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The Blanche and Irwin Lerner Center for the Study of Pharmaceutical Management Issues

Applying Supply Chain Mgmt. Concepts to Improve Healthcare Delivery

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February 25, 2015

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Agenda for our time together today

- Set the stage – How is healthcare unique?
- How do integrative SCM approaches work in hospitals?
- Deeper dive on issues of:
  - Coordination,
  - Seemingly incongruent goals,
  - Patient safety

- Career opportunities for business professionals
- Conclusion

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Let's start with a question

In a word or two, what do you think of when someone mentions the healthcare industry, or you view a story on the news?

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What are the challenges facing healthcare providers?

- **Costs** are soaring – estimated at 20% of GDP in 2015, or $4 Trillion (Hwang and Christensen, 2009; Dobrzykowski et al., 2014)
- Confidence in **quality** has diminished (Cogan et al., 2004)
- Medical tourism is changing **competition** (Einhorn and Arnst, 2008; Lagace, 2007; Marek, 2009)

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SCM: coordination of information, material & financial processes

- A value chain is a discrete, sequential value creation system? (Porter)

Supplier → Focal Firm → Customer

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SCM: coordination of information, material & financial processes

- A value chain is a discrete, sequential value creation system? (Porter)

Physician → Hospital → Patient

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Let's ask another question

In a word or two, how would you describe the experiences you (or a family member) have had as a patient when accessing care?

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Can you relate?

"The caregivers didn't appear to be talking to one another." This is how retired internist Marsha Wallace described her recent inpatient hospital stay in Kaiser Health News. "Although hospitals, the federal government, nonprofit groups and insurers want to improve the system, efforts to boost coordination and teamwork still have a long way to go," (Rabin, 2013; Dobrzykowski and Tarafdar, 2015).

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Can you relate?

"Without coordination, a patient can languish for weeks from one step to the next while her tumor grows and the illness progresses. Without integrated care, critical information is easily lost and treatment delayed or misdirected. Or, as happened to D'Agostino [a breast cancer patient], specialists offer complex and sometimes contradictory information to the patient who sorts it out alone." (Toussaint, 2012; Dobrzykowski and Tarafdar, 2015).

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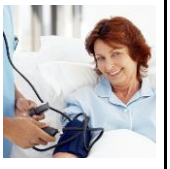
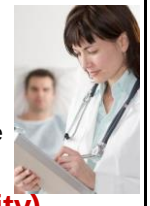
What are the challenges facing healthcare providers?

- **Costs** are soaring – estimated at 20% of GDP in 2015, or $4 Trillion (Hwang and Christensen, 2009; Dobrzykowski, 2014)



- Confidence in **quality** has diminished (Cogan et al., 2004)
- Medical tourism is changing **competition** (Einhorn and Arnst, 2008; Lagace, 2007; Marek, 2009)
- Changing reimbursement methods toward **patient outcomes and satisfaction (value)** (Salzarulo et al., 2011)



- **Physicians** drive as much as 80% of hospital costs and quality of care while often having no financial relationship with the hospital (Chilingerian and Sherman, 1990; Ilie et al., 2009)
- **So, we need to improve coordination, safety (quality) & financial performance, and patient satisfaction.**

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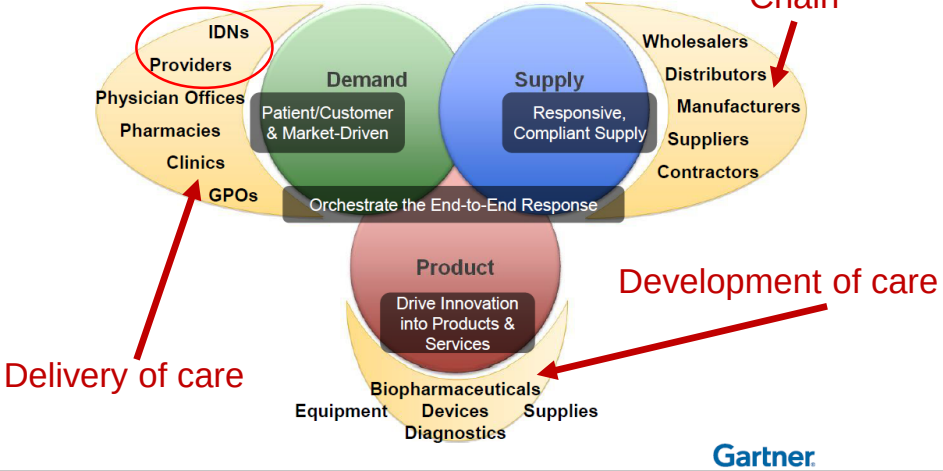
A macro-view of the healthcare supply chain from Gartner

Core Strategies for Demand-Driven Value Networks



Gartner

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Downstream healthcare supply chain

Adapted from Ford and Scanlon (2007) and Sinha and Kohnke (2009)

Dobrzykowski, 2010

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How is SCM in HCD unique?

Summary of the key characteristics of the healthcare delivery supply chain. (Dobrzykowski, 2010)

Characteristic	Summary	Literature
The co-creation phenomenon	Healthcare delivery is 1) co-produced, with 2) heterogeneous outcomes, and 3) perishability where the 4) the customer is inseparable from value creation.	Chase and Tansik, 1983; Schmenner, 1986; 2004; Smeltzer and Ramanatha, 2002.
Actor ambiguity	The patient is the customer, as well as the raw material in the 'input – output' transformation process. Nurses and physicians serve as end users of some materials (e.g., syringes, sutures, hip replacements) as well as service suppliers to each other and to patients. Physicians act as suppliers by referring/admitting patients (material) to the hospital.	Schneller and Smeltzer, 2006.
Variable demand	The co-creation phenomenon and the patient's role ambiguity makes demand difficult to estimate in terms of variety.	Schneller and Smeltzer, 2006; Shah et al., 2008.
Centrality of the physician	The physician's decisions greatly influence the supply chain, and are plagued by the agency dilemma and an absence of coordination mechanisms.	Smeltzer and Ramanatha, 2002; Schneller and Smeltzer, 2006; Ford and Scanlon, 2007; Shah et al., 2008.
Information asymmetries	Inadequacy and slow adoption of IT systems has resulted in suboptimal outcomes and provider favored information asymmetries.	Ford and Scanlon, 2007.

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Healthcare delivery processes

- There is ***uncertainty*** (Galbraith, 1973), in that healthcare professionals engaged in care delivery do not know beforehand the exact information they will require
- There is ***differentiation*** (Lawrence and Lorsch, 1967) in that various actors posses different bodies of knowledge, technical language and perspectives that can lead to strong differences in perceptions, and conflict
- There is ***interdependence*** (Thompson, 1967) between activities, which can be sequential (e.g. diagnosis depending on appropriate tests being taken), reciprocal (e.g. a physician's diagnosis depends on testing, medicine administration, bedside procedures, carried out by others), or shared responsibility (Simatupang, 2004) (e.g. multiple actors - medical technicians, physicians, nurses - are responsible for a shared work goal - patient diagnosis and cure)

Dobrzykowski & Tarafdar (JOM, 2015)

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Once you've seen one hospital…

What It Costs Here — And There

HUFF POST

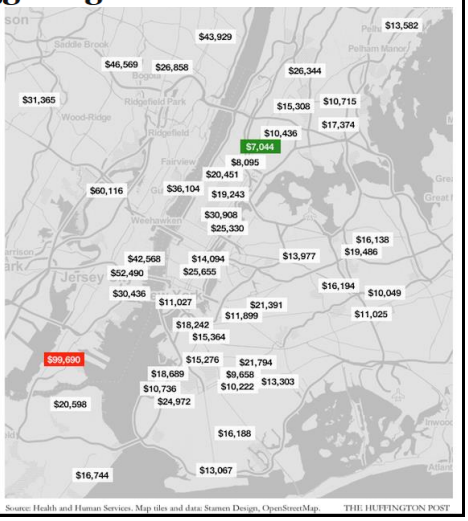
Hospital Prices No Longer Secret As New Data Reveals Bewildering System, Staggering Cost Differences

Not all hospitals are created equal.

Some hospitals must be more effective in coordinating and delivering healthcare services.

