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Simultaneous implementation of Six Sigma and knowledge management in hospitals

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Six Sigma programmes aspire to reduce variation in organizational processes and achieve clear financial results. Six Sigma initiatives have proven to be an effective technique for improving quality in manufacturing. Similarly, the importance of knowledge management has grown considerably in recent years and has emerged as a major source of competitive advantage for manufacturing firms. From the perspective of a decision support system, knowledge management is concerned with information acquisition, dissemination, and responsiveness. Little research has examined simultaneous applications of Six Sigma and knowledge management. The purpose of this paper is to explore the usefulness of knowledge management for the implementation of Six Sigma in hospitals. We hypothesize that knowledge management will enhance the implementation of Six Sigma by leading to improvements of quality programme results and sustainable competitive advantage. The results of hierarchical regression analysis demonstrate that knowledge management does ameliorate the success of Six Sigma initiatives, specifically for knowledge dissemination and responsiveness. These results are discussed in terms of the contributions to existing theory and for managers of Six Sigma and knowledge management initiatives.

Keywords: Six Sigma; Knowledge management; Competitive advantage

1. Introduction

To achieve a competitive advantage, organizations have recently adopted Six Sigma initiatives and knowledge management systems. However, investment in quality and information systems is not necessarily effective. Research has revealed significant mediators of organizational performance, such as knowledge-based dynamic capability and organizational learning (Wang *et al.* 2007, Yeung *et al.* 2007). Likewise, knowledge management could enhance the effectiveness of quality initiatives through a decision support system, such as an information technology infrastructure (Hartman *et al.* 2002, Hsu and Shen 2005). The purpose of this paper is to test the synergistic effects of Six Sigma and knowledge management on

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organizational success. Specifically, we propose that the application of knowledge management enhances the effect of Six Sigma on quality programme results and sustainable competitive advantage.

The concurrent implementation of Six Sigma initiatives and knowledge management is relatively novel and the extant literature lacks an assessment of its effectiveness. Theory development and strong empirical support for Six Sigma and knowledge management concepts originated mainly from manufacturing settings (Gunasekaran and Ngai 2007). Similar models of successful service Six Sigma and knowledge management have been proposed but have attracted less scholarly attention (Antony 2006). Given the paramount importance of patient safety issues today, quality and knowledge management provide leading opportunities for improvement of healthcare systems (Ruiz 2004). Silverstein (2006, p. 39) concluded that 'there's no better place to apply Six Sigma than the healthcare industry' as it is 'process intensive business, rife with data'. Consequently, we examine the theoretical foundations for Six Sigma and knowledge management, describe the methodology for testing our hypotheses, and present our results, conclusions, and implications for practice and future research.

2. Literature review

Six Sigma is a process improvement initiative designed by leading manufacturing companies and recently adopted by service organizations (Antony 2006). It is a systematic data-driven approach that resolves errors in processes by focusing on organizational outcomes most critical to customers (Breyfogle 2003). The Six Sigma quality level is characterized by only 3.4 or fewer defects per million opportunities. Six Sigma team members are trained in problem solving and statistical techniques. Team projects are selected based on customer requirements and on their ability to achieve clear financial returns for the organization.

Motorola pioneered the concept of Six Sigma and won the prestigious Malcolm Baldrige National Quality Award in 1988 largely due to their Six Sigma initiative. Six Sigma programmes at other manufacturing companies, such as General Electric and Allied Signal, provided a significant amount of credibility and media attention. Over the past two decades, Six Sigma has become an increasingly popular initiative across a range of industries (Kumar *et al*. 2006). Empirical results indicate that Six Sigma has contributed to process and quality improvement, customer satisfaction, and corporate competitiveness (Lee and Choi 2006). Furthermore, Gowen and Tallon (2005) found that companies with higher levels of technological intensity were more likely to implement Six Sigma, as well as more likely to achieve a competitive advantage as a result of such implementation, compared with low technological intensive companies.

