Is there a relationship between service integration and differentiation and patient outcomes?

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Abstract

Objective: To examine the level of service integration within Maryland hospitals and service differentiation across the hospital system or network and its affect on heart failure patient clinical and economic outcomes.

Data sources/Study setting: Maryland Health Services Cost Review Commission Inpatient Data for 1997 and 1998 were used for secondary data analysis.

Study design: Retrospective cross sectional. Independent variables were the level of service integration and differentiation created from the 1998 American Hospital Association Annual Survey based on the work of Bazzoli et al. [1]. The primary dependent variables were readmission, in-hospital mortality, length of stay and costs.

Data collection/Extraction methods: Patients discharged from Maryland hospitals with a diagnosis that grouped to DRG 127 (heart failure) were extracted. Multivariate linear and logistic models clustered by hospital were used to analyse results at the patient level.

Principal findings: A higher likelihood of readmission was found as the level of Community Differentiation increased. Although costs were higher as Total Differentiation increased in 1998, these results were not validated by 1997 data. No significant relationship was found between integration of services and outcomes.

Conclusions: Similar outcomes were achieved regardless of the level of service integration or differentiation. Community hospitals produce similar patient outcomes at the same cost for this diagnosis.

Keywords

integration, differentiation, organised delivery system, services, outcomes

Introduction

Hospital mergers, acquisition and redesign are frequent business activities for American health care executives. The goal of decision-makers in these efforts is usually to produce an organisation or system that is efficient (costs less) in delivering a wide range of health care services to patients. The challenge lies in making these services work together to provide effective care [2]. This effective care should focus on not only improvement of cost, but improvement in clinical outcomes.

The purpose of this study was to examine the relationship between the level of service integration within Maryland community hospitals and service differentiation across the hospital system or network and its effect on patient outcomes: readmission, mortality, length of stay (LOS) and cost. Community hospitals are non-federal, short-term general and special hospitals whose services are publicly available [3]. Length of stay and cost were measures of efficiency, while readmission and mortality measures of effectiveness. The patient sample consisted of discharges with the primary diagnosis of heart failure. Findings from this research begin to describe the effect of service organisation on the patient.

Conceptual framework, background, and hypothesis

The Quality Health Outcomes Model framed the relationships within this study through the concepts of

system, client, intervention and outcome [4]. This model is an extension of Donabedian's model, which drove the approach to quality measurement for decades. Donabedian proposed that structure (what we have) drives the processes (what we do), which produce outcomes (what we get) [5]. For example, the use of a clinical pathway (structure) will affect the processes (standardising care approaches), which will produce improved outcomes (such as compliance with medication standards, or reduce length of stay). This linear approach was revised after research failed to consistently find relationships between patient outcomes and structures or processes alone [4]. This revision resulted in a dynamic model in which system and client characteristics have a direct effect on the outcome, while interventions are moderated through system and client characteristics. This broad model consists of multiple feedback loops to represent the interrelationships that contribute to patient outcomes.

In this study, only the concepts of system, client and outcome were used. The affect of the process or intervention was not considered. The outcomes of interest were readmission, mortality, length of stay and cost. Client characteristics were age, race, gender, comorbidities, and severity of illness. The system construct was expressed as service integration and differentiation, borrowed from Contingency Theory [6].

Lawrence & Lorsch presented the concepts of integration and differentiation to organisational research hypothesising that "…different external conditions might require different organisational characteristics and behaviour patterns within the effective organisation" [6 p. 14]. Organisations differentiate into parts that must then be integrated into the organisation. Integration was defined as "…the quality of the state of collaboration that exists among departments that are required to achieve unity of effort by the demands of the environment" [6, p. 11]. It is used to describe the process as well as the organisational mechanism to achieve it. Differentiation is the differences in attitude and behaviour as well as segmentation and specialised knowledge. To have effective outcomes, the level of differentiation and integration must be in congruence [1].

Bazzolli et al. defined differentiation as "…the number of different products/services that the organisation offers reflected in the development of specialised knowledge, functions, departments, and viewpoints. Integration refers to the activities and mechanisms used to achieve unity of effort across the different specialised areas" [1, p. 1686].

To avoid confusion, it is worth mentioning that the term integration has been used to describe this unity of effort (processes), as well as organisation of services (structures). It also describes two strategies; horizontal and vertical integration that can also be discussed as processes or structures. Structurally, the horizontal integration strategy occurs as relationships are built between hospitals or similar products [7]. Vertical integration involves the successive stages of service delivery by a single organisational entity [7]. These structural strategies can also be described as processes. Horizontal integration occurs when different medical specialists collaborate on a single patient population by mechanisms such as case managers, multi-disciplinary guidelines or one medical/ nursing record [Schrijvers, G. Personal communication (2/12/03)]. Vertical integration describes the Cupertino involved in providing care across time, such as between primary health care, hospital care and long-term care [Schrijvers, G. Personal communication (2/12/03)].

