267	0.004859	1.111
Breathing problem	6.57482	-0.01171	0.08519	0.0189	0.8908	7.47E-05	-0.137
Blood clot	-0.137	0.02687	0.03254	0.6817	0.4098	0.002687	0.826
Sepsis	4.38649	-0.04642	0.04093	1.286	0.258	0.005058	-1.134
Surgical wounds	0.845372	-0.008257	0.008665	0.908	0.342	0.003576	-0.953
Clinician							

Preventable deaths	143.3038	-0.2885	0.5981	0.2326	0.63	0.0009684	-0.482
Harmful events	1.01	5.08E-05	6.45E-03	6.22E-05	0.994	2.46E-07	8.00E-03
Bed sores	0.72429	0.0202	0.02163	0.8718	0.351	3.43E-03	0.934
Collapsed lung	0.1854748	0.0008187	0.0012884	0.4038	0.526	0.001594	0.635
Broken hips	0.066976	-0.001432	0.00103	1.93	0.166	0.007572	-1.389
Kidney injury	0.94998	0.00586	0.01059	0.3062	0.581	0.001209	0.553
Breathing problem	6.60613	-0.02331	0.08	0.08488	0.771	0.0003354	-0.291
Blood clot	3.70137	0.0294	0.03055	0.926	0.3368	0.003647	0.962
Sepsis	4.4937	-0.08425	0.03818	4.869	**0.0282***	0.01888	-2.207
Surgical wounds	0.839221	-0.002851	0.008152	0.1224	0.727	0.0004834	-0.35

Note. *p < .05, **p < .01, ***p < .001.

Table 4. Hospital CEO Characteristics and Leapfrog Process Measures

Hospital Characteristics & Process Measures	**Constant**	**Coefficient of Hospital**	**Standard Deviation**	**T-statistic**	**p-value**	**R-squared**	**t-score**
Magnet Status							
Magnet							
CPOE	91.716	3.234	1.56	4.295	**0.0392***	0.01669	2.073
BCMA	92.8017	2.6299	1.3237	3.948	**0.048***	0.01536	1.987
ICU training	77.414	7.191	4.685	2.356	0.1261	0.009226	1.535
Leadership	116.4339	2.293	0.7932	8.356	**0.00426****	0.03972	2.891
Collaboration	116.7045	1.6575	1.2634	1.721	0.191	0.008449	1.312
Nursing care hours	72.733	8.145	3.911	4.336	**0.0386***	0.02143	2.082
Handwashing	79.509	-1.228	3.362	0.1334	0.715	0.000527	-0.365
CEO Background							
Nurse							
CPOE	94.0109	-0.8648	0.5807	2.218	0.138	0.008691	-1.489

BCMA	94.7033	-0.7602	0.4921	2.387	0.1236	0.009345	-1.545
ICU training	80.971	0.588	1.744	0.1137	0.736	0.0004491	0.337
Leadership	117.5566	0.2843	0.2911	0.9538	0.33	0.0047	0.977
Collaboration	117.4719	0.2749	0.4569	0.361	0.5481	0.001789	0.602
Nursing care hours	77.3011	0.1182	1.4493	0.006651	0.935	3.36E-05	0.082
Handwashing	78.4	0.713	1.246	0.3277	0.568	0.001293	0.572
Physician							
CPOE	94.0985	-0.4239	0.3868	1.201	0.274	0.004724	-1.096
BCMA	94.25322	-0.01226	0.32869	0.001391	0.97	5.50E-06	-0.037
ICU training	80.4728	0.5883	1.1591	0.2576	0.612	0.001017	0.508
Leadership	117.946	-0.138	0.1977	0.487	0.486	0.002405	-0.0698
Collaboration	118.5225	-0.5798	0.3075	3.555	0.06081	0.01729	-1.885
Nursing care hours	78.255	-0.5789	0.9636	0.361	0.549	0.00182	-0.601
Handwashing	79.7382	-0.6146	0.8278	0.5512	0.459	0.002174	-0.742
Clinician							
CPOE	94.9567	-0.7112	0.3615	3.782	0.052	0.01507	-1.968
BCMA	94.8739	-0.3073	0.3081	0.9944	0.3196	0.003915	-0.997
ICU training	79.778	0.7483	1.0882	0.4728	0.492	0.001865	0.688
Leadership	117.75122	-0.006276	0.185625	0.001143	0.9731	5.66E-06	-0.034
Collaboration	118.5031	-0.3987	0.2896	1.896	0.1701	0.009298	-1.377
Nursing care hours	78.3749	-0.4661	0.9068	0.2642	0.608	0.001333	-0.514
Handwashing	79.3882	-0.2641	0.7782	0.1152	0.7346	0.0004551	-0.339

Note. *p < .05, **p < .01, ***p < .001.

