



Research Article

Structural Factors Influencing the Standardization Process in Acute Care Hospitals

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Abstract

This paper is an attempt to explain how structural integration, innovativeness, and Information Technology (IT) capability influence the standardization process in acute care hospitals. Using the covariance structural equation modeling along with confirmatory factor analysis to measure the theoretical constructs for the data on acute care hospitals in the United States, the authors demonstrate that IT capability, hospital-physician integration, and innovativeness directly affected the variability in standardization. The authors recommend further studies to explore how standardization may mediate the relationship between the structural variables and hospital performance variables as standardization becomes more common through institutional isomorphism via coercive, mimetic, and normative mechanisms.

Keywords: Hospital Performance; Innovation; Integration; IT capability; Standardization

Introduction

Structure-Process-Outcome is a well know framework originally presented by Donabedian for evaluating the quality of medical care. Outcomes are attributed as the definitive validators of effectiveness and quality of care in healthcare service delivery. The causal linkage among the structure of the healthcare setting, the process of care, and the outcomes is complex [1,2]. This paper is an attempt to explain how structural integration, innovativeness, and Information Technology (IT) capability may influence the standardization process in acute care hospitals. The researchers used the data for 2,352 acute care hospitals from different sources to measure these theoretical constructs using confirmatory factor analysis and explored interrelations among these study variables using the covariance structural equation modeling.

Methods

Hospital structural attributes include size, ownership, and location. In this study, hospital structural attributes are categorized into three theoretical constructs: integration, innovativeness, and

IT capability. This study focuses on the factors influencing hospital standardization. The clinical/physician integration in hospitals plays an important role in shaping clinical integration, economic integration, and non-economic integration [3]. For innovativeness, this study considers the entire range of hospitals' innovation by analyzing the role of hospitals in the major spheres of innovations - product innovation, service innovation, and organization and process innovation [4,5]. Health IT adoption by hospitals that leads to cumulative IT capability, is an essential part and process of both integration and innovation. The widespread adoption of technology by hospitals across the nation-for storage, process, and exchange of health information-justifies the consideration of IT capability as another independent structural component of a hospital system. The standards and other related factors used in the process of care for better performance are used to measure standardization. Almost all hospitals have implemented standardization for different products/services through Standard Operating Protocols (SOPs), accreditation standards for hospitals, health promotion, etc. Standardization is widely expected to impact all aspects of hospital performance [6].

To ensure adequate identification, the initial model started with all the relevant observed variables selected based on

organizational theories. In order to obtain standardized estimates, the model considered at least one variable as a marker, by setting the loadings to 1. These models were refined to obtain better Goodness of Fit (GOF) or model fit estimates, by correlating the error variance of some indicators based on the modification indices generated by AMOS and justified by the theoretical understanding of the computation of these indicators that might cause measurement errors. For the purpose of parsimony, the final models excluded some of the indicators if the model estimates remained almost the same. In the first step of model evaluation, parameter estimates with the right sign and size, standard errors within reasonable ranges, correlations of parameter estimates, and squared multiple correlations checked the appropriateness of each variable. In the second step, only absolute and relative fit indices are considered to determine how well the specified model fits the data [7-9].

The measurement of IT capability, integration, innovativeness, and standardization in hospitals is done through the indicators (observed variables) of these constructs that are statistically significant to be a representation of the concepts and the data. To measure these concepts with a certain degree of quantification, driven by the knowledge from the literature review, the researchers used both implicit and explicit criteria available in the data sets [2].

The researchers merged the relevant data sets from the Centers for Medicare & Medicaid Services (CMS) Hospital Compare, American Hospital Association (AHA) survey, and Healthcare Information and Management Systems Society (HIMSS) Analytics for over 3,000 acute care hospitals into a single relational database. As a convenient sampling method, the researchers obtained the data that includes all the observed variables that are usable for the measurement of constructs. The data were prepared and validated by comparing, combining, and transforming the data elements for use in the computation of scales for measurement indicators. The final data sets comprised 2,352 acute care hospitals with complete information in regard to three data sources. This sample size represents more than half of the hospital universe in the United States.