What might some hospitals be doing differently from others?

http://www.huffingtonpost.com/2013/05/08/hospital-prices-cost-differences_n_3232678.html



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Let's ask! Data collection

- Cross-sectional survey used for data collection
- 312/671 = 46.5% response rate (Qi et al., 2009).
  - 2 were removed for missing values (Qi et al., 2009) and 8 responses from multiple raters were averaged (McFadden et al., 2009).
  - **Final *n* =302**
- T-tests (Swafford et al., 2006) and Chi-square tests (Meyer and Collier, 2001) produced negative results for non-response bias (against 124 '*decliners*').
  - Bed size & Hospital type (tertiary, community, or critical access)

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Who responded?

Table 2: Sample characteristics.

Characteristics	Respondents	Characteristics	Respondents
Hospital type		*Size – number of beds*	
Tertiary care center	67 (22%)	< 49	40 (13%)
Community hospital	189 (63%)	50-99	59 (20%)
Critical access hospital	39 (13%)	100-199	64 (21%)
Other/missing values	7 (2%)	200-399	77 (26%)
		> 400	56 (19%)
*Location**		Other/missing values	6 (2%)
Urban	163 (54%)		
Rural	132 (44%)	*Teaching status*	
Other/missing values	7 (2%)	Major teaching hospital	64 (21%)
		Minor teaching hospital	92 (31%)
Percentage of employed physicians		Nonteaching hospital	141 (47%)
< 5%	63 (21%)	Other/missing values	5 (2%)
6%-15%	57 (19%)		
16%-35%	40 (13%)	*Ownership status*	
36%-65%	57 (19%)	For-profit hospital	39 (13%)
> 66%, but not 100%	58 (19%)	Non-profit hospital	226 (75%)
100% - closed system	21 (7%)	Public hospital	31 (10%)
Other/missing values	6 (2%)	Other/missing values	6 (2%)

* Hospitals from 47 states participated in the study.
Note: Numbers represent frequency, followed by the percentage (rounded) of the sample in parentheses.

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Who responded?

Respondent characteristics (job titles)	
Characteristics	Respondents
Job title	
Director of Case Management	63 (23%)
Chief Nursing Officer	43 (14%)
Vice President of Patient Care Services	43 (14%)
Director of Nursing	22 (7%)
Director of Quality Initiatives	17 (6%)
Quality Assurance Manager	14 (5%)
Director of Patient Care Services	10 (3%)
Chief Operating Officer	7 (2%)
Unit Manager	6 (2%)
Vice President of Quality Initiatives	4 (1%)
Chief Executive Officer	2 (1%)
Other	49 (16%)
Did not report.	22 (7%)

Note: Numbers represent frequency, followed by the percentage (rounded) of the sample in parentheses.

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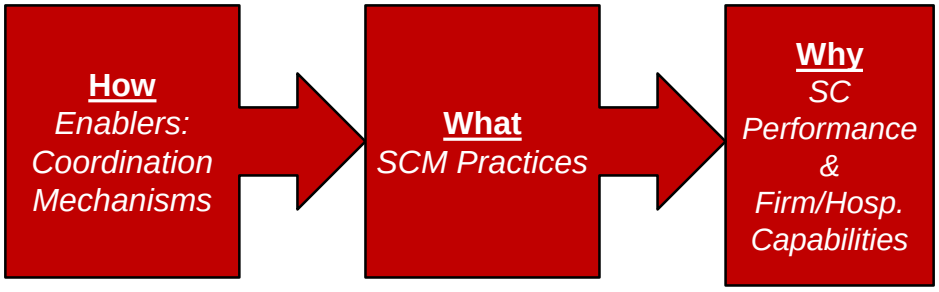
How does integrative SCM work in hospitals?



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How does SCM work – How?

Traditional SCM	SCM in HCD
Coordination Mechanisms:	*Coordination Mechanisms:*
• Contracts	•Trust
• Service Level Agreements	•Shared Vision
• Financial Arrangements	•Commitment

Li, 2002; Liao, 2008; Shah et al., 2008; Dobrzykowski, 2010

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How does SCM work – What?

Li et al., 2005; 2006; Dobrzykowski, 2010

Traditional SCM	SCM in HCD
• Strategic Supplier Partnerships	• Strategic Physician Partnership
• Customer Relationship	• Patient Relationship
• Information Sharing	• Information Sharing
• Information Quality	• Information Quality
• Lean Systems	• Lean Processes
• IT Enabled Processes	• IT Enabled Processes

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How does SCM work – Why?

Traditional SCM	SCM in HCD
SC Performance:	*SC Performance:*
• Flexibility	• Flexibility
• Integration	• Integration
• Customer Responsiveness	• Patient Responsiveness
• Supplier Performance	• Physician Performance
• Partnership Quality	• Partnership Quality

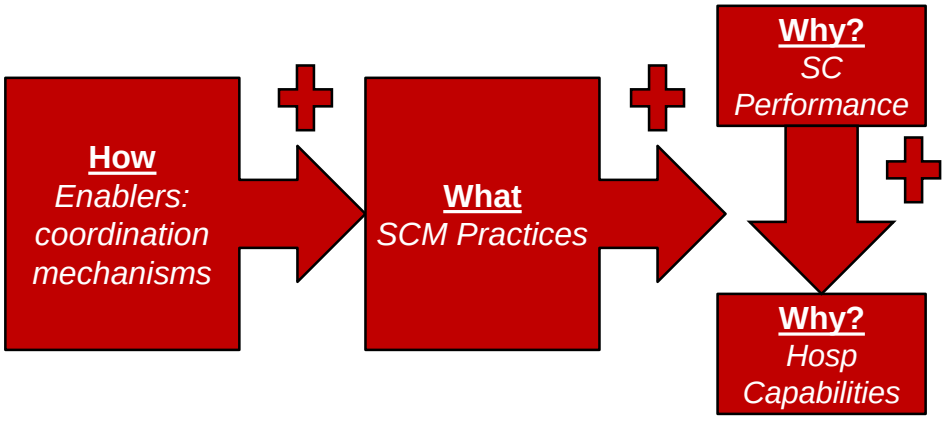
Li et al., 2002; Dobrzykowski, 2010

How does SCM work – Why?

Traditional SCM	**SCM in HCD**
Firm Capabilities:	*Hosp. Capabilities:*
• Cost	• Efficiency
• Quality	• Effectiveness
• Time	• Timeliness
• Customer Satisfaction	• Patient Centeredness
• Delivery Dependability	• Safety

Li et al., 2006; IOM, 2001; Dobrzykowski, 2010

How does integrative SCM work in hospitals?



Dobrzykowski, 2010

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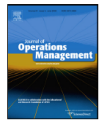
How about a deeper dive on some of these issues?

Let's start with achieving coordination!

Contents lists available at ScienceDirect

Journal of Operations Management

journal homepage: www.elsevier.com/locate/jom



Understanding information exchange in healthcare operations: Evidence from hospitals and patients

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A shift toward patient-focused care

HOME SEARCH

The New York Times

HEALTH

Doctors Strive to Do Less Harm by Inattentive Care

By GINA KOLATA FEB. 17, 2015

Dr. Michael Bennick, center, medical director for patient experience at Yale-New Haven Hospital, handles concerns

Reducing patient suffering — the kind caused not by disease but by medical care itself — has become a medical goal. The effort is driven partly by competition and a realization that suffering, from long waits, inadequate explanations or feeling lost in the shuffle, is a real and pressing issue.

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Research objective

- To understand key factors involved in achieving information exchange (coordination) in healthcare delivery operations.

- We consider three key issues facing healthcare leaders; 1) changing reimbursement methods, 2) physician-hospital relationships, and 3) technology use (ACHE, 2013).

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Issue – 1) Reimbursement

- Reimbursement to hospitals increasingly depends upon ***patient perceptions of their care*** (Russell Bennett, 2012; Ding, 2014).

- Specifically, for hospitals operating under the CMS Inpatient Prospective Payment System, HCAHPS measures will affect hospital reimbursement levels.