Kodner & Kyriacou define integrated care as "…a discrete set of techniques and organisational models designed to create connectivity, alignment and collaboration within and between cure and care sectors at the funding, administrative, and/or provider levels" [8, p. 2]. The goal of these methods and models is to enhance quality of care and quality of life, consumer satisfaction and system efficiency for patients. Failure to integrate results in disparate services, breaks in continuity, and poor outcomes. Kodner & Spreeuwenberg state that integration is a process of improving comprehensive health care delivery [9].

Their explanation of the top-down approach to integration is similar to integration strategies or structure of services created as an economic strategy. The patient centred "bottom up view", though also an economic strategy, concentrates on the structures and processes required to promote the continuity that produces integrated services.

This connectivity or continuity can be categorised into three domains—informational, relational, and management continuity [10]. Informational continuity is the transfer of information linking providers, relational continuity is the ongoing therapeutic relationship between providers and patient, while management continuity timely and complementary services [10]. The antecedent of management continuity is the availability of services. If services are available for patients within a hospital or system, then the structures are in place to promote accessible follow up.

Within this study, integration is conceptualised at the structural level. It is operationalised as the number of services offered at the hospital level. So within a hospital, more services would produce richer re-

sources. If the process of care were collaboratively focused on the patient, better outcomes would be expected.

Differentiation is also conceptualised at the structural level, and is described as the number of services available through the hospital, network, system, or contract arrangement. Assuming that the system values unity of effort and continuity for their patient population, the availability of more and diverse services would be an advantage for the patient population to promote health. If these services area accessed, this diversity should provide an advantage for the patient.

These structural conceptualisations differ from the strategies or processes of vertical and horizontal integration or differentiation discussed. The services within this study are counted to create the concepts. This conceptualisation does not consider if the differentiated services possess the infrastructure for informational, relational, or management continuity. These domains do not measure the unity of effort established within organised delivery system, nor explain a targeted service line strategy. The strategy for providing services includes multiple alternatives.

Network, system, or contract are three types of arrangements that an organised delivery system can initiate to provide services. An organised delivery system (ODS) ''…provides or arranges to provide a co-ordinated continuum of services to a defined population and is willing to be held clinically and fiscally accountable for the outcomes and the health status of the population served'' [11, p. 447]. A system is a corporation that owns or manages health facilities [3]. A network is when hospitals and providers agree to deliver a variety of services, though the ownership is maintained by each entity [3]. A contract is an arrangement by which the management of daily operations is delegated to another organisation. As the ODS provides care to their patient population, it should be more co-ordinated and cost-effective, improving value of health services [12]. This system has more control over services, and responsibility for outcomes, so outcomes should improve [8].

If system attributes affect patient outcomes, as more services are offered the organisation creates linking processes, fostering a continuum of care. These services can be at the system level (differentiation), or at the hospital level (integration). If care is organised and delivered in a seamless continuum, improved outcomes should result. If more services are available to the patient population, richer more diverse resources are available. If these services are well linked, improved co-ordination should occur.

Thus, two hypothesis were tested:

H_1: When services are highly integrated into the hospital, patients have better outcomes.

H_2: When services are highly differentiated across the system, network, or through a contract arrangement, patients have better outcomes.

Methods

Sample

The Health Service Cost Review Commission (HSCRC) 1997 and 1998 Statewide Inpatient Data in the Public Use Format was used for clinical data [13, 14]. All patients discharged from Maryland community hospitals with the diagnosis of heart failure (Diagnostic Related Group 127), over the age of forty-five, who were admitted to the medical service with the primary diagnosis of heart failure were included in the sample. Table 1 describes the diagnoses that are included in Diagnostic Related Group (DRG) 127- heart failure.

Heart failure was selected because of the prevalence, seriousness, and cost of the disease. As a primary medical diagnosis, heart failure accounted for 725,256 discharges with Medicare charges of over six billion dollars in 1997 [15]. Additionally, the mortality rate was high (5.6%) making this diagnosis a high-risk population [16].

System variables were created from hospital responses to the 1998 American Hospital Association Annual Survey [17]. Of fifty Maryland community hospitals, seven were excluded. Five had missing data on the annual survey. Two hospitals had sample sizes of less than four, indicating that they rarely discharged patients with a diagnosis of heart failure. These hospitals were excluded since low sample size for clusters makes the estimates from regression analysis unstable. This resulted in a final research sample of forty-three community hospitals. To create the integration and differentiation variables eighty-six service variables were extracted.