Considering both pedagogical and logical perspectives, the researchers selected statistical techniques - Confirmatory Factor Analysis (CFA) and covariance Structural Equation Modeling (SEM) - to explore and explain the interrelations among the study variables. The researchers scrutinized the data definitions and methodology of surveys and assignments of scores from CMS, AHA, and HIMSS sources to ensure content validity of the data elements used in the computation of indicator scales. Descriptive statistical analyses of all the variables were done, using exploratory descriptive statistics and frequency distributions with normality tests to understand the data and their distributions.

Measurement Models

The researchers performed Confirmatory Factor Analysis (CFA) of latent constructs, using IBM SPSS 24 AMOS Graphics to test the measurement models using the data files from SPSS. To ensure adequate identification, the initial model started with all relevant and observed variables selected on the theoretical basis.

Measuring IT Capability

To assess the cumulative IT capability in hospitals, this study utilized parameters (indicators) from HIMSS Analytics - Maturity Models, Electronic Medical Record Adoption Model (EMRAMSM), and the hospital survey supported by the Office of the National Coordinator for Health IT (ONC) - added as an appendix to the AHA annual survey.

The EMR Adoption ModelSM specifies eight stages (0 through 7) that HIMSS assigns to the hospitals based on criteria set forth. The data for these stages and the other parameters are available in the HIMSS Analytics(R) databases. The ONC-AHA survey has two levels (basic and full) under four categories: (a) electronic clinical information, (b) computerized provider order entry, (c) results management, and (d) decision support with subsections under each of these categories. The data source for these survey results is available from AHA Annual Survey IT Database. The EMRAM stages indicate increasing levels of clinical computing sophistication with one worldwide global standard that focuses on the workflow implications as well as installed technology.

The study uses a reflective indicator ARRA computed on several data elements that indicate the responses and published dates of CMS Meaningful Use attestations, responses to ARRA questions on Health Story implementation using HL7, speech recognition, and discrete data integration. The indicator CPOE is a scale on the percentage of affiliated physicians using the Computerized Provider Order Entry (CPOE); it is the percentage of CPOE use in various departments and mandatory CPOE use in hospitals. The EMRAM scale is based on the number of years that HIMSS validated hospitals stage 6 and stage 7 and it includes responses to various advanced features implementation questions. The indicator EMRMU is a scale based on the percentage of EMR use, the Meaningful Use attestations and the use of certified EHR. The OQR is a scale on the responses to the outpatient quality reporting health IT measures of CMS.

Measuring Integration

Integration in hospitals can include physicians or practices, ambulatory surgery centers, urgent care centers, laboratories, skilled nursing facilities, rehab centers, and patients. Integration can be structural, technical, functional, clinical, economic, and noneconomic. In this study, only the indicators pertaining to

physician integration are considered. This section discusses the four reflective indicators used to measure hospital-physician integration.

The SRVC is a scale based on the responses to over 100 questions in the AHA survey. These questions pertain to various physician services integrated into the hospital such as cardiac, orthopedic, and surgical services. The scale PHYARR is a scale based on the number of arrangements that hospitals or the hospital systems have with the physicians to work together. These are the arrangements like management service organization, closed/open physician-hospital organization, and integrated salary model. The indicator TOTPHYSNS is total number of physicians integrated into the hospital or hospital system based on several hospital-physician arrangements. The scale CLINI measures the clinical integration based on the percent range of physician documentation captured from structured templates, the percentage of physicians using the physician documentation system, and the percentage range of all medical orders entered by physicians using CPOE.