As a means for resolving patient safety issues, many healthcare organizations have undertaken Six Sigma initiatives targeted toward improving organizational performance (Lloyd and Holsenback 2006). The reduction of medical errors in healthcare can be compared to conformance quality in manufacturing. The adoption of Six Sigma programmes has expanded only recently to healthcare organizations (Carrigan and Kujawa 2006). Research suggests that the implementation of quality programmes significantly improves patient satisfaction (Marley *et al*. 2004).

Specifically, case studies of Six Sigma initiatives have resulted in diverse pragmatic improvements, such as clinical, operational, and service benefits (Carpenter 2006, Craven *et al*. 2006, Sherman 2006).

Likewise, the importance of knowledge management has grown considerably in recent years and has emerged as a major source of competitiveness mainly for manufacturing firms (Gunasekaran and Ngai 2007). For our purposes, knowledge management is defined as 'the process that creates or locates knowledge and manages the dissemination and use of knowledge within and between organizations' (Darroch 2003, p. 41). Successful knowledge management depends on the relevant technical infrastructure to capture, store, share, and use information common to a decision support system (Lee and Choi 2003). Knowledge management is a systematic and cross-disciplinary approach to improving an organization's ability to mobilize knowledge which supports decision making (Hsu and Shen 2005). Moreover, applications of knowledge management as a decision support system have proven successful in manufacturing organizations (Dayan 2003, Dayan and Evans 2006, Irani *et al*. 2007, Nachiappan *et al*. 2007) and healthcare settings (Hartman *et al*. 2002).

Knowledge management can be represented as a three-stage process of knowledge acquisition, dissemination, and responsiveness (Darroch 2003). Knowledge acquisition relates to the location, creation, and discovery processes. For example, knowledge could be acquired from employees, databases, and relationships between the firm and its customers or suppliers. Knowledge dissemination measures how knowledge is applied and distributed in the organization. Knowledge responsiveness refers to the way that the organization utilizes various types of knowledge, such as how a company can use knowledge about customer behavior to improve customer satisfaction and retention. Having knowledge available to the right people at the right time is critical in building an organization's competencies (Alazmi and Zairi 2003). Information sharing is critical for successful organizational processes, such as supply chain management (Chandra *et al*. 2007), but only if the benefits outweigh the risks (Smith *et al*. 2007). Several empirical studies have also revealed that knowledge management practices can lead to improvement of organizational effectiveness (McCann and Buckner 2004, Yeung *et al*. 2007).

Knowledge management offers a compelling complement to the success of quality management initiatives (Choo *et al*. 2007), such as the Malcolm Baldrige National Quality Award process (Meyer and Collier 2001, Lee *et al*. 2006). Information technology (IT) initiatives to support knowledge management can lead to greater organizational performance (Wang *et al*. 2007). The Institute of Medicine (2000) reported that United States' medical errors contribute to more than one million injuries and up to 98,000 deaths annually, for which 58% were preventable. Poor healthcare information, such as incorrect medication administration, accounts for many of those fatalities. The Institute of Medicine report also claimed that IT initiatives, such as electronic prescriptions, could eliminate up to 80% of dispensing errors. Likewise, IT applications have been applied to the automation of more routine tasks to resolve recent nursing staff shortages and so that nurses are allowed to devote more attention to patient safety issues (Mullaney and Weintraub 2005). Although healthcare IT initiatives have been expensive and slow, case studies reveal that they have resulted in greater quality of patient care (Carpenter 2006).

3. Sustainable competitive advantage and hypotheses

In the dynamic capabilities theory, the effective implementation of Six Sigma and knowledge management could result in sustainable competitive advantage (Barney 2002). Dynamic capabilities are organizational processes that effectively utilize organizational resources (Winter 2003). Knowledge-based dynamic capability has been reported as the link between IT support for knowledge management and firm performance (Wang *et al*. 2007). Competitive advantage can be achieved and sustained from resources and dynamic capabilities that are characterized by four factors: value, rareness, imitation cost, and non-substitutability (Hitt *et al*. 2007). Value refers to the degree that the firm's resources enable the organization to respond to external threats and opportunities. Rareness concerns the degree that competing firms do not possess the organization's particular valuable resources, such as a pharmaceutical firm's patented products. Imitation cost focuses on the cost disadvantage faced by other firms that do not possess a certain resource. Non-substitutability captures the degree that a resource has no strategic equivalent. Practically, resources limitations force an organization to capture only some measure of each factor. Certain Six Sigma dimensions, such as Black/Green Belt training and teams, other strategic human resource practices, and DMAIC (define, measure, analyse, improve, and control) process management, can be dynamic capabilities which lead to sustainable competitive advantage, as reported in empirical studies (deMast 2006, Lee and Choi 2006).

