

Appendix C Summary of the reviewed empirical literature on physician-system integration, 2005-2016 (n = 29)

Reference	Study Setting	Study Period	Theoretical Application	Organizational Factor				
				Environment	Physician Group	Hospital	Care Coordination	Health System Success
Ciliberto & Dranove ^[10]	1,031 hospitals in California	1994-2001	Bargaining-market power theory	Market Demographics	Integrating Structures	Hospital Type	n/a	Total Cost of Care
Cuellar & Gertler ^[37]	1,257 hospitals in Arizona, Florida, and Wisconsin	1994-1998	Bargaining-market power theory; transaction cost theory	• Market Structure	• Integrating Structures	• Hospital Type • Information Technology • Size • Tangible Resources	• n/a	• Financial Performance • Health Services Utilization • Quality & Safety • Total Cost of Care
Mehrotra ^[38]	1.7 million enrollees of PacifiCare (large HMO in California), CEOs, and medical directors	Jul 1999-Jun 2000; May 1999-Jun 2000	n/a	• Market Demographics	• Compensation & Incentives • Integrating Structures • Information Technology • Physician Composition • Strategies	• n/a	• n/a	• Quality & Safety
Berenson et al. ^[39]	Hospitals in 12 nationally representative metropolitan areas	2000-01 vs. 2005	n/a	• Competition • Market Structure • Regulations • Technology	• Care Delivery Structures • Compensation & Incentives • Governance • Integrating Structures • Information Technology • Physician Composition • Physician Culture • Strategies	• Care Delivery Structures • Hospital Culture • Hospital Type • Information Technology • Leadership • Mission, Vision, & Values • Patient & Payer Mix • Strategies • Tangible Resources	• n/a	• Efficiency • Financial Performance • Health Services Utilization • Market Share & Growth • Patient Experience • Physician Engagement • Quality & Safety • Reputation • Total Cost of Care
Burns & Muller ^[17]	Literature review	n/a	n/a	• Competition • Health Reform • Market Structure • Regulations • Technology	• Care Delivery Structures • Compensation & Incentives • Governance • Integrating Structures • Leadership • Physician Composition • Physician Culture • Transparency	• Care Delivery Structures • Governance • Hospital Culture • Hospital Type • Information Technology • Mission, Vision, & Values • Patient & Payer Mix • Size • Strategies • Tangible Resources • Transparency	• n/a	• Financial Performance
Casalino et al. ^[40]	Hospitals in 12 nationally representative metropolitan areas	Feb-Jun 2007	n/a	• Competition • Market Structure	• Integrating Structures • Leadership • Physician Culture • Tangible Resources	• Care Delivery Structures • Tangible Resources	• n/a	• n/a
McCullough & Snir ^[41]	1,346 hospitals	1998-2001	Agency theory	• Competition • Market Demographics • Market Structure • Regulations	• Compensation & Incentives • Integrating Structures • Physician Composition	• Care Delivery Structures • Hospital Type • Patient & Payer Mix • Size • Tangible Resources	• n/a	• IT Utilization
Strandberg-Larsen et al. (2010) ^[42]	Kaiser Permanente Northern California; Danish healthcare system	2006 (Kaiser), 2007 (Danish)	n/a	• n/a	• Physician Composition • Practice Type	• Information Technology • Patient & Payer Mix • Tangible Resources	• Case Management • Communication • Training	• n/a
Felland et al. ^[43]	Hospitals in 12 nationally representative metropolitan areas	2010	n/a	• Health Reform • Market Structure	• Integrating Structures • Information Technology • Physician Composition • Tangible Resources	• Hospital Culture • Strategies	• n/a	• Access • Financial Performance • Market Share & Growth
O'Malley et al. ^[44]	Hospitals in 12 nationally representative	2010	n/a	• Competition • Health Reform	• Compensation & Incentives	• Size	• Communication • Focus on	• Access • Efficiency