Measuring Innovativeness

Innovativeness is a means to change an organization, in terms of process, structure, or technology adoption, a proactive move to influence the environment and achieve competitive or economic advantage; and thereby enhance overall performance [10]. The innovativeness falls under the categories: product innovation (medical devices), service innovation (treatments and procedures), organization innovation, and process innovation. This study derives five indicators based on the scales computed from various services related questions in the AHA survey. The indicator PROCEDR is scale based on innovations in treatments and procedures such as extracorporeal shock waved lithotripter, hemodialysis, and robot-assisted walking therapy. The indicator IPSVCS is a scale based on services such as swing bed services, inpatient palliative care, and patient-controlled analgesia. The ‘yes’ responses to questions such as occupational health services, immunization program, and social work services compute the scale for the indicator HEALTHSVC. The responses to questions like outpatient surgery, home health services, and sleep center compute the scale for the indicator

OPSVCS. The responses to questions such as robotic surgery, proton beam therapy, and Computed-Tomography (CT) scanner compute the scale for MEDTECH indicator.

Measuring Standardization

Standardization, a process indicator, is very difficult to be quantified or measured since most of the process data are not adequately captured in the official hospital survey files. However, as the accreditation and certification authorities require adherence to the standards set forth by them, researchers were able to use the indirect measures to assess the standardization in the hospitals. We selected five indicators to measure the standardization based on the standardization implemented through process standards, hospital quality initiatives (HQI), accreditations/certifications, structural measures, and the standards for timely effective care. We computed the indicator STDSCO by assigning scores to the accreditations from organizations like TJC, Det Norske VERITAS (DNV), magnet status, Medicare certifications from CMS, and memberships of AMA, and AHA. The analysis included the average scores of HQI standards to compute the indicator HQI, sum of scores of processes of care standards to compute PROCESS, the count of structural standard measures adopted to calculate STRUC, and the average scores of timely and effective care standards to compute the indicator TEC.

Results

We treated the construct “standardization” as an endogenous process variable that mediates the relationship of exogenous structure variables such as IT capability, innovativeness, and integration to endogenous outcome variables such as efficiency, patient safety, and effectiveness. Figure 1 presents a reasonably well-fitted covariance structure equation model, which enables us to analyze the effects of structural factors on standardization. Table 1 shows the estimates and model fit statistics of the model. The major results are: 1) all three structural factors had statistically significant and positive effects on standardization; 2) the effect of integration was twice as much as that of the two other structural factors; and 3) the structural factors were correlated.