Competitive advantage could result from other dynamic capabilities, such as appropriately designed knowledge management initiatives (Gunasekaran and Ngai, 2007). The value and rareness of knowledge management applications can improve through greater efficiency in their implementation. Also, adaptation of Six Sigma and knowledge management to unique hospital conditions and patient needs could increase imitation cost and non-substitutability. Therefore, more appropriate implementation of knowledge management could enhance the success of Six Sigma programmes beyond that of employing only Six Sigma practices.

As described above, the implementation of Six Sigma is associated with improvement in quality programme results, such as quality, customer satisfaction, net cost savings and reduction of errors, as well as improvement in competitive advantage. Furthermore, it is expected that the three dimensions of knowledge management will also enhance Six Sigma initiatives in terms of greater quality programme results and sustainable competitive advantage. Therefore, the previous literature review leads to the following research hypotheses:

H1: Six Sigma initiatives will have a positive effect on quality programme results.

H2: Knowledge acquisition will have a positive effect on quality programme results, in the context of Six Sigma initiatives.

H3: Knowledge dissemination will have a positive effect on quality programme results, in the context of Six Sigma initiatives.

H4: Knowledge responsiveness will have a positive effect on quality programme results, in the context of Six Sigma initiatives.

H5: Six Sigma initiatives will have a positive effect on sustainable competitive advantage.

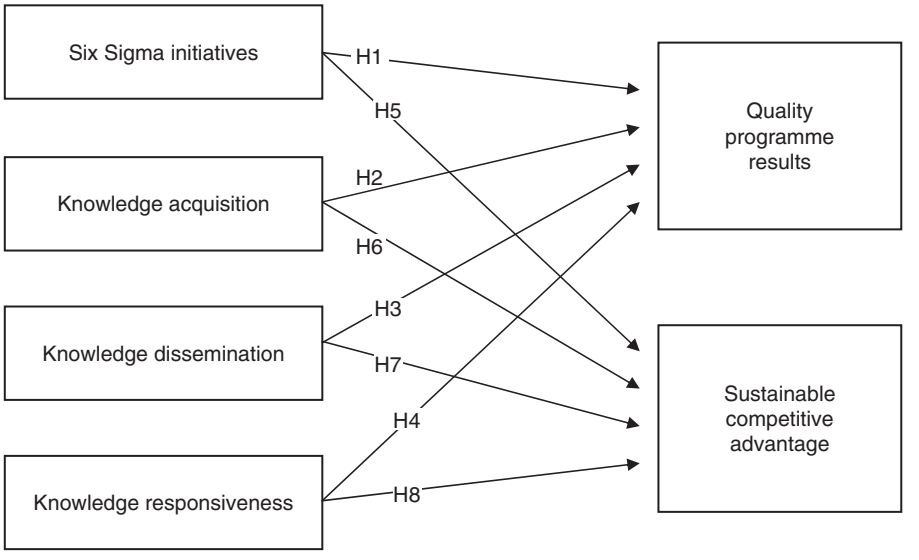

Figure 1. Framework for the effects of Six Sigma and knowledge management on quality programme results and sustainable competitive advantage.

H6: Knowledge acquisition will have a positive effect on sustainable competitive advantage, in the context of Six Sigma initiatives.
H7: Knowledge dissemination will have a positive effect on sustainable competitive advantage, in the context of Six Sigma initiatives.
H8: Knowledge responsiveness will have a positive effect on sustainable competitive advantage, in the context of Six Sigma initiatives.

These hypotheses are diagrammed by the conceptual model in figure 1 that guides this study.