	metropolitan areas			<ul style="list-style-type: none"> ● Market Structure ● Technology 	<ul style="list-style-type: none"> ● Integrating Structures ● Information Technology ● Physician Composition ● Physician Culture ● Strategies ● Tangible Resources 		Continuity of Care	<ul style="list-style-type: none"> ● Financial Performance ● Health Services Utilization ● Market Share & Growth ● Patient Experience ● Physician Engagement ● Quality & Safety ● Total Cost of Care
Evans et al. [45]	Literature review	1985-2013	Complex-adaptive systems	<ul style="list-style-type: none"> ● Health Reform ● Market Demographics 	<ul style="list-style-type: none"> ● Governance ● Integrating Structures ● Physician Composition 	<ul style="list-style-type: none"> ● Governance ● Size ● Tangible Resources 	<ul style="list-style-type: none"> ● Case Management ● Communication ● Training 	<ul style="list-style-type: none"> ● Efficiency ● Financial Performance ● Health System Culture ● Market Share & Growth ● Patient Experience ● Quality & Safety ● Reputation ● Total Cost of Care
Hwang et al. [19]	Literature review	2000-2011	n/a	<ul style="list-style-type: none"> ● Health Reform ● Market Demographics 	<ul style="list-style-type: none"> ● Governance ● Integrating Structures ● Physician Composition 	<ul style="list-style-type: none"> ● n/a 	<ul style="list-style-type: none"> ● Case Management ● Training 	<ul style="list-style-type: none"> ● Efficiency ● Health Services Utilization ● IT Utilization ● Quality & Safety ● Total Cost of Care
Kauk & Bray [46]	Literature review	n/a	n/a	<ul style="list-style-type: none"> ● Health Reform 	<ul style="list-style-type: none"> ● Compensation & Incentives ● Leadership ● Mission, Vision, & Values ● Physician Culture 	<ul style="list-style-type: none"> ● Hospital Culture ● Leadership ● Mission, Vision, & Values 	<ul style="list-style-type: none"> ● n/a 	<ul style="list-style-type: none"> ● Financial Performance ● Quality & Safety ● Total Cost of Care
Lammers [47]	4,502 hospitals	2008	Internal organization of hospitals; transaction cost theory	<ul style="list-style-type: none"> ● Market Demographics ● Market Structure ● Regulations 	<ul style="list-style-type: none"> ● Integrating Structures 	<ul style="list-style-type: none"> ● Hospital Type ● Patient & Payer Mix ● Size 	<ul style="list-style-type: none"> ● n/a 	<ul style="list-style-type: none"> ● IT Utilization
McWilliams et al. (2013)[48]	4.29 million Medicare beneficiaries	2009	n/a	<ul style="list-style-type: none"> ● Market Demographics ● Market Structure 	<ul style="list-style-type: none"> ● Integrating Structures ● Physician Composition 	<ul style="list-style-type: none"> ● Patient & Payer Mix 	<ul style="list-style-type: none"> ● n/a 	<ul style="list-style-type: none"> ● Health Services Utilization ● Quality & Safety ● Total Cost of Care
Page et al. [49]	Literature review	1992-Mar 2012	n/a	<ul style="list-style-type: none"> ● Health Reform ● Regulations 	<ul style="list-style-type: none"> ● Compensation & Incentives ● Leadership ● Physician Composition ● Physician Culture ● Tangible Resources 	<ul style="list-style-type: none"> ● Leadership 	<ul style="list-style-type: none"> ● n/a 	<ul style="list-style-type: none"> ● n/a
Sowers et al. [50]	Literature review	n/a	n/a	<ul style="list-style-type: none"> ● Health Reform ● Regulations 	<ul style="list-style-type: none"> ● Compensation & Incentives ● Governance ● Integrating Structures ● Leadership ● Mission, Vision, & Values ● Physician Composition ● Physician Culture 	<ul style="list-style-type: none"> ● Governance ● Hospital Culture ● Leadership ● Mission, Vision, & Values ● Size ● Strategies 	<ul style="list-style-type: none"> ● Case Management 	<ul style="list-style-type: none"> ● Efficiency ● Health System Culture ● Patient Experience ● Quality & Safety
Baker et al. [13]	2.1 million hospital claims from non-elderly, privately insured patients	2001–2007	Bargaining-market power theory; transaction cost theory	<ul style="list-style-type: none"> ● Competition ● Market Demographics ● Market Structure 	<ul style="list-style-type: none"> ● Integrating Structures 	<ul style="list-style-type: none"> ● Hospital Type ● Size ● Tangible Resources 	<ul style="list-style-type: none"> ● n/a 	<ul style="list-style-type: none"> ● Health Services Utilization ● Total Cost of Care
Cho et al. [51]	U.S. hospitals	2010	n/a	<ul style="list-style-type: none"> ● Market Demographics 	<ul style="list-style-type: none"> ● Integrating Structures 	<ul style="list-style-type: none"> ● Care Delivery Structures ● Hospital Type ● Size ● Tangible Resources 	<ul style="list-style-type: none"> ● n/a 	<ul style="list-style-type: none"> ● Health Services Utilization ● IT Utilization
Janus & Brown [52]	151 integrated care organizations in U.S., England, and Germany	n/a	n/a	<ul style="list-style-type: none"> ● n/a 	<ul style="list-style-type: none"> ● Compensation & Incentives ● Physician Composition 	<ul style="list-style-type: none"> ● n/a 	<ul style="list-style-type: none"> ● n/a 	<ul style="list-style-type: none"> ● n/a