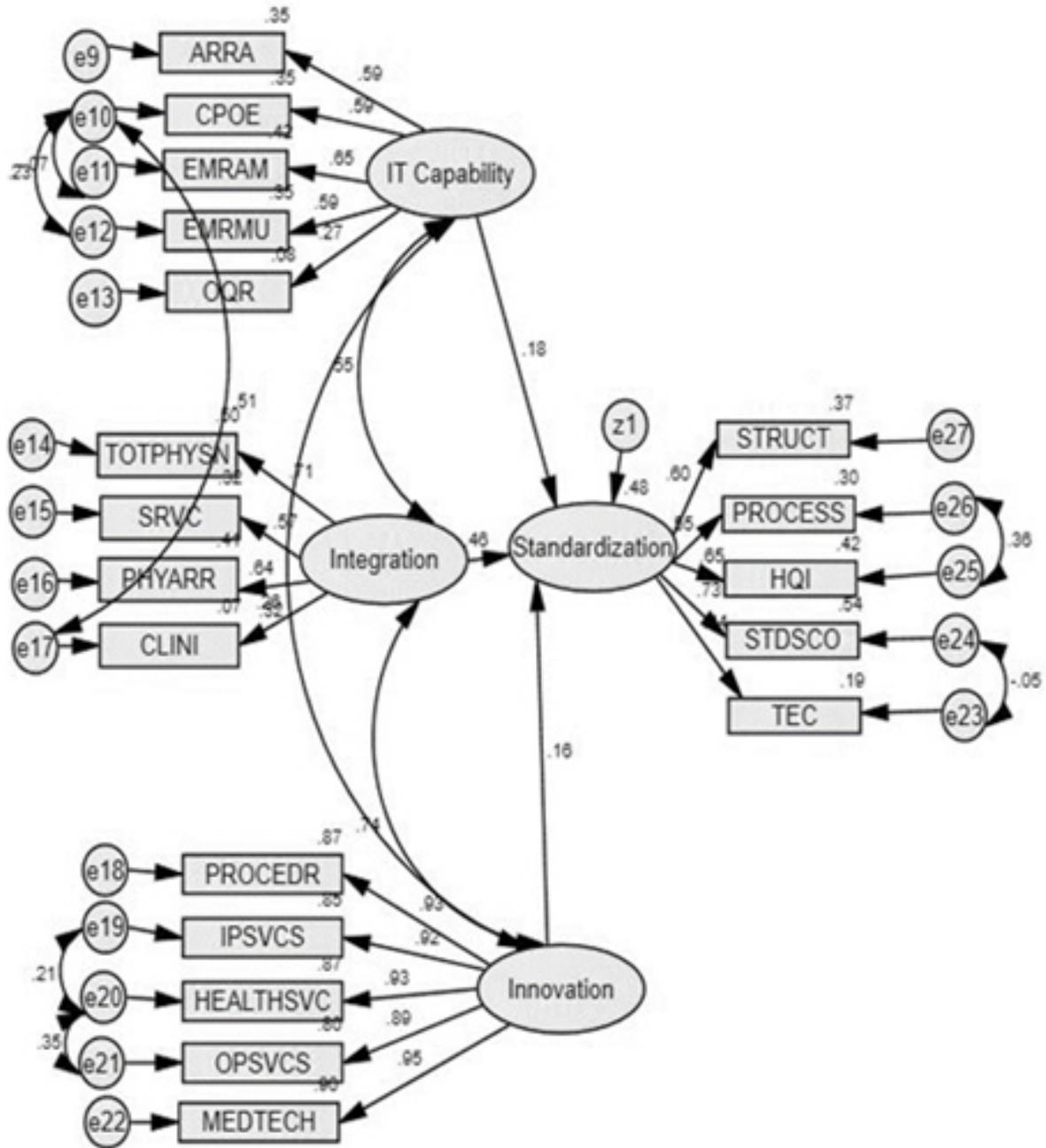


Figure 1: Covariance Structural Equation Model for Standardization in Acute Care Hospitals.

Indicator	Std. Reg. Wt.	Reg. Wt.	S.E.	C.R.	P
Standardization <--- IT Capability	.181	.021	.004	5.152	*
Standardization <--- Innovation	.158	.178	.048	3.728	*
Standardization <--- Integration	.455	.046	.007	6.668	*
* Unstandardized estimates statistically significant at $p < .001$ Squared Multiple Correlations (R²) Estimate: Standardization.431					
Correlation between constructs	Correlation				
Integration <--> IT Capability	.554				
Innovation <--> Integration	.742				
Innovation <--> IT Capability	.324				
Goodness of fit (GOF) statistics for the structural equation model: Chi-square = 2076.001, Degrees of freedom = 139 and Probability level = .000; RMR=153.189, GFI=.921, AGFI=.892, PGFI=.674, NFI=.923, RFI = .905, IFI=.928, TLI=.911, CFI=.927, FMIN=.883, RMSEA = .077, AIC=2178.001, HOELTER (.01) =190					

Table 1: Estimates and GOF Statistics for Standardization SEM.

Discussion

The research question sought to determine the interrelationships among IT capability, integration, innovativeness, and standardization. In accordance to the hypothesis, confirmatory factor analysis of these constructs confirmed that IT capability, integration, innovativeness, and standardization were four distinct concepts that showed the positive structural and functional relationships among themselves. The constructs IT capability, integration, and innovativeness represent the hospital structure characteristics whereas standardization is an attribute of the processes in hospital operations.