See: http://www.hcahpsonline.org/executive_insight/

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Issue – 2) Physician relationships

- **Physicians tend to have higher professional than organizational loyalty and substantial autonomy** (Nembhard et. al., 2009; Boyer and Pronovost, 2010).
- Physicians have traditionally functioned as "…owner-operator[s] of [their] own ongoing firm" when providing services to patients in a hospital setting (McLean, 1989: p. 67).
- The ***social interaction ties*** that characterize the relationships among the hospital staff/nurses and doctors are an important consideration (Fredendall et al., 2009).

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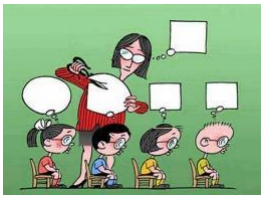
Issue – 3) IT / EHR

- **Healthcare processes are information intensive and complex** (Nembhard et al., 2009).
- EHR ought to improve inefficiencies and quality problem in healthcare (GAO, 2005).



- EHR stands to substantially improve performance in healthcare, but these benefits are often more speculative than factually based (CBO, 2008).

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Issue – 3) IT / EHR

- Research on the impacts of EHR (and HIT) use has been mixed and inconclusive (Chaudhry et al., 2006; McCullough, 2010).
- While some studies show negative associations between EHR use and inpatient mortality and length of stay, others show little impact (Goh et al., 2011).

Advantages:

- Reduced costs (Li and Benton, 2006).
- Improved patient satisfaction (Queenan et al., 2011).

Disadvantages:

- Increased physician documentation time, and
- Reduced reporting flexibility (Poissant et al., 2005; Lahiri and Seidmann, 2012).
- Large variation in use (Dobrzykowski, 2012).

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Issue – 3) IT / EHR

- Practice-based experiences…

- Cedars Sinai Medical Center invested **$34 million** in an EHR system only to find that "than did the physicians found that it took much, much longer to use the new computer system same ordering with pen and paper… [and placed] severe limitations on their ability to make medical judgments," (Smelcer et al., 2009: p. 70)

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Issue – 3) IT / EHR

- Practice-based experiences…

- Kaiser experienced that clinicians were taking 30 to 75 minutes longer per day to do their work with an EHR system (Scott et al., 2005)

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Research questions

- Does coordination in the form of **information exchange relationship** among physicians and a hospital's healthcare providers mediate the link between **IT use** and **patient experiences**?
- What is the effect of the **social interaction ties** among the physician and the hospital staff in mediating **IT use** and **information exchange relationship**?
- What is the effect of **vertical integration (physician employment)** on the link between **IT use** and social **interaction ties**, and between **IT use** and **information exchange relationship**?

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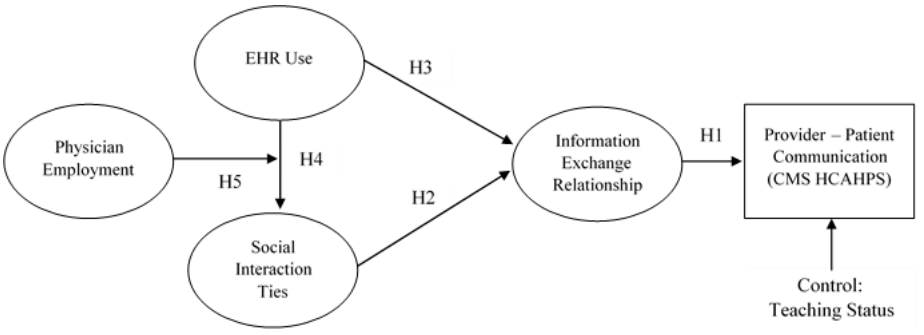
Research model



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Variable definitions & measures

Exhibit 2. Constructs, construct definitions, measurement items, and supporting literature.

Construct	Definition	Measurement Items[1]	Literature
EHR Use	A hospital's healthcare delivery providers (i.e. doctors, nurses and staff) utilization of electronic health records systems for viewing clinical results such as those from lab and radiology.[2]	*We use EHR to view:* E1: lab results. E2: radiology reports. E3: diagnostic test results.	Ash et al., 2004; Cutler et al., 2005; Jha et al., 2009.
Social Interaction Ties	A willingness demonstrated by admitting physicians to expend efforts to work cooperatively with hospital staff.	*Our admitting/attending physicians:* SIT1: exert effort to maintain our relationship. SIT2: are willing to provide assistance to our staff. SIT3: abide by their commitments. SIT4: make an effort to work with our staff.	Nahapiet and Ghoshal, 1998; Wasko and Faraj, 2004; Carey et al., 2011; and Villena et al., 2011.
Information Exchange Relationship	Accurate, timely, adequate, and credible information interchange among those involved in a particular process.	*Information exchange between our admitting/attending physicians and us is:* IER1: timely. IER2: accurate. IER3: complete. IER4: adequate. IER5: reliable.	Doll and Torkzadeh, 1988; Delone and McLean, 2003; Lee, 1997; Metters, 1997; Li et al., 2005.

Notes:
1) Likert scales used for to measure EHR Use, Social Interaction Ties, and Information Exchange Relationship: 1-strongly disagree, 2-disagree, 3-nuetral, 4-agree, 5-strongly agree. N/A was also offered as a response choice.
2) The use of EHR to capture this type of data is prevalent in hospitals and likely to improve patient care (Jha et al., 2009). EHR use for results viewing is particularly relevant for this study because it facilitates collaboration among healthcare providers (AHRQ, 2013).
3) Respondents were asked to opine for each item with regard to their hospital's dealings with employed physicians and non-employed physicians.

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Variable definitions & measures

Exhibit 2. Constructs, construct definitions, measurement items, and supporting literature.

Construct	Definition	Measurement Items[1]	Literature
Provider – Patient Communication (CMS HCAHPS)	Doctors and nurses effectively providing medical information to patients.	*Percentage of patients who reported that:* PPC1: their doctors "Always" communicated well. PPC2: their nurses "Always" communicated well. PPC3: staff "Always" explained about medicines before giving it to them.	Ammentrop et al., 2014; Bennett, 2012; RTI, 2011.
Employed / Non-employed Physician	An 'employed physician' is a doctor who receives financial compensation from a hospital in exchange for treating patients.	Two sets of items were measured for each measurement item; one for employed physicians and a second for non-employed physicians.[3]	Schneller, 2001; Fink and Hartzell, 2010; Andrabi, 2012.
Teaching Status (Control)	A hospital's participation in medical student and resident education.	Major Teaching Hospital Minor Teaching Hospital Non-teaching Hospital	Goldstein and Iossifova, 2012; Goldstein and Naor, 2005; Li and Benton, 2006; McFadden et al., 2009; Queenan et al., 2011.

Notes:
1) Likert scales used for to measure EHR Use, Social Interaction Ties, and Information Exchange Relationship: 1-strongly disagree, 2-disagree, 3-nuetral, 4-agree, 5-strongly agree. N/A was also offered as a response choice.
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3) Respondents were asked to opine for each item with regard to their hospital's dealings with employed physicians and non-employed physicians.

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Data collection & sample

Table 2. Sample characteristics (n=173).

Characteristics	Respondents	Characteristics	Respondents
Hospital type		*Size – number of beds*	
Tertiary care center	38 (22%)	< 49	15 (9%)
Community hospital	118 (68%)	50-99	40 (23%)
Critical access hospital	13 (8%)	100-199	43 (25%)
Other/missing values	4 (2%)	200-399	37 (21%)
		> 400	36 21%)
*Location**		Other/missing values	2 (1%)
Urban	93 (54%)		
Rural	77 (45%)	*Teaching status*	
Other/missing values	3 (2%)	Major teaching hospital	37 (21%)
		Minor teaching hospital	53 (31%)
Percentage of employed physicians		Nonteaching hospital	81 (47%)
< 5%	36 (21%)	Other/missing values	2 (1%)
6%-15%	37 (21%)		
16%-35%	22 (13%)	*Ownership status*	
36%-65%	34 (20%)	For-profit hospital	20 (12%)
> 66%, but < 100%	34 (20%)	Non-profit hospital	131 (76%)
100% - closed system	9 (5%)	Public hospital	18 (10%)
Other/missing values	1 (1%)	Other/missing values	4 (2%)

* Hospitals from 46 states participated in the study.
Note: Numbers represent frequency, followed by the percentage (rounded) of the sample in parentheses.