4. Methodology

This research employs a survey methodology to collect data in order to test our research hypotheses, using the hospital organization as the unit of analysis. To obtain a list of US hospitals for this survey, we utilized a comprehensive directory of the 6000 hospitals posted on the website *Hospitallink.com*. From the hospital websites, we were able to obtain the addresses and telephone numbers for a random sample of the hospitals. An initial questionnaire was tested in a pilot survey sent to several hospital Quality Directors. Phone interviews were also initially conducted to improve the clarity and to reduce the ambiguity of our questions.

We contacted the Quality Director and Information Systems Director at each hospital to obtain multiple raters who could complete our survey. For additional raters, we also contacted the Director of Nursing and Risk Manager at each hospital. By calling the hospitals directly, we were able to ensure that the surveys were emailed to the appropriate people. Flynn *et al.* (1990) advocates this approach as an effective means for improving the response rate. Another method we used to increase our

response rate was to send two email reminders with the questionnaire attached at three-week intervals.

We limited our data set to those hospitals from which we received multiple responses. The final sample of 112 hospitals yielded a response rate of approximately 61%. This response rate compares favourably with the response rates cited in other published survey-based research studies in the field of operations management (Flynn *et al.* 1990). The Cronbach Alpha (CA) inter-rater reliability, which was calculated for the responses from multiple raters for each hospital, exhibited an average CA value of 0.71, which is deemed acceptable (Flynn *et al.* 1990). For each survey variable, the multiple rater responses were averaged to give a value for each item from each hospital. Finally, we used Harman's one-factor test to check whether common method bias was present (Podsakoff *et al.* 2003). Harman's one-factor test resulted in nine factors accounting for 68.2% of the variance, with the first factor at 11.6%. Because no factor accounted for most of the variance, the single method of data collection was an acceptable risk.

4.1 *Variables*

The key constructs in our conceptual framework are:

- Six Sigma initiatives.
- Knowledge acquisition.
- Knowledge dissemination.
- Knowledge responsiveness.
- Quality programme results.
- Sustainable competitive advantage.

The questionnaire items for each construct were drawn from the previous literature and are shown in the Appendix. The Six Sigma initiatives (SSI) variable was measured by four items asking the respondent to assess the level of implementation of each of these items (Six Sigma system, black/green belt training, DMAIC process, and quality system financial rewards). The knowledge acquisition (KA), knowledge dissemination (KD), and knowledge responsiveness (KR) constructs were measured by items from those scales developed and validated by Darroch (2003, 2005) and Darroch and McNaughton (2003). The quality programme results (QPR) construct was measured by four items (quality improvement, patient satisfaction increase, net cost savings, and reduction in the severity of errors) based on prior research in healthcare quality (Kazandjian and Lied 1999, Spath 2000, Gowen *et al.* 2006a, McFadden *et al.* 2006a, b). The final construct in the conceptual framework, sustainable competitive advantage (SCA) was measured by four items (value added, rareness, costly-to-imitate, and non-substitutability), described previously (Gowen *et al.* 2006b) and based on the dynamic capabilities model (Barney 2002, Winter 2003).

Principal components factor analysis for all of the constructs of this study confirmed those scales, as reported in table 1, using varimax rotation with Kaiser normalization advocated by Hinkin (1995). The Cronbach Alpha scale reliability values for these six constructs consisted of a range of 0.65 to 0.84, which is beyond the minimum acceptable level of 0.60 for exploratory research (Flynn *et al.* 1990).

Table 1. Results of factor analysis and Cronbach Alpha scale reliability for all constructs.

Construct	Items	Loading	Alpha
Six Sigma initiatives	Six Sigma system	0.844	0.653
	Black/green belt training	0.838	
	DMAIC process	0.559	
	Quality programme rewards	0.564	
Knowledge acquisition	Survey employees regularly	0.765	0.842
	Managers ask employees work feelings	0.831	
	Appraisals for employees needs	0.828	
	Employees attend training seminars	0.730	
	Staff meetings with employees	0.624	
	Employees take college courses	0.747	
Knowledge dissemination	Marketing assesses patient needs	0.804	0.848
	Marketing information accessible	0.819	
	Meetings for marketing trends	0.739	
	Patient information database accessible	0.641	
	Patient satisfaction data sent to all levels	0.747	
	Records of internal best practices	0.775	
Knowledge responsiveness	Immediate action on quality issues	0.771	0.868
	Respond to new patient service needs	0.825	
	High effort for patient service requests	0.807	
	Quick response to patient complaints	0.838	
	Quick response to employee concerns	0.814	
Quality programme results	Quality improvement	0.825	0.723
	Patient satisfaction increase	0.809	
	Net cost savings	0.777	
	Reduction in the severity of errors	0.541	
Sustainable competitive advantage	Value added	0.707	0.778
	Rareness	0.852	
	Costly-to-imitate	0.838	
	Non-substitutability	0.690	

The items for each scale were averaged to create the variables used in the subsequent regression analysis.