The findings on covariance structural model demonstrate that IT capability, hospital-physician integration, and innovativeness directly affected the variability in standardization. The impact of integration on standardization was much larger than IT capability and innovativeness, with a standardized regression weight of 0.47 compared to the weights of IT capability (.16) and innovativeness (.18). This was a very important finding which demonstrated that hospitals should focus on standardization aspects as they invest in IT capability, hospital-physician integration, and innovations. Furthermore, standardization may mediate the relationship between the structural variables and hospital performance variables. This should be explored in the future.

Among the reflective indicators for IT capability, the significant ones were CPOE, adherence to the Health Information Technology for Economic and Clinical Health (HITECH) Act requirements, meaningful use of EMR, and achieving higher stages in EMRAM validation [11]. The hospital-physician integration seemed to be vital for hospitals as integration benefits greatly

from IT capability and positively influences standardization. The indicators of integration such as clinical integration, arrangements to collaborate with physicians, and physician services provided by the hospital were all very significant [12,13].

The analysis discovered that standardization can be the mediator through which the structural factors indirectly affect the variability in performance measurements. The reflective indicators of IT capability, integration, and innovativeness have positive influences on standardization and may eventually lead to better performance.

Being a recursive and infinite process, the standardization should optimize compatibility, interoperability, repeatability, and usability over time, positively influencing the hospital overall performance. This is possible only if there is consensus and collaboration among all stakeholders and there is an ongoing evaluation of standardization process.

The most significant contribution of this study is the introduction of standardization concepts in the evaluation of performance measurement. As standardization through coercive, mimetic, and normative mechanisms derived from the institutional theory - becomes more common through system integration and increased governance, there is a greater need for research on the impact of institutional isomorphism on standardization and performance [14].

The technology adoptions, diffusion of innovations, and integration may reach a threshold beyond which the enhancements provide only legitimacy rather than improve performance [14]. The ability and willingness of the patients to travel also changes the market dynamics. Hospitals lean towards integrating more

physicians to get a larger patient base, and introducing more innovations to attract more physicians. Hospitals tend to operate influenced by the isomorphic pressures which often conflict with market economy rationale [15,16].

Isomorphism perpetuated by standardization need not create iron cages. Max Weber, a German social scientist coined the term iron cage as a metaphor for a state of the individual or a system that one gets into, through increased rationalization in capitalistic societies based on teleological efficiency and controls through bureaucratization. The studies have shown that institutional pressures may not perpetuate to the creation of iron cages. The unplanned implementation of standards without considering the heterogeneity of the hospital characteristics and the market dynamics can cause improper standardization that lead to adverse effects on outcomes. The hospital administrators instead of simply yielding to the institutional pressures (compromise or acquiescence), should wield those pressures for strategic and tactful standardizations that suit the local culture and environment of the hospital, to make positive impacts on outcomes [17-19].

In this study, the top among the reflective indicators of standardization is the scale that represents the accreditations, certification, and professional membership authorities which implies that coercive and normative pressures from these organizations are very high. Some of the standards can be demanding high resources and overlapping with standards from other organizations. The next strong indicator are the standards from hospital quality initiatives (HQI), which CMS initiated in conjunction with Hospital Quality Alliance, a public-private collaboration on hospital measurement and reporting. The standards are related to three serious medical conditions (heart attack, heart failure, pneumonia) and surgical care improvement. These and other standards for process, timeliness, and effectiveness of care are highly regulated and enforced by CMS and state agencies. These coercive pressures can be more potent as they are also in conjunction with normative pressures. Though CMS directs the standards, the process of implementing these standards is at the discretion of the hospital clinicians and administrators. Hospital administrators have to judiciously address the strategic and tactical questions by including all the stakeholders to establish the organized, recursive, and infinite process of standardization that is most suitable locally [20,21].

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