Confounding variables

Age, gender, race, comorbidity and severity were used to control for client characteristics. The Charlson Index was used to control for comorbidities [18]. Weights for each diagnosis were assigned based on work by Charlson et al. [18] and diagnosis based on the work of Deyo et al. [19]. Severity was controlled through a dichotomous variable designating patients who had a

Table 1. Diagnosis that group to heart failure (DRG 127)

ICD-9	Diagnosis
398.91	Failure, heart, congestive with rheumatic fever, inactive
402.01	Hypertensive, heart disease, with CHF, malignant
402.11	Hypertensive, heart disease, with CHF, benign
402.91	Hypertensive, heart disease, with CHF, unspecified
404.01	Hypertensive, heart and renal disease, with CHF, malignant
404.03	Hypertensive, heart and renal disease, with CHF and renal failure, malignant
404.11	Hypertensive, heart and renal disease, with CHF, benign
404.13	Hypertensive, heart and renal disease, with CHF or renal failure, benign
404.91	Hypertensive, heart and renal disease, with CHF, unspecified
404.93	Hypertensive, heart and renal disease, with CHF and renal disease, unspecified
428	Failure, heart
785.5	Shock, unspecified without mention of trauma
785.51	Shock, cardiogenic

Source: Schultz, 1999 [44].

Critical Care Admission (CCA) at any time during their hospital stay.

Independent variables

Organisational variables for integration and differentiation were constructed based on a model by Bazzoli et al. (1999) [1], which was based on the work of Dranove et al. [20]. Integration was expressed as the percent of services available at the hospital level, calculated by dividing the number of services offered by the total available services. Integration was operationalised into three domains and seventy-eight service designation variables created from organisational responses to the American Hospital Association Annual Survey for 1998 [17]. The specific variables that grouped to each domain can be reviewed in Table 2. Domains of hospital service integration were: Total, High Tech, and Long Term. High Tech included services such as Cardiac Surgery or Angioplasty. Long Term included services such as Assisted Living, Arthritis Program, or Nutrition Programs. Total integration of services at the hospital level ranged from 24 to 86%, with similar ranges in high tech and long term chronic care services.

Differentiation was operationalised from eighty-six service designation variables as the number of services available within the hospital, system, network or contract and expressed as the percentage of services available within the hospital, system or network divided by the total possible services in each dimension. The domains were: Total, Acute Care, Long Term Care, and Community Differentiation. Total differentiation included all services possible. The domain of acute care included services such as the operating room, cardiac care, or a variety of diagnostic services. Long Term care included the presence of skilled nursing or residential type elder service. Community Differentiation included items related to how the hospital interacted with their local population. For example, resources for community benefit, or use of health status indicators for defined populations to design new services [3].

Total Differentiation scores ranged from 37 to 97% of all services offered either at the hospital, system, network, or through a contracted arrangement. Similar findings were achieved for all subcategories of differentiation, with the exception of Community Differentiation with a range of 50–100%.

Organisational cost to charge ratios

Cost to charge ratios were calculated from data supplied by the Health Service Cost Review Commission by dividing the average inpatient expense by the average impatient revenue of each hospital [21]. Cost to charge ratios allowed a conversion from the patient charge to the organisational cost of providing care. This ratio was then multiplied by each patient's charge to obtain the cost per admission.

Statistical analysis

Analysis was conducted using SPSS 10.0 [22] (SPSS Inc., 1999) and STATA 6.0 [23] using logistic and multiple regression clustered by hospital. Client and appropriate integration and differentiation variables were entered as a block in each equation. The association between dichotomous dependent variables (in-hospital mortality and readmission) and client control variables was tested using logistic regression. The association between continuous dependent (LOS and charges) and clinical control variables was tested using log transformed linear regression. A square root transformation was used for LOS and a log 10 transformation for cost with improvement in the z score. Regression coefficients for the continuous outcomes

Table 2. Operationalised integration and differentiation based on factor analysis

Survey service dimensions	AHA service categories
Differentiation: **Breadth of tertiary acute services**	
Cardiology services	C.5, C.20, C.25, C.47
Diagnostic	C.55.a-55.f
Emergency care	C.31a, C.31b
High-technology services	C.31b, C.62, C.32, C.47, C.55d
Home health care	C.40, C.41
Pediatric services	C.2, C.8, C.27
Specialty services	C.9, C.11, C.32, C.39, C.46, C.51, C.54
Surgical services	C.4, C.47, C.48, C.62
Women's health/OBG	C.3, C.6, C.7, C.23, C.24, C.56, C.66
Breadth of long-term/chronic care services	
Community services	C.22, C.28, C.29, C.33, C.36–38, C.43–45, C.49, C.50, C.58, C.60, C.61, C.63
General acute care services	C.1, C.26, C.34, C.42, C.52, C.64
Geriatric services	C.18, C.21, C.35, C.57
Long-term services	C.14–16
Other services	C.17, C.30, C.59, C.65
Psychiatric services	C.12, C.13, C.19, C.53a-53g
Breadth of community orientation	D1–8
Integration: **Extent of long-term care/chronic care** **provided at the health network/system level**	
Community services	C.22, C.28, C.29, C.33, C.36–38, C.43–45 C.49, C.50, C.58, C.60, C.61, C.63
General acute care services	C.1, C.26, C.34, C.42, C.52, C.64
Geriatric services	C.18, C.21, C.35, C.57
Long-term services	C.14–16
Other services	C.17, C.30, C.59, C.65
Psychiatric services	C.12, C.13, C.19, C.53a-53g
Specialty services	C.9, C.11, C.32, C.39, C.46, C.51, C.54
Women's health/OBG	C.3, C.6, C.7, C.23, C.24, C.56, C.66
Extent of high-tech services provided at the **health network/system level**	
Cardiology services	C.5, C.20, C.25, C.47
Diagnostic	C.55.a-55.f
Emergency care	C.31.a, C.31.b
High-technology services	C.31b, C.62, C.32, C.47, C.55d
Home health care	C.40, C.41
Surgical services	C.4, C.47, C.48, C.62