In order to control for four possible confounding variables, our analysis included the level of 'experience' (EXP) the hospital had with quality systems, the 'size' of the hospital (measured by the number of beds), the number of 'full time equivalent employees' (FTE) dedicated to quality programmes, and the primary mission of hospital in terms of the 'type' (TYP, i.e. community, teaching, or other type of hospital). Table 2 shows descriptive statistics for these variables. In addition, table 2 includes Pearson correlation coefficients showing the strength of the bivariate relationships between the variables.

5. Analysis and results

To test our hypotheses, we used hierarchical regression analysis (Cohen *et al*. 2002). In this approach, control variables were entered into multiple regression analysis.

Table 2. Descriptive statistics and Pearson correlation coefficients for quality system experience (EXP), hospital size (SIZE), full-time equivalent number of quality programme employees (FTE), type of hospital (TYP), six sigma initiatives (SSI), knowledge acquisition (KA), knowledge dissemination (KD), knowledge responsiveness(KR), quality program results (QPR), and sustainable competitive advantage (SCA).

	Mean	SD	EXP	SIZE	FTE	TYP	SSI	KA	KD	KR	QPR
EXP	13.23	6.880									
SIZE	150.14	172.000	0.127								
FTE	3.79	9.610	0.109	0.023							
TYP	2.04	0.371	0.160	0.152	0.001						
SSI	1.49	0.855	0.007	0.175	−0.127	0.271**					
KA	3.60	0.746	0.180	0.334**	−0.062	0.132	0.296**				
KD	3.09	0.828	0.245**	0.311**	0.142	0.303**	0.192*	0.632**			
KR	3.82	0.564	0.157	−0.014	−0.068	0.195*	0.068	0.528**	0.547**		
QPR	3.28	0.631	0.096	0.112	0.006	0.182	0.290**	0.454**	0.555**	0.537**	
SCA	2.52	0.702	0.100	0.268**	−0.008	0.211*	0.290**	0.407**	0.369**	0.344**	0.497**

SD, standard deviation; *$p < 0.05$; **$p < 0.01$.

Theoretically grouped sets of variables were then entered into the regression, and an F statistic was calculated to determine whether the change in variance explained (R^2) by the additional variables was statistically significant. Tables 3 and 4 show the cumulative result of entering the control variables, then the SSI construct, and finally the three knowledge management variables into the overall regression model. In table 3, the dependent variable was QPR. In the first model, the control variables were entered and none was statistically significant. In the second model, the SSI

Table 3. Regression results for quality programme results as the dependent variable (standardized coefficients shown).

	Model		
	1	2	3
EXP	0.060	0.070	−0.038
SIZE	0.081	0.043	−0.021
FTE	−0.002	0.030	0.013
TYP	0.160	0.093	−0.040
SSI		0.260**	0.212*
KA			0.013
KD			0.346***
KR			0.341***
Overall R^2	0.044	0.104	0.429
Overall F	1.226	2.462*	9.693****
Change in R^2		0.060	0.325
F for change		7.127**	19.585****
$n = 112$			

*$p < 0.05$; **$p < 0.01$; ***$p < 0.005$; ****$p < 0.001$.

Table 4. Regression results for sustainable competitive advantage as the dependent variable (with standardized coefficients shown).