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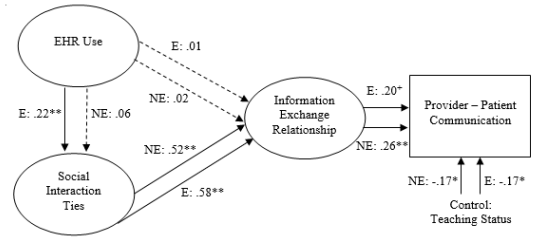
Results

Table 5. SEM results for direct and indirect effects

Hypothesis	Employed Physicians			Non-employed Physicians			Weighted Composite Variables		
	Direct effect	T-stat	Indirect effect	Direct effect	T-stat	Indirect effect	Direct effect	T-Stat	Indirect effect
H1: Info Exch Rel → Prov-Pt Com	.20+	1.92	--	.26**	2.63	--	.29**	2.86	--
H2: Social Int Ties → Info Exch Rel	.58**	7.15	--	.52**	6.28	--	.56**	7.21	--
H3: EHR Use → Info Exch Rel	.01	0.12	.13**	.02	0.25	.03	-.01	-0.09	.06
H4: EHR Use → Social Int Ties	.22**	2.71	--	.06	0.72	--	.10	1.22	--
EHR Use → Prov-Pt Com	.04	0.51	.00	.01	0.09	.01	.01	0.15	.01
Social Int Ties → Prov-Pt Com	-.14	-1.27	.12**	-.13	-1.33	.14**	-.07	-0.71	.16**

Figure 2. Path model results.



**p < 0.01; *p < 0.05; +p < 0.10
Solid lines: Statistically significant · Dashed lines: Not statistically significant
E: Employed Physicians · NE: Non-Employed Physicians

At 67% employment, Information Exchange Relationship is significant on Provider-Patient Communication (H1: β=0.25, *p*=0.02), Social Interaction Ties is significant on Information Exchange Relationship (H2: β=0.57, *p*=.00), and EHR Use is significant on Social Interaction Ties (H4: β=0.16, *p*=.05).

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Implications re: reimbursement

Go home and talk to…

- Clinical operations: emphasize that an information exchange relationship among hospital staff and physicians that provides for timely, accurate, adequate, complete, and reliable information sharing improves HCAHPS.
- Practice acquisition: proactively establish an information exchange relationship with those physicians targeted for recruitment.
- Physician relations: social interaction ties (indirectly) increase HCAHPS, so foster relationships with physicians who are likely to exert effort to maintain a relationship with the hospital, provide assistance to the hospital staff, abide by their commitments, and genuinely make an effort to work with the staff.

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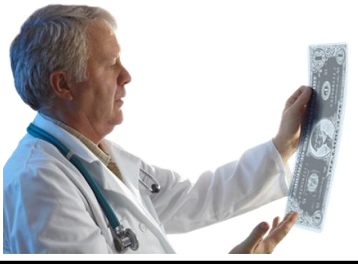
Implications re: physician relations

- Practice acquisition: employing physicians does influence coordination, but through…
- Physician relations: social interaction ties motivate coordination and improve provider-patient communication.
- Practice acquisition: the inflection point of 67% is the level at which the relationship between EHR use and social interaction ties becomes significant.



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Implications re: HIT / EHR

- CMIO: implementing is not enough! EHR use is not directly related to improved patient outcomes.
- CMIO: information exchange and social interaction ties may be key to using EHR *meaningfully.*
  - Remember Ebola at Texas Health Presbyterian Hospital
- Practice acquisition: EHR preferences of acquired practices may be more important than we previously thought.
- Finally, executives leading *teaching hospitals* ought to be particularly interested in these findings given that teaching status is negatively linked to HCAHPS scores.

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How about a deeper dive on some of these issues?

Do I really want my healthcare Lean? Are goals related to quality (safety) and financial performance incongruent?

David D. Dobrzykowski, PhD, Kathleen L. McFadden, PhD & Mark A. Vonderembse, PhD

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Issues of safety & cost

- Patient safety and financial performance have been the focus of increased attention in healthcare (Li and Benton, 2006; McFadden et al., 2009)
- James (2013) reports that the number of deaths associated with preventable medical errors about 400,000 deaths per year.
- Medical errors the third leading cause of death, behind heart disease and cancer.
- Healthcare spending will account for approximately 20% of GDP by 2015 (Bourgeois et al., 2009)
- Hospitals account for approximately 40 percent of total spend, making them a ripe target for cost reduction efforts (CMS, 2011)

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We need a Lean Six Sigma team!

- Hospitals have been implementing lean process improvement with the goal of improving operations (Shah et al., 2008; LaGanga, 2011)
- But, lean concepts such as changing and standardizing processes, eliminating waste, etc. may actually limit the ability of healthcare professionals to make autonomous decisions and provide safe care (Graban, 2009)
- Empirically, studies have failed to find significant relationships between process improvement and either financial performance or customer satisfaction (Douglas and Fredendall, 2004)
- Others found evidence that quality initiatives can actually increase HAIs (McFadden et al., 2014).

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Research objective

- To understand how the use of a Comprehensive Lean Orientation in hospitals influences seemingly incongruent outcomes such as safety and net income.
- We:
  - Acknowledge that healthcare is "…complex, customized and reliant upon the knowledge and expertise of the server" (Heineke, 1995: p. 255)
  - Illustrate the complexity in healthcare delivery by drawing on the professional services (Abbott, 1988; Goodale et al., 2008; Lewis and Brown, 2012)
  - Address the complexity in healthcare through the modularity literature (Schilling, 2000)

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Professional services in healthcare

- Professional services operations (PSOs) create and sell their production capacity by organizing professional service providers who have abstract expert knowledge and skillfully apply it in complex and customized cases (Goodale et al., 2008)

- PSOs can be conceptualized using three distinctive characteristics:
  - 1) customer contact and customization,
  - 2) service process variation, and
  - 3) external influences on service providers (Lewis and Brown, 2012)

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Professional services in healthcare

Process Variation

- PSOs and healthcare delivery face circumstances where the judgment of individual service providers (and/or small groups) plays a dominant role in service delivery (Lewis and Brown, 2012)

- These factors contribute to slow throughput times and a high degree of service process variation (Schmenner, 2004)

- In healthcare delivery, service processes are further complicated by a third factor; role ambiguity (Schneller and Smeltzer, 2006; Smeltzer and Ramanathan, 2002)

Professional services in healthcare

External influences on service providers

- Physician decisions influence the patient's length of stay (LOS), a key outcomes metric (Gnanlet and Gilland, 2009), along with other consumption drivers of hospital materials and resources (Schneller and Smeltzer, 2006)
- The centrality of the physician in the healthcare delivery supply chain presents two unique challenges related to:
  - 1) an agency dilemma (Ford and Scanlon, 2007), and
  - 2) a lack of coordination mechanisms (Shah et al., 2008)
- Finally, healthcare workers engage in continuing education and membership in professional societies which influence the methods employed by service providers, attenuating the influence of managers in PSOs (Harvey, 1990; Lewis and Brown, 2012).