Note: *Peds not included in integration because it split evenly on both factors.

represent the percent change in readmission and mortality as integration and differentiation changes by one service. Intraclass correlation was used to estimate the variation in the outcome attributed to the differences in hospitals. Model Chi-square was used to validate logistic model significance. Findings from 1998 were compared with findings from 1997 data, since conclusions consistent for a validation sample support the reliability of the prediction of the outcomes [24, 25].

Results

Patient characteristics

The sample consisted of 13,732 discharges in 1998 with 13,258 in the 1997 validation sample (see Table 3). The gender, race and marital status of patients were similar in 1997 and 1998. Females were predominate (57%). Race was collapsed to two categories, white and non-white. The majority of the sample was over seventy-five years of age (53%), followed by sixty-five to seventy-four years of age (25%), and forty-five to sixty-four (22%) years of age.

Similar percentages were married (41%) or widowed (39%). Most of the patients were admitted emergently (86%) followed by urgent admissions (10%). Admission source was predominately from home locations (85%). Most of the sample was discharged home (70%) or to home health care (8%). The majority of patients had insurance coverage by Medicare (74%) followed by patients covered by a Health Maintenance Organisation (HMO) (11%).

The mean score for the Charlson Comorbidity Index was 1.37, with 94% of the sample having scores of three or less. Patients who died had an average index of 1.65 while patients who lived had an average score of 1.36. The distribution of the totalled summed scored was severely skewed. As a result, the index was collapsed into three categories based on the number of comorbidities: zero to one, two to three, and four or over. The predominate distribution of the resulting frequencies were in scores of 0–1 (66%), followed by 2–3 (28%), and four or greater (6%).

Patient outcomes

A summary of 1998 patient outcomes can be reviewed in Table 4. Eighteen percent of the patients had been readmitted within thirty-one days of discharge. Three percent of the total sample died. The mean length of stay was 4.58 days. The distribution was normalised by a square root transformation. Readmitted patients had a higher length of stay (4.74 vs. 4.54).

There was no significant difference in the cost to charge ratios in 1997 and 1998 using a paired t-test (p = 0.942). The average cost per patient in 1998 was $4,287. Cost was severely skewed and kurtotic. Multivariate outliers with Mahalanobis distances of greater than 9.99 (cost greater than $12,219.10) were recoded to $12,219.10. Attempts to transform the data using a Log 10 transformation failed to reduce the z score to below three.

Patient outcomes from hospitals included in the sample, and those hospitals not included were reviewed to determine if a difference existed in outcomes (see Table 4). Hospitals not included in the sample were those that did not respond the AHA Annual Survey (five facilities). The two hospitals that discharged less than four patients, which were excluded from the sample, were not considered in this analysis. There were no significant differences in mortality or length of stay. Significant differences were found in cost and readmission outcomes. Patients in the sample had a lower readmission (18.4% compared to 20.1%) and a lower cost per admission ($4,287 compared to $4,723).

Although not statistically significant, hospitals in the sample had a lower number of admissions and beds set up and staffed (see Table 4). The sample also included rural hospitals and a lower percentage of teaching hospitals. This would indicate that there was a better representation of hospitals in the sample, and that those not included represented more teaching, urban facilities that discharged a larger number of patients.

Design effect

Intraclass correlation (ICC) between hospitals and outcomes were examined on the combined 1997 and 1998 samples for readmission, mortality, length of stay, and cost to determine the design effect, or the variance in the outcome that can be attributed to hospital endogeniety [26]. The ICC is an estimate of the variation explained in the outcome by the differences in hospitals. Higher ICCs are associated with increased endogeniety at the hospital level. The highest ICC was associated with readmission (8.3%) and the lowest associated with mortality (0.5%) (see Table 5).