Robinson & Miller (2014)[15]	4,5 million patients in California	2009-2012	n/a	<ul style="list-style-type: none"> Market Demographics 	<ul style="list-style-type: none"> Governance Integrating Structures Physician Composition 	<ul style="list-style-type: none"> Tangible Resources 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Financial Performance Total Cost of Care
Cho [53]	24 physicians and hospital administrators	Apr-Nov 2012	n/a	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Integrating Structures 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Communication 	<ul style="list-style-type: none"> Market Share & Growth Patient Experience Total Cost of Care Total Cost of Integration
Chukmaitov et al. [54]	5,4 million patient records in Florida	2006-2009	Contingency theory	<ul style="list-style-type: none"> Competition Market Demographics Market Structure 	<ul style="list-style-type: none"> Integrating Structures 	<ul style="list-style-type: none"> Hospital Type Size Tangible Resources 	<ul style="list-style-type: none"> Post-Acute and Outpatient Care 	<ul style="list-style-type: none"> IT Utilization Quality & Safety Total Cost of Care
Neprash et al. [55]	7,391,335 non-elderly enrollees in PPOs or point-of-service plans	Dec 1, 2013 - Jul 13, 2015	Bargaining-market power theory	<ul style="list-style-type: none"> Competition Market Demographics 	<ul style="list-style-type: none"> Integrating Structures 	<ul style="list-style-type: none"> Hospital Type 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Total Cost of Care
Song et al. [56]	806,266 Medicare beneficiaries; 12,567,069 commercially insured individuals	2007-2012	n/a	<ul style="list-style-type: none"> Market Demographics 	<ul style="list-style-type: none"> Integrating Structures 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Health Services Utilization
Trybou et al. [20]	Literature review	Jan 1989 - Jun 2013	Agency theory	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Compensation & Incentives Integrating Structures 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Financial Performance
Baker et al. [57]	400,000 physicians	2009	Agency theory	<ul style="list-style-type: none"> Market Demographics 	<ul style="list-style-type: none"> Governance Integrating Structures 	<ul style="list-style-type: none"> Hospital Type Size 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Health Services Utilization Financial Performance Quality & Safety
Everson et al. [58]	2,920 hospitals	2009-2012	Transaction cost theory	<ul style="list-style-type: none"> Competition Market Demographics 	<ul style="list-style-type: none"> Integrating Structures Physician Composition 	<ul style="list-style-type: none"> Hospital Type Size 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> IT Utilization Quality & Safety
Lanese [59]	1 hospital in the Midwest	2012-2013	n/a	<ul style="list-style-type: none"> Health Reform 	<ul style="list-style-type: none"> Integrating Structures 	<ul style="list-style-type: none"> Hospital Culture 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Patient Experience Quality & Safety Total Cost of Care

Appendix A. Definitions of physician integrating structures by the American Hospital Association (American Hospital Association, 2015)

Physician Integrating Structure	Definition
Open physician-hospital organization (PHO)	A joint venture between the hospital and all members of the medical staff who wish to participate. The PHO can act as a unified agent in managed care contracting, own a managed care plan, own and operate ambulatory care centers or ancillary services projects, or provide administrative services to physician members.
Closed physician-hospital organization (PHO)	A PHO that restricts physician membership to those practitioners who meet criteria for cost effectiveness and/or high quality.
Group practice without walls	Hospital sponsors the formation of, or provides capital to physicians to establish, a “quasi” group to share administrative expenses while remaining independent practitioners.
Independent practice association	A legal entity that holds managed care contracts. The IPA then contracts with physicians, usually in solo practice, to provide care either on a fee-for-service or capitated basis. The purpose of an IPA is to assist solo physicians in obtaining managed care contracts.
Management services organization	A corporation, owned by the hospital or a physician/hospital joint venture, that provides management services to one or more medical group practices. The MSO purchases the tangible assets of the practices and leases them back as part of a full-service management agreement, under which the MSO employs all non-physician staff and provides all supplies/administrative systems for a fee.
Equity model	Allows established practitioners to become shareholders in a professional corporation in exchange for tangible and intangible assets of their existing practices.
Foundation	A corporation, organized either as a hospital affiliate or subsidiary, which purchases both the tangible and intangible assets of one or more medical group practices. Physicians remain in a separate corporate entity but sign a professional services agreement with the foundation.
Employed/Salary model	Physicians are salaried by the hospital or another entity of a health system to provide medical services for primary care and specialty care.