Modularity – addressing complexity

- "Modularity is a general systems concept: it is a continuum describing the degree to which a system's components can be separated and recombined," (Schilling, 2000: p. 312)
- It provides a means to efficiently organize complexity by dividing a complex system into components (Baldwin and Clark, 1997)
- The recombination aspect of modularity enables independently functioning components or subsystems of a service to be grouped in various combinations to meet heterogeneous customer needs efficiently and effectively, thereby coping with complexity (De Blok et al., 2014)

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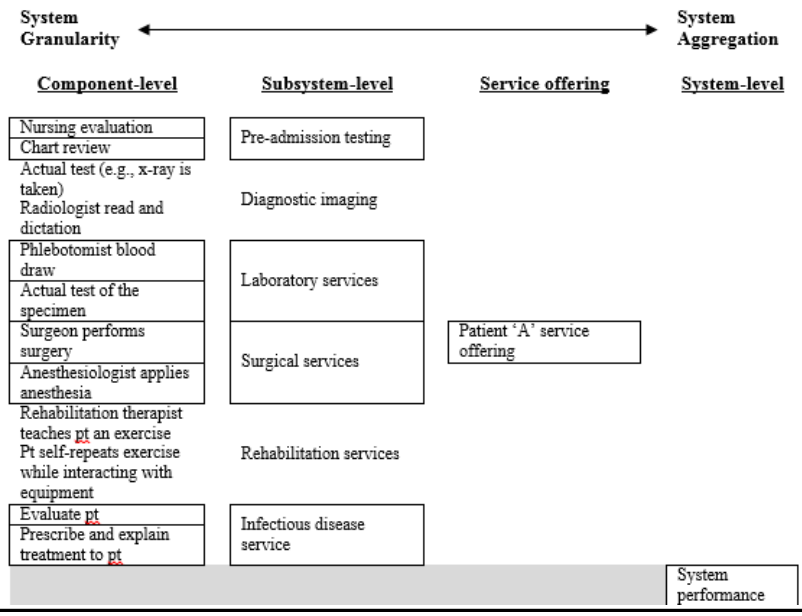
Modularity – addressing complexity



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Modularity – addressing complexity

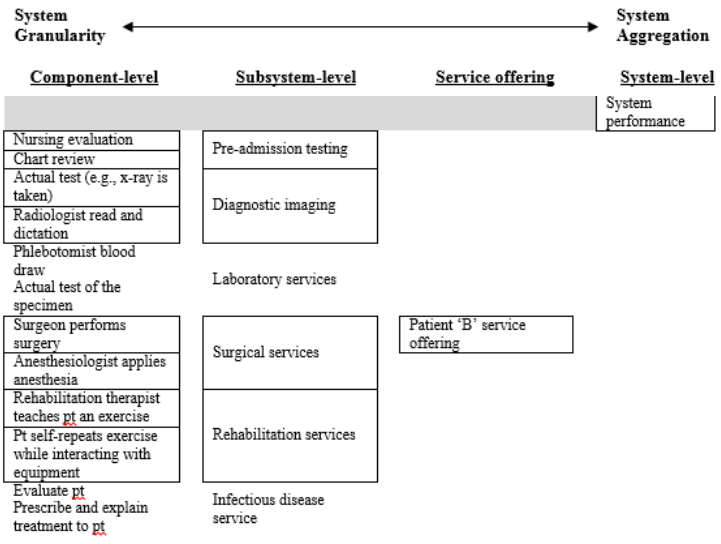

Fig. 2. Example of modularity in healthcare delivery (based on De Blok et al., 2014; Schilling, 2000).

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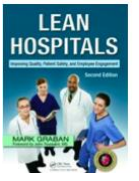
Theory

- Dynamic capabilities theory emphasizes the key role of strategic management in effectively adapting, integrating, and re-configuring organizational skills, resources, and functional competences (e.g., components, subsystems, and systems) in a changing business environment (Teece and Pisano, 1994)
- Continuous improvement can be derived from the dynamics capability perspective (Anand et al., 2009)
- Lean institutionalizes organizational learning (Linderman et al. 2004)
- Leaders ensure that adherence to new processes occurs and they encourage employees to monitor compliance among the staff (Graban, 2009)



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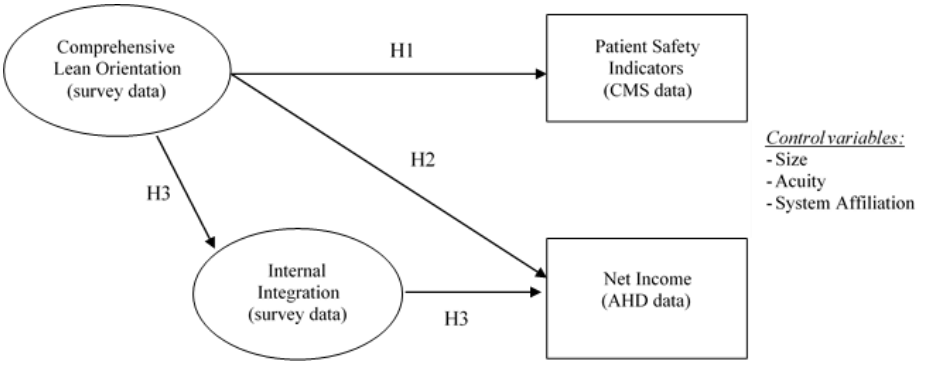
Research model



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Variables definitions

- **Comprehensive Lean orientation** is the extent to which a hospital encourages actors involved in providing patient care to continuously improve processes to eliminate waste and non-value added activities, while understanding the importance of quality and patient needs (Graban, 2009; Qi et al., 2009; Vonderembse et al., 2006)
- **Patient safety** is the extent to which those involved in healthcare delivery are able to reduce medical errors in treating patients (IOM, 2001; IOM, 2009; McFadden, Stock, and Gowen, 2006)
- **Net income** is a proxy for the financial performance of the hospital which can be aided by internal integration (Schoenherr and Swink, 2012)
- **Internal integration** is the extent to which communication, coordination, and teamwork exists across functions within an organization (Pagell, 2004; Fredendall et al., 2009; Schoenherr and Swink, 2012; Williams et al., 2013)

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Theory and hypotheses

- Comprehensive Lean should address the issues of:
  - 1) customer contact and customization by developing a mindset of adapting to patients needs and eliminating unnecessary activities among service providers,
  - 2) service process variation by working toward clarifying roles and care pathways, and
  - 3) external influences on service providers by developing shared understandings amongst health care professionals regarding how clinical pathways ought to be executed.

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Theory and hypotheses

- The effects of lean have been shown to be attenuated by complexity (Browning and Heath, 2009)
- Lean is expected to be positively related to improved net income as eliminating waste, streamlining handoffs, and focusing on the patient ought to improve system-level performance.

- **Hypothesis 1.** Comprehensive Lean orientation will be positively associated with improved patient safety indicators.
- **Hypothesis 2.** Comprehensive Lean orientation will be positively associated with improved net income.

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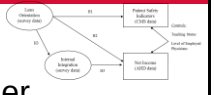
Theory and hypotheses



- Health care teams could include admitting and attending physicians that are integrated with other functional area personnel for process design and improvement (Fredendall et al., 2009)
- Generally speaking, research suggests integration leads to greater operational performance (Schoenherr and Swink, 2012)
- Considering modularity, each of the components in healthcare delivery can be optimized for efficiency by applying specialized labor and automation, but then must be coordinated to gain overall system goals (De Blok et al., 2014; Schilling, 2000)

- **Hypothesis 3.** Internal integration will partially mediate the relationship between Comprehensive Lean orientation and net income.

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Methods – Measures

Measurement items (operational definitions)

Comprehensive Lean Orientation (primary survey data)

Scale: 1-strongly disagree, 2-disagree, 3-nuetral, 4-agree, 5-strongly agree.

In care delivery, our hospital leadership encourages:
LO1: understanding of patient needs.
LO2: elimination of waste.
LO3: process improvement.
LO4: adapting to change.
LO5: providing personalized care.

Integration (primary survey data)

Scale: 1-strongly disagree, 2-disagree, 3-nuetral, 4-agree, 5-strongly agree.

In our hospital:
IN1: cross-functional teams which include admitting/attending physicians are integrated for process design and improvement.
IN2: there is a high level of coordination among all functions.
IN3: there is a high level of communication among all functions.
IN4: information systems are integrated. *(deleted)*

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Methods – Measures

Measurement items (operational definitions)

Patient Safety Indicators (weighted mean taken from the following CMS secondary data measures)

Scale: 1 – Worse than the U.S. national rate, 2 – Not different than the U.S. national rate, 3 – Better than the U.S. national rate.

PS1: Death among surgical inpatients with serious treatable complications.
PS2: lactogenic pneumothorax.
PS3: Postoperative respiratory failure.
PS4: Postoperative PE or DVT.
PS5: Postoperative wound dehiscence.
PS6: Accidental puncture or laceration.
PS7: Composite – Complication/patient safety for selected indicators.

Net Income (AHD secondary data)

Scale: percentage. Net income (or loss) is taken from a hospital's Medicare Cost Report (W/S G-3, line 31 – Total Revenue minus Total Expenses). A percentage is computed from total revenue.

***n* = 211 in this study**

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Measurement model results

Table 1
Measurement model statistics.