Service integration effect

Analysis consisted of multivariate logistic regression, clustered by hospital, examining the effect of service

Table 3. Characteristics of study CHF discharges

	1997 Frequency (%) n = 13,258	1998 Frequency (%) n = 13,732
Admitting nature		
Emergent	11,506 (87%)	11,766 (86%)
Urgent	1374 (10%)	1319 (10%)
Scheduled	328 (3%)	636 (5%)
Admitting source		
Home	11,666 (88%)	11,615 (85%)
On site ASU	888 (7%)	1265 (9%)
Nursing Home	413 (3%)	442 (3%)
Transferred to specialty Centre	89 (1%)	59 (1%)
Transferred from another hospital	92 (1%)	265 (2%)
Gender*		
Male	5610 (42%)	5857 (43%)
Female	7648 (58%)	7873 (57%)
Race		
White	9199 (69%)	9433 (69%)
African American	3900 (29%)	4060 (30%)
Other	159 (1%)	239 (2%)
Marital status**		
Single	1441 (11.%)	1529 (11%)
Married	5241 (40%)	5606 (41%)
Separated	352 (3%)	310 (2%)
Divorced	923 (7%)	879 (6%)
Widow/Widower	5201 (39%)	5304 (39%)
Age		
45–64	2789 (21%)	3007 (22%)
65–74	3576 (27%)	3490 (25%)
Over 75	6893 (52%)	7235 (53%)
Payor		
Medicare	10,018 (76%)	10,169 (74%)
Medicaid	648 (5%)	699 (5%)
Blue cross	570 (4%)	590 (4%)
Commercial	446 (3%)	460 (3%)
Self pay	238 (2%)	276 (2%)
HMO	1241 (9%)	1459 (11%)
Other	97 (1%)	79 (1%)

Note: All Percents rounded – Percents less than 1% not reported, *Two unknown in 1998, **One hundred four unknown in 1998.

integration on the likelihood of readmission and mortality. Likewise, ordinary least squares regression was used for length of stay and cost. All models were significant predictors of outcomes of interest (see Table 6). Domains were examined in separate equations from the total score. Patient level data (age, gender, race, collapsed Charlson Index, and CCA admission) was used as patient control variables to account for differences among hospitals in patient characteristics. No significant relationship was found between any service integration domain and the patient's likelihood of readmission, mortality, cost or length of stay (see Table 6). Hypothesis one was not supported.

Table 4. Comparison of 1998 patient outcomes and hospital characteristics, sample, non-sample, and total

Variable	Sample	Not in sample	Total
Patient (N)	13,732	2,171	15,903
Readmission (%)	2,521 (18.4%)	437 (20.1%)*	2958 (18.6%)
Mortality (%)	414 (3.0%)	49 (2.3%)	463 (2.9%)
LOS (SD)	4.58 (3.53)	4.44 (3.25)	4.56 (3.5)
Cost (SD)	$4,287 (695)	$4,723 (324)	$4,392 (3,343)
Organisation (N)	43	5	48
Urban (%)	35 (81.4%)	5 (100%)	40 (83.3%)
Teaching (%)	9 (20.9%)	3 (60.0%)	12 (25%)
Admissions (%)	11,131 (7,810)	16,496 (4,446)	11,690 (7,677)
Beds set up and staffed	250 (213)	326 (99)	258 (205)

Note: Two organisations were not included since sample sizes were less than 4 *p < 0.05.

Table 5. Intraclass correlations (ICC) between hospital and outcomes for design effect in combined 1997 and 1998 samples

	Readmission	Mortality	Length of stay	Cost
ICC	0.083	0.005	0.022	0.030
SD* of hospital effect	0.110	0.012	0.516	550.62
SD within hospital	0.363	0.177	3.44	3153.13
Reliability**	0.98	0.750	0.934	0.950

Note: *Standard Deviation (SD), **Reliability is the stability of group average scores.

Service differentiation effect

Analysis consisted of multivariate logistic regression, clustered by hospital, examining the effect of service differentiation on the likelihood of readmission and mortality. Likewise, ordinary least squares regression was used for length of stay and cost. All models were significant predictors of outcomes of interest (see Table 7). Domains were examined in separate equations from the total score. Patient level data (age, gender, race, collapsed Charlson Index, and CCA admission) was used as patient control variables. No significant relationship was found between likelihood of readmission, mortality or the patient's length of stay and total differentiation. There was a significant relationship between Total and Community Differentiation and the cost of care (see Table 7). However, the skew and kurtosis of the distribution were not normal, which may lead to Type I error indicating that results must be interpreted with caution [25].

Data were then analysed using the domains specified by Bazzoli et al. [1] Significant relationships were found between the transformed Community Differentiation variable and the likelihood of readmission and cost (see Table 6). Increased Community Differentiation was associated with a higher likelihood of readmission (2.54, 95% CI 1.15, 5.62). Organisations with higher Community Differentiation (score of seven or eight) had significantly higher average daily census (197 vs. 87)(t = −3.36, df = 41, p = 0.002) and staffed beds (284 vs. 197) (t = −3.38, df = 41, p = 0.002). Higher costs were also associated with Community Differentiation (0.07, 95% CI 0.021, 0.112).

