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**Literature search results**

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**Search details**

Evaluation and impact assessments of improvement methodologies; lean, six sigma, business process reengineering, statistical process control, model for improvement, quality improvement, continual/continuous improvement process.

**Resources searched**

NHS Evidence; HMIC; Health Business Elite

**Database search terms:** “quality improvement”, exp. QUALITY IMPROVEMENT, "quality management", exp QUALITY MANAGEMENT, ("total quality management" OR TQM), "continu* improvement", "continu* quality improvement", "improvement model*", "improvement method*", "improvement process*", "model* for improvement", "lean six sigma", ("lean thinking" OR "lean production" OR "lean enterprise" OR "lean manufacturing"), "lean principle*", exp LEAN THINKING, "six sigma", ("business process re-engineering" OR "business process reengineering"), exp BUSINESS PROCESS REENGINEERING, ("statistical process control" OR SPC), "impact assessment*", "impact evaluation*", (effect* OR impact* OR evauat* OR assess* OR result* OR apprais* OR using OR utilis* OR utiliz* OR application* OR compar* OR examin* OR analyz* OR review*)

**Google search string:**

**Summary**

There is some evidence that improvement methodologies have positive impact in healthcare settings. Lean thinking is the method which retrieves the most results.

**Business Process Reengineering:** One case study (95) shows that a reengineering process resulted in continued improvement at a faster rate than peer-group average for Leicester Royal Infirmary. However, the attribution of change is difficult as a lack of data means that BPR initiatives are not quantifiable using routine date measures. Consistency of routine data benchmarking is needed. As it emphasises processes it has contributed to the growing interest in redesigning pathways etc. (77).
Lean thinking: Has had successful applications in healthcare settings (20). Various examples of successful lean applications (4, 14, 21, 22, 34, 37, 39, 60, 84). Lean thinking might not translate into improvements in safety outcomes unless a system-wide approach is adopted (37). In 2009 it was argued that successful wholesale application had not yet been demonstrated (48).

Model for Improvement: One example of improvements achieved (40).

Six Sigma: Some suggestion of results (23, 48, 74, 92) and there is a growing interest in the combination of six sigma and lean methodologies (74). However, in 2010 it was argued that there is weak evidence that this combination improves healthcare (17).

Statistical process control: SPC charts have been used as an effective communication tool and seen as valuable for disseminating data (51).

Total Quality Management/Continuous Quality Improvement: One example of success (22).

Guidelines
None found

Evidence-based reviews

Journal of Healthcare Quality
The Utilization of Six Sigma and Statistical Process Control Techniques in Surgical Quality Improvement (2010)
Surgeons have been slow to incorporate industrial reliability techniques. Process control methods were applied to surgeon waiting time between cases, and to length of stay (LOS) after colon surgery. Waiting times between surgeries were evaluated by auditing the operating room records of a single hospital over a 1-month period. The medical records of 628 patients undergoing colon surgery over a 5-year period were reviewed. The average surgeon wait time between cases was 53 min, and the busiest surgeon spent 29.5 hr in 1 month waiting between surgeries. Process control charting demonstrated poor overall control of the room turnover process. Average LOS after colon resection also demonstrated very poor control. Mean LOS was 10 days. Weibull's conditional analysis revealed a conditional LOS of 9.83 days. Serious process management problems were identified in both analyses. These process issues are both expensive and adversely affect the quality of service offered by the institution. Process control mechanisms were suggested or implemented to improve these surgical processes. Industrial reliability and quality management tools can easily and effectively identify process control problems that occur on surgical services.

NHS Quality Improvement Scotland
A systematic narrative review of quality improvement models in health care (2009)
The review considers each of these approaches individually, while recognising that the models are not always well defined and that health care organisations often draw on a range of tools and principles from different approaches. After reviewing the background and evidence for each of the five models, the review considers the evidence internationally on five system-wide multi-model approaches that stood out in the literature because of the descriptive and evaluative work that has accompanied their implementation. These are Jonkoping County (Sweden), Kaiser Permanente and the VA QUERI initiative (the US), the ‘Organising for Quality’ case successes (Europe/US), and the IHI’s ‘100,000 Lives Campaign’ and related quality and safety initiatives (worldwide).

Quality and Safety in Health Care
Efficacy and efficiency of a lean cataract pathway: a comparative study (2010)
In the lean pathway, patient visits decreased by 23%, and access to the cataract pathway increased with 42%. A 40% decrease in patient visits and a 76% increase in access could have been realised if healthcare staff would have adhered to the lean pathway's specifications. Lean pathways can realise large improvements, and still have a significant gap between expected and actual care delivery. The challenge for healthcare teams is not
to improve care delivery by using lean pathways as opposed to using traditional pathways, but to strive for optimal performance by consistently adhering to the specifications of the lean pathway.