Construct	Indicator	Std. Loadings	*t* value
Comprehensive Lean Orientation (CLO)	CLO1	0.76	-[a]
	CLO2	0.69	9.73
	CLO3	0.81	11.50
	CLO4	0.81	11.45
	CLO5	0.70	9.87
Integration (INT)	INT1	0.68	-[a]
	INT2	0.97	11.91
	INT3	0.88	11.81
Patient Safety Indicators [b]	-	-	-
Net Income [b]	-	-	-
Acuity [b]	-	-	-
Size [b]	-	-	-
System Affiliation [b]	-	-	-

Model fit: X^2=52.15, d.f.=49, X^2/d.f.=1.06, GFI=0.96, AGFI=0.93, RMSEA=0.02, and CFI=0.99.
[a] Fixed parameter of multi-item survey variable.
[b] Single-item measure.

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Correlations, validities & reliabilities

Variables and descriptives	**1** CR=0.87	**2** CR=0.89	**3** (archival)	**4** (archival)	**5** (control)	**6** (control)	**7** (control)
1 Comprehensive Lean Orientation (α=0.87) μ = 4.65; σ = 0.51	**.57/.75**						
2 Integration (α=0.87) μ = 3.35; σ = 0.74	.388***	**.73/.85**					
3 Patient Safety μ =1.93; σ = 0.17	.140*	.032					
4 Net Income μ = 1.81; σ = 3.35	.085	.168**	-.107				
5 Acuity μ = 3.23; σ = 1.10	.099	-.022	-.212***	.077			
6 Size μ = 3.23; σ = 1.30	-0.10	-.030	-.268***	.081	.543***		
7 System Affiliation μ = 0.55; σ = 0.50	.148**	.094	-.141**	.194***	.182***	.114*	--

Notes:
1) The AVE for each variable is shown bolded on the diagonal immediately followed by the square root of the AVE (also bolded) for discriminant validity testing.
2) ***p<0.01; **p<0.05; *p<0.10
3) The logarithm transformation was used in the analysis of the Net Income variable. The descriptive statistics for the original variable are reported here. The logarithm transformation produces acceptable values (< 10) for kurtosis.

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Results – Structural model

Table 3
Path model results (n = 211).

Hypotheses	Direct effect coeff.	T-Stat	p-val	Indirect effect coeff.	p-value
H1: Comprehensive Lean Orientation → Patient Safety	0.18**	2.29	0.022	--	--
H2: Comprehensive Lean Orientation → Net Income	0.00 n/s	-0.05	0.958	0.06**	0.041
H3a: Comprehensive Lean Orientation → Integration	0.39***	4.78	0.000	--	--
H3b: Integration → Net Income	0.16**	2.04	0.042	--	--
Significant control relationships					
Size → Patient Safety	-0.20***	-2.56	0.010		
System Affiliation → Comprehensive Lean Orientation	0.14*	1.83	0.068		
System Affiliation → Patient Safety	-0.12*	-1.85	0.065		
System Affiliation → Net Income	0.17**	2.48	0.013		

Notes:

1) Model fit: X^2=53.35; df=50; X^2/df=1.07; GFI=0.96; AGFI=0.93; CFI=0.99; RMSEA=0.02.
2) ***p<0.01; **p<0.05; *p<0.10; n/s Not statistically significant.
3) Direct and indirect relationships tested for all variables in the model.
4) Controls: size (number of beds), acuity (case mix index), and affiliation in a health system were linked to all variables.

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Implications for researchers

- Our study provides a highly nuanced description of healthcare delivery as a PSO which is useful in better understanding how complexity may affect the process improvement efforts in this important operational context (Heineke, 1995)
- The complexity in healthcare can be addressed using the modularity literature (Schilling, 2000)
- A deeper understanding of how the integration of components and/or subsystems can effect service operations is warranted as we strive to improve service delivery (Van der Aa and Elfring, 2002). Extends De Blok et al. (2014)

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Implications for researchers

- Contributes to the literature on lean in healthcare which is limited and has in some cases produced counter-intuitive results.
- Comprehensive Lean orientation can standardize effective care delivery procedures and at the same time encourage adaptation to patient needs, thereby improving patient safety.
  - McFadden et al. (2014) found that process improvement initiatives increase hospital acquired conditions.
- Integration is key in linking lean orientation to net income.
  - Carmen et al. (1996) failed to find a direct link between quality practices and cost per admission.
  - Douglas and Fredendall (2004) found no relationship between process improvement and financial performance.

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Implications for healthcare leaders

- Defrays the notion that "… implementing lean will allow us to standardize all of our processes which should only kill a few patients."
  - Lean directly improves the performance of the service provider in *gemba*, thus improving safety (Graban, 2009)

- Lean can payoff… indirectly!
- Implementing lean is insufficient; hospitals need also to focus on clinical integration to realize financial benefits. Take a modularity view!
- Larger hospitals and IDNs may struggle with patient safety, increasing the important of lean! IDNs improve net income.

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Implications for healthcare leaders

"I plan to share this paper with several individuals within [XYZ Health System]. It will be interesting to several leaders and will also help our Process Improvement Engineers with articulating the value of *lean* and where the benefits accrue which isn't always to the financial statement."

- Senior VP of Quality and Performance Management responsible for *lean process improvement* for a ten-hospital, $2.5 Billion health system

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How about a deeper dive on some of these issues?

How can we improve patient satisfaction?
Particularly given reimbursement shifts!

David D. Dobrzykowski, PhD, Stephen Callaway, PhD & Mark A. Vonderembse, PhD

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Why is patient satisfaction important?

- Finding ways to improve patient satisfaction is important (revenue - Wood et al., 2000; growth - Goldstein, 2003; patients' intention to repurchase and willingness to recommend - Choi et al., 2004; profitability - Goldstein, 2003; Zeithaml, 2000; Ancarani et al., 2011).
- Patient-directed health benefits have placed patients in a position to choose providers (Salzarulo et al., 2011).
- Regulatory reimbursement trends (ACOs) incentivizing patient-centered outcomes (Bennett, 2012).
- Patient satisfaction drives revenue (Wood et al., 2000), growth (Goldstein, 2003), patients' intention to return when new services are needed, willingness to recommend the hospital (Choi et al., 2004), and profitability (Ancarani et al., 2011).

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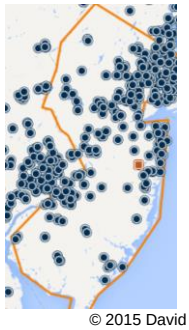
What can be done? Innovation?

- Through the CMS Innovation Center (created by the ACA), $10 billion has been allocated to support hospitals in developing innovative service delivery models that improve patient care. See: http://innovation.cms.gov/
- The increased focus on innovation is evidenced in that over one million patients annually receive care from providers participating in the Innovation Center initiatives (CMS, 2012).

- Many projects right here in NJ!



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But… (Our research objective)

"One of the striking differences between hospitals and other organizations is that so many more groups play important leadership or stakeholder roles in hospitals: administrators, hospitalists (doctors in health care systems), specialists, nurses, regulators, insurers and many more. Unless these groups can learn to work together, innovation gets lost."

- McCreight (2013), see also (Plsek, 2014).

This study addresses two research questions:

(1) How do hospitals translate innovation orientation into patient satisfaction?

(2) How does the use of employed physicians influence this translation?

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Theory; what ought to be done!

Table 1: Mapping Relational RBV (RRBV) concepts to the variables in this study (based on Dyer and Singh, 1998).