Explanatory powers of the models were low with a R^2 range of 0.03 for length of stay to 0.07 for cost. Results were validated using 1997 data, confirming all findings with a few exceptions. There was no significant relationship found between Total Differentiation or Community Differentiation and cost in 1997. There was a new significant relationship found between mortality and acute and long-term service differentiation (see Table 8). Higher mortality rates were found in 1997 as acute services increased (OR = 14.33, 95% CI 3.36, 61.24). Wide confidence intervals resulted from the variation in the mortality rates by degree of differentiation. Midrange differentiation was associated

with the largest number of deaths in hospital while low differentiation and high differentiation hospitals had fewer deaths. Lower likelihood of mortality was associated with an increase in Long Term Services (OR = 0.102, 95% CI 0.027, 0.393).

Discussion

Service integration and differentiation and outcomes

Readmission
Integration and differentiation of services had little relationship with readmission in this patient sample, with the exception of Community Differentiation. Only Community Differentiation was related to readmission such that patients in hospitals with higher community differentiation were more likely to be readmitted. The hospitals with higher Community Differentiation (greater than seven) were larger hospitals with greater staffed beds and average daily census. One explanation is that these hospitals have a more acute population whose comorbidities and severity were not captured in this measure. An alternate perspective is that as organisational community involvement increased, readmission is encouraged when resources are available. In Maryland, hospitals benefit economically by decreased length of stay and increased admission. This would be consistent with findings in which patients were more likely to be admitted to hospitals in areas where there were more beds [27].

Lower readmission rates and a lower length of stay were found in this study than in the literature reviewed. These lower rates are most likely associated with changing patterns of readmission related to the managed care penetration in Maryland. Hospitals are pressured to reduce the length of say and cost for all patient populations.

The degree of readmission, explained by our model R^2 in this study, was low for integration and differentiation measures. However, Krumholz et al. reported Pseudo R^2 to be 0.037 in a similar patient population [28]. The authors acknowledged the ''…inadequate adjustment for the baseline characteristics of the patients'' [28, p. 103].

Table 6. Significance of total integration and subdomains in predicting outcomes, 1998 (n = 13,730, 43 Clusters)

Integration	Readmission OR (95% CI)	Mortality OR (95% CI)	Length of stay+ % Change (95% CI)	Cost++ % Change (95% CI)
Total#	1.10 (0.105, 1.55)	2.97 (0.647, 13.59)	−0.048 (−0.316, 0.220)	0.044 (−0.074, 0.162)
R²	0.0081	0.0516	0.0327	0.0651
Wald χ² or F	χ² = 59.79*	χ² = 188.04*	F = 28.83 (8, 42)*	F = 22.38 (8, 42)*
Long term##	1.17 (0.182, 7.60)	1.42 (0.234, 8.57)	−224 (0.532, 0.084)	−0.033 (−0.200, 0.134)
High tech##	0.802 (0.734, 8.75)	3.14 (0.580, 17.03)	0.350 (−0.040, 0.739)	0.132 (−0.104, 0.369)
R²	0.0082	0.0524	0.0361	0.0676
Wald χ² or F	χ² = 59.12*	χ² = 184.08*	F = 29.80 (9, 42)*	F = 22.09 (9, 42)*

Note: # Equation contains patient characteristics and Total Integration, ## Equation contains patient characteristics and Long Term and High-Tech Integration, +Length of Stay is Square Root Transformation of Length of Stay, ++Cost is Log 10 Transformation of Cost *p < 0.05.

Mortality

No significant relationships between integration and differentiation were associated with mortality with the exception of the validation sample in 1997 in which a higher likelihood of mortality was found with an increase of Acute Service Differentiation, and a lower likelihood associated with Long Term Differentiation. Three percent of the sample died. The validation sample had a slightly higher percent mortality (3.5%). Comorbidity was also higher in the validation sample. Eight percent had a collapsed Charlson score of four or greater, in opposition to six percent of the research sample. It would be expected that hospitals with a larger scope of acute care services would attract a sicker population, resulting in a higher mortality rate. It would also be reasonable to understand a lower mortality rate associated with long term services, since provisions would be enhanced to support death in a long term or community setting. Patients are more likely to die in the hospital when the hospital capacity of beds is higher [27]. More differentiated systems may have more services available, either created to serve the more complex patient or created to attract the more complex population, in which a higher mortality rate would be expected.

Age category and gender characteristics of the population studies were similar to other studies [29]. However, a lower mortality rate (3%) and length of stay (4.6–4.7 days) were found (vs. 6.5 days LOS and 7.3% mortality). Like readmission, a lower rate is not surprising as pressure increases to decrease the length of stay in Maryland hospitals.