	Model		
	1	2	3
EXP	0.045	0.054	−0.008
SIZE	0.237*	0.205*	0.167
FTE	−0.019	0.010	0.029
TYP	0.168	0.110	0.060
SSI		0.225*	0.181*
KA			0.145
KD			0.049
KR			0.223*
Overall R^2	0.104	0.149	0.263
Overall F	3.093*	3.706***	4.586***
Change in R^2		0.045	0.114
F for change		5.621*	5.303***
$n = 112$			

*$p < 0.05$; **$p < 0.01$; ***$p < 0.005$.

variable was also entered. SSI was positive and significant (at $p<0.01$); the change in R^2 was statistically significant as well. In the third model, the three knowledge management variables were entered as a group and the change in R^2 was significant (at $p<0.001$). Also, both KD and KR were significant (at $p<0.005$), but the control variables and KA were not significant. In this last model, SSI, KD, and KR were significant and positive, which indicates support for hypotheses H1, H3, and H4.

Table 4 shows the results of the hierarchical regression where SCA was the dependent variable. In the first model with only control variables, hospital size was statistically significant (at $p<0.05$). In the second model, the change in R^2 was significant; SSI and hospital size were significant and positive (at $p<0.05$). In the third model, SSI and KR were both significant and positive (at $p<0.05$) and the change in R^2 was significant (at $p<0.005$). For this final model, the control variables, KA, KD were not significant. Therefore, the results in table 4 show support for hypotheses H5 and H8.

6. Discussion and limitations

These results extend the literature by examining the efficacy of concurrent implementation of Six Sigma initiatives and knowledge management. Our support for the effects of Six Sigma on increasing quality programme results and competitive advantage aligns with the previous descriptive literature (Barry *et al.* 2002) and empirical research (Lee and Choi 2006). Similarly, our findings demonstrate that knowledge management practices improve quality programme results and competitive advantage, which confirms the extant literature (Darroch 2003, 2005, Darroch and McNaughton 2003, Yeung *et al.* 2007). Furthermore, our result that knowledge dissemination leads to greater quality programme results supports the knowledge management literature (Gunasekaran and Ngai 2007). The lack of a significant effect on competitive advantage suggests that hospital administrators have not designed knowledge dissemination to improve the implementation of Six Sigma from a competitive perspective. Likewise, our findings indicate that knowledge responsiveness enhances organizational performance and competitiveness beyond the impact of Six Sigma alone. Finally, the results indicate a surprisingly ineffective impact of knowledge acquisition on quality programme results and competitive advantage.

Although few studies have contrasted the relative effects of the three dimensions of knowledge management, our findings are consistent with the dynamic capabilities theory and previous research. Resource acquisition is not as important as resource configuration for transforming organizational core capabilities into sustainable competitive advantage, as posited in the dynamic capabilities theory (Barney 2002, Winter 2003). Applying this position to knowledge management, limited research does stress the greater importance of knowledge sharing than knowledge acquisition (VanderBij *et al.* 2003, Irani *et al.* 2007). Likewise, the results of this study are consistent with research which reports the relative importance of the three stages of knowledge management. For a sample of New Zealand manufacturing and service firms, the mean values and correlations of knowledge management with firm performance demonstrate the superiority of knowledge responsiveness, as opposed to knowledge acquisition and knowledge dissemination (Darroch 2003, 2005). Practically, our findings imply that healthcare organizations have not utilized the full

potential of all stages of knowledge management, as previously reported in general (McCann and Buckner 2004). Hospitals may have focused so far on the efficiency emphasis of first-stage knowledge management and could benefit by moving to the greater outcomes of synergy and innovation at the higher stages (Hsu and Shen 2005).

There are some limitations of our exploratory study. Potential drawbacks common to survey research include the reliance on perceptual data and the use of a single method of data collection. The use of multiple respondents from each hospital assists in addressing these issues. Relative to the perceptual data issue, research indicates that self-reported evaluations are highly consistent with more objective observations, especially when the respondents are at the appropriate point in the organization to make such evaluations (Ketokivi and Schroeder 2004). However, subjectivity is still inevitable due to individual judgments. Furthermore, Bommer *et al*. (1995) argue that objective measures alone are no panacea due to their narrow focus. Unfortunately, triangulation with more objective data on hospital quality practices and programme results was prohibited due to the legal barriers to obtaining actual medical error information. Similarly for the potential common method variance issue, the application of Harman's one-factor test reported previously and other methods (Podsakoff *et al*. 2003) suggest that the single method of data collection is an acceptable risk. For future research, replication of the design and analyses would enhance the generalizability of our findings.