Appendix B. Frequency of Value Chain dimensions by health system success factor

Health System Success Factor	Structure	Culture	Resources	Pre-Service	Point-of-Service	After-Service	Total
Access	2	2	1	2	1	1	9
Efficiency	13	7	7	4	5	3	39
Financial Performance	26	11	23	4	4	3	71
Health Services Utilization	25	5	10	1	1	1	43
Health System Culture	16	6	8	5	8	0	43
IT Utilization	38	0	16	7	0	0	61
Market Share & Growth	6	3	3	3	3	3	21
Patient Experience	10	6	6	4	4	1	31
Physician Engagement	12	11	10	5	2	2	42
Quality & Safety	59	8	22	6	6	1	102
Reputation	4	2	3	1	1	0	11
Total Cost of Care	32	7	14	5	3	1	62
Total Cost of Integration	0	0	0	3	0	0	3
Total	243	68	123	50	38	16	538

Appendix D. Number of articles that used each organizational factor of the physician-system integration conceptual model (n = 29)

Dimension	Organizational Factor	# of Articles Using Factor	% of Articles Using Factor	Total # of Factors	Average # of Factors Per Article
Environment	Competition	9	31.0%	18	2.00
	Health Reform	9	31.0%	13	1.44
	Market Demographics	15	51.7%	21	1.40
	Market Structure	11	37.9%	22	2.00
	Regulations	6	20.7%	11	1.83
	Technology	3	10.3%	4	1.33
	Any Environmental Factor	25	86.2%	71	2.84
Physician Group	Care Delivery Structures	2	6.9%	9	4.50
	Compensation & Incentives	10	34.5%	32	3.20
	Culture	7	24.1%	14	2.00
	Governance	7	24.1%	9	1.29
	Integrating Structures	25	86.2%	71	2.84
	Information Technology	4	13.8%	4	1.00
	Leadership	5	17.2%	10	2.00
	Mission, Vision, & Values	2	6.9%	3	1.50
	Physician Composition	15	51.7%	25	1.67
	Practice Type	1	3.4%	1	1.00
	Strategies	3	10.3%	3	1.00
	Tangible Resources	4	13.8%	7	1.75
	Transparency & Feedback	1	3.4%	1	1.00
Any Physician Group Factor	29	100.0%	153	5.28	
Hospital	Care Delivery Structures	5	17.2%	8	1.60
	Culture	6	20.7%	8	1.33
	Governance	3	10.3%	3	1.00
	Hospital Type	12	41.4%	17	1.42
	Information Technology	4	13.8%	7	1.75
	Leadership	4	13.8%	7	1.75
	Mission, Vision, & Values	4	13.8%	8	2.00
	Patient & Payer Mix	6	20.7%	8	1.33
	Size	12	41.4%	14	1.17
	Strategies	4	13.8%	9	2.25
	Tangible Resources	12	41.4%	21	1.75
	Transparency	1	3.4%	1	1.00
	Any Hospital Factor	23	79.3%	72	3.13
Care Coordination	Post-Acute and Outpatient Care	1	3.4%	1	1.00
Coordination	Case Management	4	13.8%	5	1.25
	Communication	4	13.8%	6	1.50
	Focus on Continuity of Care	1	3.4%	2	2.00
	Training	3	10.3%	3	1.00
	Any Care Coordination Factor	7	24.1%	12	1.71
Health System Success	Access	2	6.9%	2	1.00
	Culture	2	6.9%	2	1.00
	Efficiency	5	17.2%	6	1.20
	Financial Performance	10	34.5%	24	2.40
	Health Services Utilization	9	31.0%	14	1.56
	IT Utilization	6	20.7%	9	1.50

Market Share & Growth	5	17.2%	7	1.40
Patient Experience	6	20.7%	6	1.00
Physician Engagement	2	6.9%	3	1.50
Quality & Safety	12	41.4%	38	3.17
Reputation	2	6.9%	2	1.00
Total Cost of Care	14	48.3%	20	1.43
Total Cost of Integration	1	3.4%	3	3.00
Any Health System Success Factor	26	89.7%	109	4.19

Appendix E. Cluster means, standard deviations, and ANOVA results for differences along clustering measures for health system success factors

	Cluster					F
	1 n=4	2 n=1	3 n=3	4 n=1	5 n=4	
Structure	12.75 (sd=2.50)	26.00	31.67 (sd=6.51)	59.00	3.00 (sd=2.58)	53.53***
Culture	7.50 (sd=2.38)	11.00	4.00 (sd=3.61)	8.00	1.75 (sd=1.26)	4.80*
Resources	7.75 (sd=1.71)	23.00	13.33 (sd=3.06)	22.00	1.75 (sd=1.50)	37.17***
Pre-Service	4.50 (sd=0.58)	4.00	4.33 (sd=3.06)	6.00	2.25 (sd=0.96)	1.54
Point-of-Service	4.75 (sd=2.50)	4.00	1.33 (sd=1.53)	6.00	1.25 (sd=1.26)	3.04
After-Service	1.50 (sd=1.29)	3.00	0.67 (sd=0.58)	1.00	1.00 (sd=1.41)	0.80

*p<0.05, **p<0.01, ***p < 0.001