No relationship was found between any service integration variable. This was surprising since High Tech integration has been found in other studies to be associated with lower mortality rates [30, 31]. Hartz et al. utilised aggregated means to formulate conclusions in a study of 3,100 hospitals [30]. Silber defined high technology as the presence of a burn unit, open-heart surgery, or organ transplantation [31]. These same categories were included in the High Tech integration variable, in which no relationship was found. Perhaps utilising hierarchical linear models, controlling for patient characteristics imposed a more rigorous statistical control.

Length of stay

No significant relationship was found between differentiation or integration and length of stay. Although similar patient characteristics were used for risk adjustment in other studies, higher LOS in the heart failure population has been found to be associated with system hospital membership, higher patient volumes, and higher years of physician practice, and urban location [29].

Table 7. Relationship between total differentiation and subdomains in predicting outcomes in 1998 (n = 13, 730, 43 Clusters)

Differentiation	Readmission OR (95% CI)	Mortality OR (95% CI)	Length of Stay+ % Change (95% CI)	Cost++ % Change (95% CI)
Total#	0.794 (0.126, 5.02)	1.50 (0.348, 6.46)	−0.012 (−0.244, 0.219)	0.161 (0.044, 0.279)*
R²	0.0083	0.0497	0.0326	0.0834
Wald χ² or F	χ² = 51.17*	χ² = 197.30*	F = 29.11 (8, 42)*	F = 45.23 (10, 42)*
Acute Care##	19.76 (0.354, 102.4)	3.88 (0.884, 17.00)	−0.031 (−0.493, 0.429)	0.178 (−0.105, 0.461)
Long Term##	0.142 (0.013, 1.42)	0.556 (0.138, 2.24)	0.038 (−0.321, 0.396)	0.034 (−0.177, 0.244)
Community##=	2.54 (1.15, 5.61)*	1.20 (0.831, 1.75)	0.041 (−0.051, 0.133)	0.066 (0.021, 0.112)*
R²	0.0274	0.0508	0.0332	0.0831
Wald χ² or F	χ² = 78.24*	χ² = 221.66*	F = 27.30 (10, 42)*	F = 43.05 (10, 42)*

Note: # Equation contains patient characteristics and Total Differentiation, ## Equation contains patient characteristics and Acute, Long Term, and Community Differentiation, = Community Differentiation is Transformed Square Root, + Length of Stay is Square Root Transformation of Length of Stay, ++Cost is Log 10 Transformation of Cost, *Significant 95% CI.

Table 8. 1997 Domains of differentiation that did not validate 1998 findings (n = 13,258, 43 Clusters)

Differentiation	Readmission OR (95% CI)	Mortality OR (95% CI)	Length of stay # % Change (95% CI)	Cost ## % Change (95% CI)
Total				0.073 (−0.021, 0.167)
Acute care		14.33 (3.36, 61.24)**		
Long-term		0.102 (0.027, 0.393)**		
Community*				0.042 (−0.009, 0.093)

Note: Only results that did not validate are shown, *Community Differentiation is Transformed Square Root, # Length of Stay is Square Root Transformation of Length of Stay, ## Cost is Log 10 Transformation of Cost, **p < 0.05.

Cost

There was no relationship found between cost and service integration or differentiation. The high level of alliances, networks, and systems in this sample may spread or shift the cost of care among the services. Because of the rate setting mechanisms in Maryland, variations may have more to do with the reduction of length of stay, and fiscal management decisions related to how to spread the cost throughout the organisation. Costs were higher as Community Differentiation increased. Higher levels of Community Differentiation were associated with hospitals that had more staffed beds and higher average daily census.

Methodological considerations

There are some methodological considerations that need to be discussed in light of the conclusions that hospital integration and differentiation of services are not related to patient outcomes. First, is that we assumed patients are readmitted to the same hospital from which they were discharged. For example, a patient could be discharged from a low integration hospital and readmitted to a high integration hospital. They would be classified as exposed to a high integration hospital when their care was at a low integration. This random misclassification biases a study toward the null. Second, utilising secondary data analysis restricted the clinical detail that may have added to explanatory power for the patient variables, as well as specific system process measures that may have been important. Third, the measure may have been valid for service components, but was not sensitive enough or did not measure care at the level of intervention or process that may have a greater impact. Mitchell et al. calls for more sensitive outcomes than mortality and morbidity to measure the organisational effects of outcomes [32]. Fourth, there may have been no direct relationship between the structural variables and this patient population. Mortality rate may be a more valid measure for some diagnoses than for others, making inferences related to hospital quality questionable [33]. Differentiation was an important concept in the taxonomy formation for system and networks Bazzoli et al., however, that model classified systems by their structural attributes, and was not intended to link structure to patient outcomes [1]. In addition, the current study did not include physician or insurance variables, which were included in the taxonomy formation that may have also added to the explanatory power of the relationship.

Statistically, using clustering of patient level data by hospital imposed statistical control by accounting for within group variability. This technique is preferred since it controls for threats to independence within each hospital, so that error can be reduced, and results can be interpreted when multiple units of analysis are under study.