RRBV concepts	Dyer & Singh (1998)'s conceptual view	Variable	Variable definition	Logic mapping variable to RRBV
Institutional environment	Social controls or norms that facilitate the creation of relational rents (North, 1990).	**Innovation Orientation (INN)**	the extent to which a hospital promotes new, pioneering services and is on the leading edge of technology (Burke & Menachemi, 2004; Jambulingam et al., 2005; Hwang & Christensen, 2008; Salge & Vera, 2009; Lee et al., 2011; McCreight, 2013).	The hospital's orientation provides norms and expectations and thus guides the behaviors of employees and physicians working closely with the hospital. The ultimate aim of innovation is to satisfy customers (patients) which is inherently a relational rent (Ancarani et al., 2011).
Knowledge-sharing routines	Interactions that permit the creation of specialized knowledge (Cohen and Levinthal, 1990; Grant, 1996).	**Physician Partnering (PPT)**	the extent to which a hospital collaborates with its admitting/attending physicians in activities aimed at improving mutual performance (Prahalad & Ramaswamy, 2004; Vargo & Lusch, 2004; 2006; Boyer & Pronovost, 2010).	Physicians and a hospital's clinical staff (e.g., nurses) possess specialized, but overlapping knowledge about patients that is beneficial to each other's efforts in providing services to patients, and is thus useful to share (Fredendall et al., 2009; Boyer and Pronovost 2010). This captures hospital-physician knowledge-sharing.
	Interactions that permit the creation of specialized knowledge (Cohen and Levinthal, 1990; Grant, 1996).	**Customer Relationship Management (CRM)**	the extent to which the hospital employs practices for the purposes of managing patient complaints, building relationships with patients, and improving patient satisfaction (Schneller & Smeltzer, 2006; Greenberg, 2010).	CRM systems capture patient feedback that is useful to physicians and the hospital's clinical staff when collaborating to providing services to patients (Schneller and Smeltzer, 2006). This captures patient-hospital knowledge-sharing.
Relation-specific assets (Human asset specificity)	Know-how developed through exchange relationships. Dyer & Singh (1998: p. 662) provide an example of dedicated supplier engineers who learn the systems, procedures, and the individuals idiosyncratic to the buyer.	**Physician Performance (PPF)**	the extent to which admitting/attending physicians provide dependable, timely, high quality, and appropriate services to patients (Schneller & Smeltzer, 2006; Lambert & Garcia-Dastugue, 2006; Vargo and Lusch, 2004; 2006; Callaway & Dobrzykowski, 2009).	Dependable, timely, high quality, and appropriate services are manifestations of know-how possessed by physicians via hospital-physician partnering and hospital CRM (Schneller & Smeltzer, 2006). Physicians can only perform in this manner when they understand patient needs and cognize the systems, procedures, and the individuals idiosyncratic to the hospital.
Comple-mentary capabilities	Distinctive competencies or capabilities of partners that collectively generate greater rents than the sum of those obtained by an individual (Oliver, 1997). These are typically achieved through multiple functional interfaces.	**Hospital Responsive-ness (HR)**	the extent to which a hospital can provide prompt attention to a patient's needs (Zhang & Chen, 2008; Salzarulo et al., 2011).	Responding to patients' needs requires the contributions of physicians, nurses, and multiple other functions in the hospital (Salzarulo et al., 2011). (i.e., a physician should not respond to a patient's need for a prescription without considering the other medications the patient is taking which is information previously collected by a nurse.)
Relational rents	Supernormal performance generated through relationships that cannot be generated in isolation.	**Patient Satisfaction (PS)**	the extent to which patients judge the overall hospital experience favorably (Marley et al., 2004; Kane et al., 1997; Ancarani et al., 2011).	Patient satisfaction is measured at the hospital level and represents the totality of the efforts contributed by physicians and hospital clinical staff (CMS, 2012).
Governance	Formal self-enforcing safeguards providing financial motivation for partners to engage in value co-creation (Klein, 1980; Williamson, 1983).	**Physician Employment (PE)**	the percent of doctors who practice medicine in the hospital as employees rather than as independent service providers (Schneller, 2001; Fink & Hartzell, 2010; Andrabi, 2012).	Governance of hospital-physician interactions range from arm's length relationships to fully integrated employment (Kapoor and Lee, 2013; Williamson, 1975). Hospitals employ physicians with the aim of aligning financial interests and behaviors (Fink & Hartzell, 2010).

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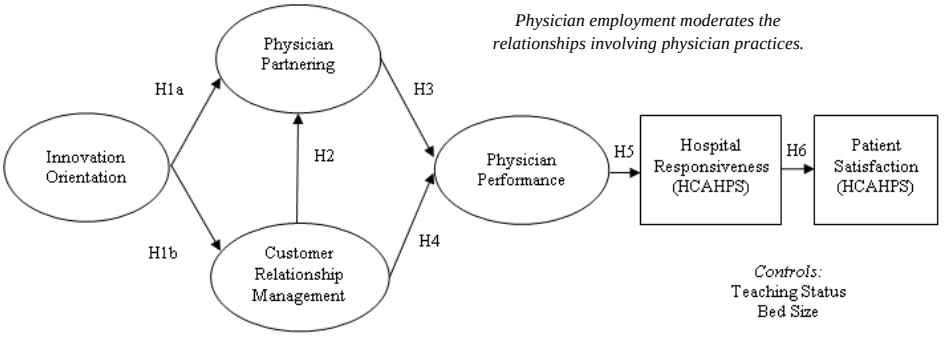
Theory; what ought to be done!

Figure 1: Testable path model: linking innovation orientation and patient satisfaction. All hypothesized relationships are positive.



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Methods – Measures

Appendix A. MEASUREMENT ITEMS – OPERATIONAL DEFINITIONS.

Unless otherwise indicated, Likert scales items: 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree.

N/A was also offered as a response choice. *- deleted items.

Innovation orientation

INN1: Our hospital is known as an innovator among hospitals in our region.

INN2: Our hospital promotes new, innovative services.

*INN3: Our hospital provides leadership in creating new services.

INN4: Our hospital is on the leading edge in creating new technologies

Physician partnering

PPT1: With our admitting/attending physicians we partner in planning and goal-setting.

PPT2: With our admitting/attending physicians we partner to improve quality (i.e., through CMEs).

PPT3: With our admitting/attending physicians we partner on continuous improvement initiatives.

PPT4: With our admitting/attending physicians we regularly partner to solve problems.

Customer relationship management

*CRM1: We set service expectations with patients.

CRM2: We have a program dedicated to improving patient satisfaction.

CRM3: We have a system for managing patient complaints.

CRM4: We monitor patient satisfaction.

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Methods – Measures

Appendix A. MEASUREMENT ITEMS – OPERATIONAL DEFINITIONS.

Unless otherwise indicated, Likert scales items: 1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree.

N/A was also offered as a response choice. *- deleted items.

Physician performance

PPF1: Our admitting/attending physicians provide timely services (e.g., rounding) to patients.

PPF2: Our admitting/attending physicians provide dependable services to patients.

PPF3: Our admitting/attending physicians provide high quality services to patients.

PPF4: Our admitting/attending physicians provide an appropriate level of services to patients.

Hospital responsiveness (Secondary data from CMS HCAHPS)

1) The proportion of patients who reported that they "Always" received help as soon as they wanted.

Patient satisfaction (Secondary data from CMS HCAHPS)

1) The proportion of patients who gave their hospital a rating of 9 or 10 for overall satisfaction on a scale from 0 (lowest) to 10 (highest).

Control: Teaching status

Please check all that apply. □Major Teaching Hospital; □Minor Teaching Hospital; or □Non-teaching Hospital

Control: Bed size

Please estimate the number of staffed beds in your hospital. □ 1 – 49; □ 50 – 99; □ 100 – 199; □ 200 – 399; □ More than 400

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Who responded?

Table 2: Sample characteristics (n=173).

Characteristics	Respondents	Characteristics	Respondents
Hospital type		*Size – number of beds*	
Tertiary care center	38 (22%)	< 49	15 (9%)
Community hospital	118 (68%)	50-99	40 (23%)
Critical access hospital	13 (8%)	100-199	43 (25%)
Other/missing values	4 (2%)	200-399	37 (21%)
		> 400	36 21%)
*Location**		Other/missing values	2 (1%)
Urban	93 (54%)		
Rural	77 (45%)	*Teaching status*	
Other/missing values	3 (2%)	Major teaching hospital	37 (21%)
		Minor teaching hospital	53 (31%)
Percentage of employed physicians		Nonteaching hospital	81 (47%)
< 5%	36 (21%)	Other/missing values	2 (1%)
6%-15%	37 (21%)		
16%-35%	22 (13%)	*Ownership status*	
36%-65%	34 (20%)	For-profit hospital	20 (12%)
> 66%, but not 100%	34 (20%)	Non-profit hospital	131 (76%)
100% - closed system	9 (5%)	Public hospital	18 (10%)
Other/missing values	1 (1%)	Other/missing values	4 (2%)

* Hospitals from 46 states participated in the study.