Table 5. Hospital CEO Characteristics and CMS Hospital Compare Structural Measures

Hospital Characteristics & Structural Measures	**Constant**	**Coefficient of Hospital**	**Standard Deviation**	**T-statistic**	**p-value**	**R-squared**	**t-score**

Magnet Status							
Magnet							
Nurse communication	88.6293	1.7448	0.265	43.34	**2.63E-10*** **	0.1463	6.584
Doctor communication	89.2241	1.2795	0.2201	33.79	**1.84E-08*** **	0.1178	5.813
Staff response	78.9397	2.046	0.4478	20.87	**7.68E-06*** **	0.07621	4.568
Medication communication	73.1293	1.993	0.4039	24.35	**1.46E-06*** **	0.08778	4.934
Discharge planning	84.3103	1.9486	0.3773	26.67	**4.89E-07*** **	0.09537	5.165
CEO Background							
Nurse							
Nurse communication	89.5016	0.1279	0.106	1.456	0.229	0.005722	1.207
Doctor communication	89.8837	0.06151	0.08676	0.5026	0.479	0.001982	0.709
Staff response	79.934	0.1963	0.1722	1.299	0.255	0.005109	1.14
Medication communication	74.19277	0.03723	0.15672	0.05643	0.812	0.000223	0.238
Discharge planning	85.33709	0.05759	0.14698	0.1535	0.6955	0.0006064	0.392
Physician							
Nurse communication	89.44062	0.09556	0.07042	1.841	0.176	0.007225	1.357
Doctor communication	89.82429	0.0665	0.05759	1.333	0.249	0.005243	1.155
Staff response	80.042933	0.008183	0.114814	0.005079	0.943	2.01E-05	0.071
Medication communication	74.0436	0.1177	0.1039	1.282	0.259	0.00504	1.132
Discharge planning	85.16602	0.14119	0.09735	2.104	0.148	0.008246	1.45
Clinician							
Nurse communication	89.3015	0.13418	0.06585	4.153	**0.0426***	0.01615	2.038

Doctor communication	89.74978	0.08266	0.05398	2.344	0.127	0.009181	1.531
Staff response	79.88076	0.08378	0.10771	0.6051	0.437	0.002386	0.778
Medication communication	73.9697	0.1183	0.0976	1.47	0.226	0.005777	1.213
Discharge planning	85.06697	0.14702	0.09135	2.59	0.1088	0.01013	1.609

Note. *p < .05, **p < .01, ***p < .001.

4. Discussion

Almost all of the hospitals in the total sample were assigned Leapfrog HSGs from 2020 to 2022. This representation of data indicates that the sample analyzed should be representative of the total population of US non-specialized teaching hospitals. Notably, a greater proportion of the teaching hospitals that make up this sample held Magnet designation than the total population of US hospitals. The Magnet-designated subset of this sample also had a slightly proportionally higher number of clinician CEOs (both of nursing and medical backgrounds) than the total sample. No statistically significant relationships between CEO background and Magnet designation were found.

Studying all of the CEOs of the hospitals in the sample, nurse CEOs were very uncommon, and physicians held the CEO position more than twice as much as nurses. CEO tenure was also evaluated across subgroups, and it was found that nurse CEOs served for fewer years on average than did physician CEOs in the five-year period. Notably, clinicians led these hospitals less than half of the time from 2018 to 2022, a surprisingly high percentage which is likely inflated in teaching hospitals due to the increased emphasis on clinician advancement and education in these institutions as well as the fact that many of these institutions are associated

with a medical and/or nursing school. Furthermore, once a nurse or physician CEO is appointed, the physician CEOs remain in their position approximately 25% longer than the nurse CEOs.

The safety outcomes analyzed in this study offer preliminary approaches to assessing the data available for investigating the connection between clinician leadership at the CEO level and hospital performance, as indicated by Magnet Status and Leapfrog grades. Leapfrog Hospital Safety Grades and Magnet designation are two publicly accessible resources that are strong indicators for both the quality and safety of US hospitals. According to the Leapfrog Group, hospitals with higher HSG's perform exceptionally well in keeping patients safe from preventable harm and medical errors, as compared to peer institutions. Magnet hospitals had a higher average Leapfrog HSG than non-Magnet hospitals, and also exceeded the average grade for the total sample of US hospitals that were assigned grades. The average safety score for hospitals with only non-clinician CEOs was greater than that of clinician CEOs, however, statistical significance was not found to explain the differences in safety scores and thus this hypothesis was not supported.