There may also be a variety of unmeasured variables that affect readmission, mortality, length of stay, and cost. These may include the level of family support, the insurance carrier and presence of absence of a case manager, or the distance from the hospital. For example in the Al-Haider found that inclusion of community variables explained 15% more variance of the outcome mortality than organisational attributes (R^2 0.12 to 0.27) [34].

A Maryland sample was used, which does not limit the generalisability of the study to other states. Maryland has a variety of types of hospitals including rural and urban, academic and community, small and large, and all organisations are under the same external pressure to reduce the cost of care by monitoring and reducing labour expenses and supplies. However, the inclusion of one DRG limits the generalisability to other populations. Another consideration is the relationship between the sample and outcomes. Heart failure is a common diagnosis, with a plethora of literature and pathway resources available to clinicians. Using a high volume diagnosis and structure as opposed to process measures may have reduced the variability in findings. A lower volume diagnosis, the inclusion of process measures as system attributes, and outcomes that were population specific would be more useful in future research. Perhaps the variation in outcomes relates more to patient characteristics that could not be assessed using secondary data, than to system characteristics [32].

This study supports a comparable standard of care for patients with heart failure. The finding of no significant difference is positive, from the perspective of the evaluation of health service changes on generic outcomes for Maryland patients. The findings, however, do bring a variety of management, research and policy implications.

Management, research and policy implications

Health care service changes are prevalent in American hospitals. These changes bring executives the responsibility to build systems that promote continuity of care, the need to measure these changes for the affect on the patient (effectiveness of service reorganisation on efficiency and effectiveness), and the need to use the findings of these measures to influence policy.

Management

Health care executives are charged with assuring not only economic, but also quality outcomes as services are provided. To optimise services for patients, executives must work across multi-disciplinary boundaries, as well as across multiple organisational boundaries. Based on interviews with Maryland nurse executives, a variety of skills are required in the integrated system, that were not needed in independent (non-system) hospitals [35]. These included technical skills (computer expertise, payer knowledge, financial management, and marketing), interpersonal skills (communication, networking, relationship building, and collaboration), intrapersonal skills (embrace learning and development, creative thinker, tolerance of ambiguity, flexibility), and analytical skills (market savvy, shifts gears, panoramic view, program evaluation, system thinker, change master, and political savvy). In addition, leadership in the integrated delivery system is positively related to establishing a system culture, strategic planning and resource allocation [36]. Focused attention to these areas with the goal of high quality care will align health care efforts. Co-ordinated efforts produce more efficient care [37]. To promote a continuous system of care, executives and clinicians must work together building processes with patient outcomes as a central tenet.

Clinicians (i.e. physicians and nurses) need to be involved in the promotion of clinical integration of services. Direct care providers understand the fundamental underpinnings of the patient needs [38]. For example, as services clinically integrate, nurses may be involved in the development of new home care programs [39], integration of emergency services [40], developing case management strategies, or community disease management [41].

Executives must also promote education and mentoring in building multidisciplinary services and systems for staff, leading to the development of skills that include collaboration in a broader context. The multidisciplinary team needs to understand the system, how services are co-ordinated, and know that clinical integration is an expected outcome [42].

Research

The structural measures in this study have a small effect on the variance in generic outcomes. Future research of the affect of health system changes on patients should focus on what we do for patients, the processes of care instead of the structure of care (what we have). Process measures should provide greater sensitivity when linked with diagnosis specific outcomes. For example, are patients discharged with a diagnosis of heart failure educated about the importance of weighing themselves daily, and calling the physician with weight increases? Extending the questions further, do they actually weigh themselves and call the physician if they have a weight gain? This simple yet important self-care strategy may prevent readmission by catching changes early so symptoms can be managed. As patients are being discharged earlier to decrease the length of stay, measures as this are needed to monitor system performance across the continuum of care.

In addition, further research should be conducted to test the Quality Health Outcomes Model. Model testing will estimate if structural attributes contribute directly, mediate, or moderate outcomes when controlling for patient level characteristics as the model posits.

Health policy

The implication of this research for health policy is that community hospitals are providing a similar standard of care for heart failure patients, despite the organisational changes that have occurred in Maryland facilities. Changes in the structures of services have not affected generic outcomes of efficiency and effectiveness.

As studies focus on the relationship between volume and outcomes, the frequent diagnosis of heart failure does not show variability in the generic outcomes of interest. There may be some types of disease or diagnosis, which should be referred to high volume or special facilities [43]. For patients with this common

diagnosis, treatment delivered in the community hospital is comparable.

Conclusions and recommendations

The results of this study support similar outcomes for patients discharged with a diagnosis of heart failure from Maryland hospitals in 1997 and 1998. A higher likelihood of readmission was found as the level of community differentiation increased. Variations in service provision at the hospital and multi-organisational level have not affected the patient's likelihood of readmission and mortality or length of stay and cost for the patients discharged with the diagnosis of heart failure in Maryland.

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