Note: Numbers represent frequency, followed by the percentage (rounded) of the sample in parentheses.

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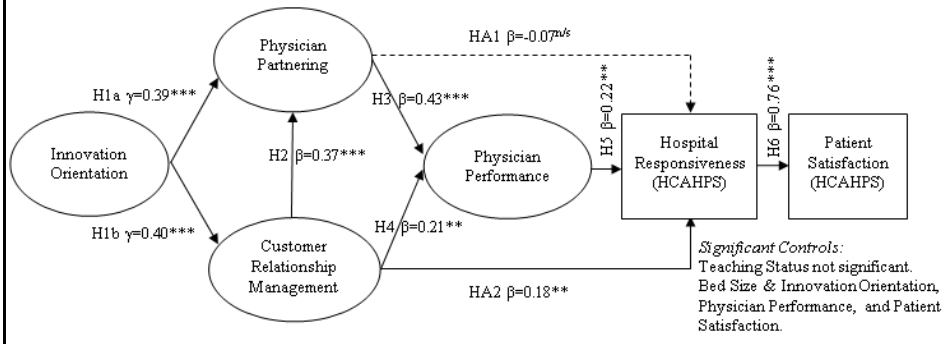
Structural model results

Figure 3: Path relationships **(Model A_2):** Full sample and subsamples of high and low employment levels. Full Sample below.



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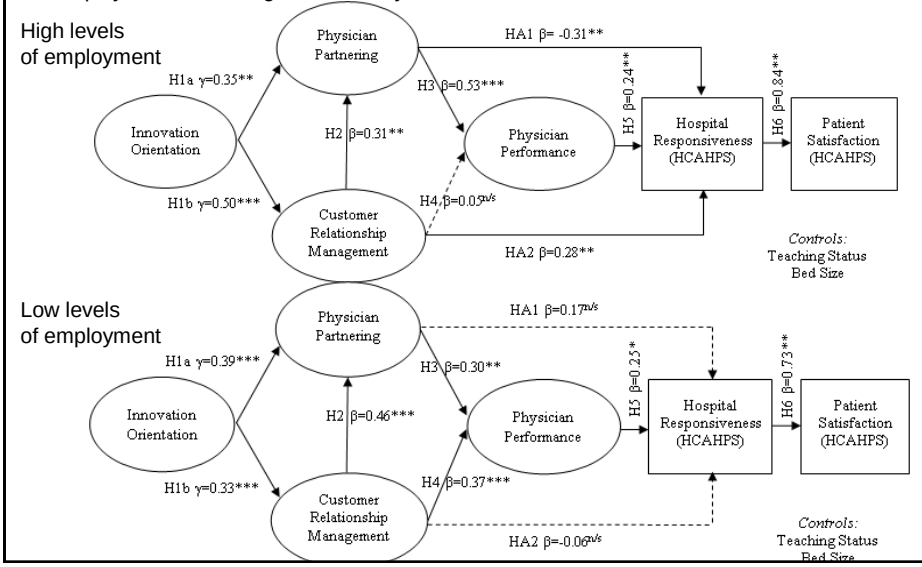
So, what did we find?

Figure 3: Path relationships **(Model A_2):** Full sample and subsamples of high and low employment levels. High, followed by low.



Implications for healthcare leaders

- **An innovation orientation and achieving customer satisfaction through better practices and performance.**
- Create an institutional environment that focuses on becoming an innovator, promoting new, innovative services, and operating on the leading edge by creating new technologies.
- **Develop and execute an innovation orientation which motivates the use of CRM systems to better understand patients' needs and build partnerships with physician to improve performance.**
- Physician partnering activities involve planning and goal-setting, quality improvement training, continuous improvement initiatives, and problem solving.
- CRM programs ought to focus on improving patient satisfaction, managing patient complaints, and monitoring patient satisfaction.

Implications for healthcare leaders

- Physician partnering and CRM practices aid admitting/attending physicians in providing timely, dependable, and high quality service to patients, which improves hospital responsiveness and ultimately patient satisfaction.
- **Physician performance and CRM drive HCAHPS!**
- The results illuminate positive pathways to improve hospital responsiveness and patient satisfaction under high employment models, but also potentially uncover a dark side of physician employment in the negative relationship between physician partnering and hospital responsiveness.
- Physician employment improves the link between physician partnering and physician performance, and ultimately hospital responsiveness.

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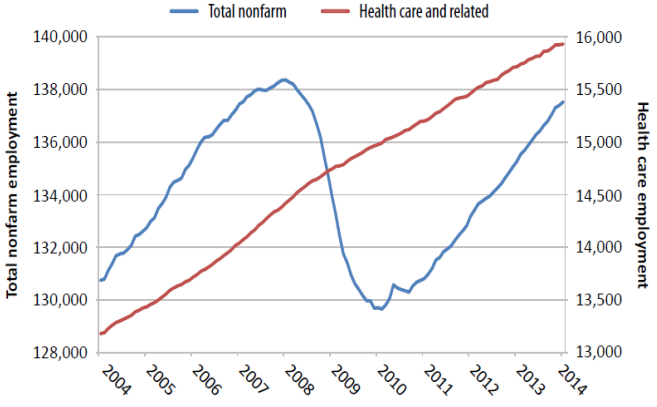
What does this mean for me and my career?

Chart 1: Total nonfarm employment and healthcare and related employment, January 2004–14 (in thousands)



Note: Health care and related include series CEU6562000101, CEU9091622001, CEU9092262201, and CEU9093262201. January 2014 data are preliminary.
Source: U.S. Bureau of Labor Statistics, Current Employment Statistics (wage and salary employment, seasonally adjusted).

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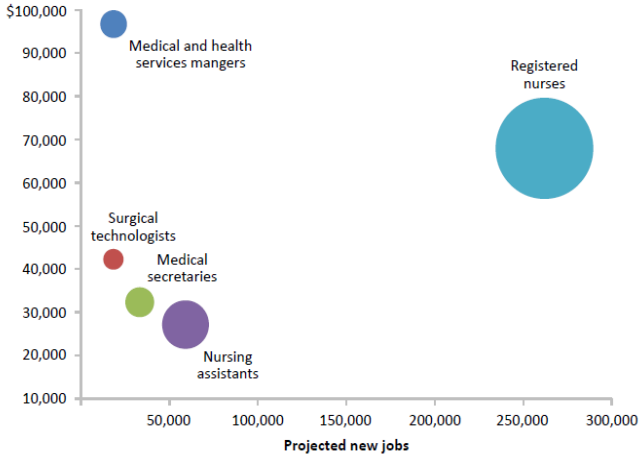
What does this mean for me and my career?

Chart 2: Occupations with the most new jobs in hospitals, projected 2012–22; employment and median annual wages, May 2013



Source: U.S. Bureau of Labor Statistics, Employment Projections program (projected new jobs, 2012–22) and Occupational Employment Statistics survey (employment and median annual wages, May 2013).

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What does this mean for me and my career?

- "We hire people out of college all the time."
- "Students turn out to be our best recruits."
- "Some go on to lead clinics…"

- VP of Performance and Planning at XXX Health System…

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What does this mean for me and my career?

Potential Job Titles (to start…)

- Supply Chain Analyst
- (Senior) Management Engineer *(Systems Engineer)*
- Physician Relations
- Project Manager
- Process Improvement Coordinator
- Hospital Operations Manager

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What does this mean for me and my career?

Desired attributes & skills

- Persuasive – “Humility & Tenacity”
- **Process-oriented**
- Problem Solver – Self Starter
- Continuous Learner
- Project Management – Over teams of volunteers
- Basic Change Management

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What does this mean for me and my career?

Desired attributes & skills

- Synthesize a room full of opinions into salient points
- Statistics / analytical skills are important!
- Basic computer skills

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So, what did we talk about?

- Set the stage – How is healthcare unique?
- How do integrative SCM approaches work in hospitals?
- Deeper dive on issues of:
  - Coordination,
  - Seemingly incongruent goals,
  - Patient safety

- Career opportunities for business professionals
- Conclusion

The Blanche and Irwin Lerner Center for the Study of Pharmaceutical Management Issues

Applying Supply Chain Mgmt. Concepts to Improve Healthcare Delivery

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