This paper first investigated whether hospitals with higher ratings in Leapfrog Hospital Safety Grades (HSGs) also received Magnet designation. The Magnet-designated hospitals within this dataset were statistically significantly correlated with higher overall Leapfrog Safety Grades. This study also examined whether Magnet-designated hospitals were safer than non-Magnet hospitals across dimensions. Leapfrog Process Measures indicate the frequency at which hospitals provide patients with the recommended treatment for a specific diagnosis or procedure. Magnet designation was independently associated with higher overall HSGs and performed better in several outcome, structure, and process measures.

Linear regression analysis revealed a positive correlation between nurse, physician, or clinician CEO status and all five CMS Hospital Compare process measures (also considered patient experience indicators), although these results lacked statistical power. It is possible that the small sample size of these subgroups nullified the data, so further study is indicated with a larger sample size to confirm whether or not clinician CEOs are associated with better patient experiences. However, a statistically significant correlation was identified between Magnet status and all five CMS Hospital Compare process measures (nurse communication, doctor communication, staff responsiveness, communication about medicines, and discharge information). This evidence indicates that patients report better experiences at Magnet-designated hospitals than non-Magnet hospitals, suggesting that Magnet institutions employ care models which structure patient care in such a way that maximizes patient experience. This analysis also revealed a statistically significant correlation between Magnet status and four of the seven structural measures included in the Leapfrog HSG (computerized physician order entry (CPOE), bar code medication administration (BCMA), culture of safety leadership structures and systems, and total nursing care hours per patient day). Structural Measures attempt to describe the hospital environment with which patients interact. This evidence suggests that Magnet-designated hospitals allocate more resources to adjust processes and structures within the hospital. Furthermore, these results indicate that such investment toward quality improvement occurs across many dimensions and manifests as improved patient experiences with hospital care.

Additionally, Magnet-designated hospitals demonstrated higher Leapfrog grades in several structural measures, although they did not consistently show better infection rates. Only one type of healthcare-associated infection (HAI), MRSA infections, had lower rates in Magnet

hospitals compared to non-Magnet hospitals. These findings indicate that enhancements in process and structural measures may not necessarily lead to reduced HAIs. Specific quality improvement strategies targeting each HAI may be necessary, given their weak correlations with one another. Future research should aim to determine effective process and structural measures for the reduction of HAIs and how these factors should be considered in evaluating Magnet designation criteria.

No statistically significant relationships between CEO background and Magnet designation were found. However, clinician CEO leadership was associated with improved reported quality measures; hospitals in clinician-led hospital systems performed better in the incidence of sepsis, as well as in the utilization of CPOE medication orders nurse communication than non-clinician-led hospitals. Similar to Magnet hospitals, the weak correlations between most outcome measures suggest further attention to nosocomial infection reduction may be necessary. Furthermore, additional research would help to identify effective institutional policies for infection reduction and improved patient experience.

In an effort to further comprehend the association of CEO background with hospital safety and patient-reported experience outcomes, this study was only able to find limited results with statistical significance. Other researchers have found variable results in evaluating the effect of physician leadership on hospital performance. See and colleagues (2022) determined that physician-led hospital systems had higher quality ratings compared with non-physician-led hospital systems. However, research conducted by Moores and colleagues (2021) revealed increased 30-day cardiovascular deaths in hospitals led by physicians compared to those led by nonphysicians. This association was rendered inconclusive in the multivariate linear regression analysis. The authors proposed that this pattern might impact clinical outcomes, though due to

the study's design, establishing temporality was not feasible. Furthermore, they highlighted the need for future studies to incorporate CEOs with a minimum tenure of three years, a factor not addressed in this project.

5. Limitations

This study has several limitations to consider. Firstly, cross-sectional studies are unable to assess causality. This paper attempted to eliminate only a limited set of potential confounding factors by controlling the data sample, however others may still be present. Secondly, the study design does not establish temporal relationships with regard to CEO background. Higher-quality hospitals, which may have access to a larger pool of CEO candidates, may be drawn to more qualified and experienced leaders, such as those with a nursing or medical degree. Thirdly, the study findings are specific to non-specialty teaching hospitals that participated in the Leapfrog survey and may not be representative of all AHA-recognized hospitals. Notably, approximately 50% of Leapfrog-rated hospitals in 2022 received an A or B grade, while approximately 86% of the hospitals included in the sample achieved a grade of A or B. Fourthly, this study did not consider certain potentially significant confounders, such as CEO tenure, years of CEO clinical experience, years of CEO administrative experience and risk adjustment. There may be inaccuracies in CEO background because data were sourced from publicly available internet platforms that may not always be current or accurate. Additionally, some administrators who are further into their careers may fail to report their educational history in its entirety on their LinkedIn page or other sources. The COVID-19 Pandemic is another potential confounding factor in this analysis however the effects of the pandemic would likely be approximately equal across hospitals and outcome categories.