7. Conclusions and managerial implications

These results of the effect of implementation of knowledge management as a facilitator of Six Sigma initiatives make a novel contribution to the growing body of literature. In addition to research on the success of Six Sigma in manufacturing firms, this study provides compelling evidence for the effectiveness of Six Sigma in healthcare organizations. Furthermore, these results extend the efficacy of knowledge management to a seldom studied but knowledge-intensive industry. There has been little, if any, research so far about the effects of simultaneous implementation of Six Sigma and knowledge management. This study contributes uniquely by elucidating the synergistic impact of knowledge management for greater effectiveness of Six Sigma programmes. As a test of the three-stage model of knowledge management (Darroch 2003, 2005), these results demonstrate different levels of efficacy among the stages. Knowledge responsiveness emerges as the most statistically and practically important stage for quality results and competitive advantage. This observation is highly relevant for healthcare organizations for which success may depend more on patient-driven knowledge responsiveness than on knowledge gathering and sharing.

The pragmatic contribution of this study for healthcare administrators lies in the opportunities offered by sophisticated knowledge management support for Six Sigma initiatives. These findings imply that the expansion of efforts toward strategic 'third stage' knowledge management offers unique opportunities for creating Six Sigma success (Hsu and Shen 2005). At the same time, the results suggest greater urgency for hospital executives to explore ways to exploit knowledge dissemination and acquisition for greater results and competitive advantage. This timely study

provides empirical evidence that these knowledge management initiatives are highly related to Six Sigma success and will provide direction to healthcare administrators to initiate or enhance their quality programmes. Therefore, more effective healthcare knowledge management practices should lead to improvements in the results from Six Sigma initiatives.

Appendix: Questionnaire items for each construct in this study

Respondents provided a score for each item below on a scale of 0 to 5, where 0 was 'None,' 1 was 'Very Low,' 2 was 'Low,' 3 was 'Moderate,' 4 was 'High,' and 5 was 'Very high.'

Six Sigma initiatives

To what extent are these elements implemented in your hospital's quality programme?

- Six Sigma system
- Black/green belt training
- DMAIC (define, measure, analyse, improve, and control) process
- Quality programme financial rewards for employees

Knowledge acquisition

Indicate how well each item describes your hospital.

- We survey employees regularly to assess their attitudes to their work.
- Managers frequently try to find out employees' true feelings about their jobs.
- We have regular staff appraisals in which we discuss the needs of our employees.
- Employees are encouraged to attend training seminars and conferences.
- We have regular staff meetings with employees.
- Employees are encouraged to undertake university or technical courses.

Knowledge dissemination

Indicate how well each item describes your hospital.

- Our marketing people frequently spend time discussing patients' future needs with people in technical departments.
- When people in our organization need information about marketing issues, they know exactly who to ask.
- There are regular meetings between departments to discuss market trends and developments.
- We keep a database of patient information that is easy to access.

- Information about patient satisfaction is disseminated to all levels of our organization on a regular basis.
- We often record internal best practices.

Knowledge responsiveness

Indicate how well each item describes your hospital.

- When we find our patients are unhappy with the quality of our services, we act immediately.
- We usually respond to changes in our patients' service needs.
- When we find that a patient would like us to modify a service, the departments involved make a concerted effort to do so.
- We are quick to respond to patient complaints.
- We are quick to respond to concerns raised by employees.

Quality programme results

To what extent have results been realized in each of these areas?

- Quality improvement.
- Patient satisfaction increase.
- Net cost savings.
- Reduction in the severity of errors.

Sustainable competitive advantage

How well does your quality programme achieve a sustainable competitive advantage in terms of:

- *Value added:* How well do your firm's resources and capabilities enable your firm to respond to external threats and opportunities?
- *Rareness:* How much are your firm's resources and capabilities not possessed by competitors?
- *Costly-to-imitate:* How much do firms without your resources and capabilities face a cost disadvantage to duplicate your programme?
- *Non-substitutability:* How much is there no strategic equivalent for your programme?

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