6. Conclusions and Future Implications

This study described the context of Magnet status and Leapfrog grades for teaching hospitals listed in the 2018-2022 AHA survey data and combined CEO clinical background based on publicly available data sources. The findings of this study failed to identify a statistically significant association between a CEO's nursing or medical background and hospital performance, indicated by Magnet designation and Leapfrog grades. A negative correlation was identified between physician CEOs and one outcome measure, as well as between clinical CEOs and several outcome measures. However, the multivariable analysis did not indicate an association between hospital nurse CEOs and the examined quality and safety outcomes. Additionally, it is important to note that almost all of the nurse CEOs identified in the dataset were female. Future research should address the role of gender as it relates to administrative dynamics and other organizational dimensions. As the US healthcare system places more emphasis on the value of care, addressing the present challenges requires structural solutions to enhance patient care. Additional research is necessary to further explore the relationship between the hospital chief executive's clinical background and patient safety in U.S. hospitals.

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Appendix

Supplemental Table 1. The Leapfrog Group's Hospital Safety Grade: Components, data sources, weights and letter grade boundaries for Fall 2023

MEASURE	PRIMARY DATA SOURCE *(Secondary data source)*	STANDARD WEIGHT
Process & Structural Measures (N=14; Domain Weight=50%)		
Computerized Physician Order Entry (CPOE)	2023 Leapfrog Hospital Survey *(Imputation Model Applied)*	5.578%
Bar Code Medication Administration (BCMA)	2023 Leapfrog Hospital Survey *(Imputation Model Applied)*	5.424%
ICU Physician Staffing	2023 Leapfrog Hospital Survey *(Imputation Model Applied)*	7.220%
SP #1: Culture of Safety Leadership Structures and Systems	2023 Leapfrog Hospital Survey	3.147%
SP #2: Culture Measurement, Feedback & Intervention	2023 Leapfrog Hospital Survey	3.326%
Total Nursing Care Hours per Patient Day	2023 Leapfrog Hospital Survey	4.958%
Hand Hygiene	2023 Leapfrog Hospital Survey *(Imputation Model Applied)*	4.745%
H-COMP-1: Nurse Communication	CMS Hospital Compare	3.094%
H-COMP-2: Doctor Communication	CMS Hospital Compare	3.093%
H-COMP-3: Staff Responsiveness	CMS Hospital Compare	3.145%
H-COMP-5: Communication about Medicines	CMS Hospital Compare	3.144%
H-COMP-6: Discharge Information	CMS Hospital Compare	3.126%
Outcome Measures (N=10; Domain Weight=50%)		
Foreign Object Retained	CMS HACs	4.276%
Air Embolism	CMS HACs	2.443%
Falls and Trauma	CMS HACs	4.890%
CLABSI	2023 Leapfrog Hospital Survey *(CMS Hospital Compare)*	4.512%
CAUTI	2023 Leapfrog Hospital Survey *(CMS Hospital Compare)*	4.595%
SSI: Colon	2023 Leapfrog Hospital Survey *(CMS Hospital Compare)*	3.409%
MRSA	2023 Leapfrog Hospital Survey *(CMS Hospital Compare)*	4.496%
C. Diff	2023 Leapfrog Hospital Survey *(CMS Hospital Compare)*	4.434%
PSI 4: Death rate among surgical inpatients with serious treatable conditions	CMS ARHQ PSIs	1.981%
CMS Medicare PSI 90: Patient safety and adverse events composite	CMS ARHQ PSIs	14.964%
LETTER GRADE BOUNDARIES		
	Safety Score Criteria (at or above cut point)	Standard Deviations
A	≥3.202	0.6 SD Above Mean
B	≥2.991	0.00 SD Above Mean
C	≥2.464	1.5 SDs Below Mean
D	≥1.938	3.0 SDs Below Mean
F	<1.938	>3.0 SDs Below Mean

Note: **SP=Safe Practices; SCIP=Surgical Care Improvement Project; INF=Infection; VTE= Venous Thromboembolism; AHA=American Hospital Association; HIT=Health Information Technology; CLABSI=Central line-associated bloodstream infection; CAUTI=Catheter-associated urinary tract infection; SSI=Surgical site infection; PSI=Patient Safety Indicators; CMS=Centers for Medicare and Medicaid Services; AHRQ=Agency for Healthcare Research and Quality. Note that when measures are missing, weights within the same domain are adjusted proportionally upwards. For full methodological details, see Leapfrog Methodology Report from November 2023, available at https://www.hospitalsafetygrade.org/media/file/Safety-Grade-Methodology-Fall2023.pdf**

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