**Published research**

**General overviews**

44. **Effective quality improvement: conclusions**
   **Author(s):** Powell, Alison, Rushmer, Rosemary, Davies, Huw
   **Citation:** British Journal of Healthcare Management, 2009, vol./is. 15/8, 1358-0574
   **Publication Date:** 2009
   **Abstract:** In this series of articles, the authors have examined the research evidence on the use and impacts of five of the major organisation-level approaches to quality improvement in health care in the past two decades: Total Quality Management/Continuous Quality Improvement, Business Process Reengineering, practitioner-led rapid cycle change, Lean thinking and Six Sigma. But how much do the approaches differ, and does it matter which approach is used? Cites numerous references. [Journal abstract]
   **Source:** HMIC
   **Full Text:** Available in fulltext at EBSCOhost [Link]
   Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

53. **Quality improvement theory and practice**
   **Author(s):** Boaden, Ruth
   **Citation:** British Journal of Healthcare Management, 2009, vol./is. 15/1, 1358-0574
   **Publication Date:** 2009
   **Abstract:** In October 2008, the NHS Institute for innovation and improvement published a report which focused on the many quality improvement approaches used in health care (Boaden et al, 2008). It reviewed the Plan-Do-Study-Act cycle. Statistical Process Control, Six Sigma, Lean thinking, Theory of Constraints and Mass Customisation, and drew on academic and empirical sources of information to provide a series of challenges for healthcare managers and leaders. Quality improvement approaches from industry are increasingly applied in health care and this article considers what evidence exists of their effectiveness and applicability. Cites numerous references. [Journal abstract]
   **Source:** HMIC
   **Full Text:** Available in fulltext at EBSCOhost [Link]
   Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

**Business Process Reengineering:**

95. **Can we use routine data to evaluate organizational change? : lessons from the evaluation of business process re-engineering in a UK teaching hospital.**
   **Author(s):** Brennan, A.
   **Citation:** Health Services Management Research, 2005, vol./is. 18/4(265-276), 0951-4848
   **Publication Date:** 2005
   **Abstract:** OBJECTIVE: To review and critically evaluate a multidisciplinary independent evaluation of business process re-engineering within a UK hospital using routine data. METHODS: Routine data measures of hospital cost efficiency are used to compare rates of changes at Leicester Royal Infirmary (LRI) with a ‘peer group’ of 22 teaching hospitals and to ascertain changes attributable to re-engineering. Different adjustment factors are quantified and the robustness of individual measures discussed. In addition to providing context to the quantitative primary research and the qualitative research on change management, service performance and quality indicators not captured in overall efficiency measures are assessed using detailed routine data measures. RESULTS: LRI is one of the most efficient teaching hospitals in England and continued improvement during re-engineering is shown to be at a faster rate than the peer group average, although attribution of changes is difficult. Lack of availability and inconsistency of data for support services meant that many re-engineering initiatives are not quantifiable using routine data.
measures. CONCLUSIONS: When combining different measures, routine data is a valuable tool in evaluating organizational change initiatives. However, use in future evaluations would require consistent benchmarking of routine data. 1 fig. 4 tables 23 refs. [Abstract]

Source: HMIC

Full Text:
Available in fulltext at EBSCOhost

Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

77. Effective quality improvement: BPR.
Author(s): Powell, Alison, Davies Huw, Rushmer, Rosemary
Citation: British Journal of Health Care Management, 2009, vol./is. 15/4(166-171), 1358-0574
Publication Date: 2009
Abstract: Developed in the U.S. in the 1990s, Business Process Reengineering (BPR) soon filtered into health care, and was the focus of several high-profile NHS initiatives in the late 1990s. However, the radical 'fresh start' approach of BPR, and many of its underlying principles, did not fit well into healthcare settings. Its most enduring legacy is likely to be its emphasis on processes, which has contributed to the growing interest in redesigning patient pathways and clinical processes. 1 table 28 refs. [Abstract]

Source: HMIC

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Lean:

Overview

20. Lean thinking in healthcare: a realist review of the literature
Author(s): Mazzocato, Pamela, Savage, Carl, Brommels, Mats, Aronsson, Hakan, Thor, Johan
Citation: Quality and Safety in Health Care, 2010, vol./is. 19/5, 1475-3898
Publication Date: 2010
Abstract: The objective of the study was to understand how lean thinking has been put into practice in healthcare and how it has worked. The design was a realist literature review. The data sources were, the authors systematically searched for articles in PubMed, Web of Science and Business Source Premier (January 1998 to February 2008) and then added articles through a snowball approach. The review methods were, the authors included empirical studies of lean thinking applications in healthcare and excluded those articles that did not influence patient care, or reported hybrid approaches. The authors conducted a thematic analysis based on data collected using an original abstraction form. Based on this, they articulated interactions between context, lean interventions, mechanisms and outcomes. The results were, the authors reviewed 33 articles and found a wide range of lean applications. The articles describe initial implementation stages and emphasise technical aspects. All articles report positive results. The authors found common contextual aspects which interact with different components of the lean interventions and trigger four different change mechanisms: understand processes to generate shared understanding; organise and design for effectiveness and efficiency; improve error detection to increase awareness and process reliability; and collaborate to systematically solve problems to enhance continual improvement. The conclusions were lean thinking has been applied successfully in a wide variety of health settings. While lean theory emphasises a holistic view, most cases report narrower technical applications with limited organisational reach. To better realise the potential benefits, healthcare organisations need to directly involve senior management, work across functional divides, pursue value creation for patients and other customers, and nurture a long-term view of continual improvement. Cites 64 references. [Journal abstract]

Source: HMIC

48. Effective quality improvement: Lean
Author(s): Powell, Alison, Rushmer, Rosemary, Davies, Huw
Lean thinking was developed by Toyota in the 1950s. It emphasises streamlining processes to provide what the customer wants with minimal waited time, effort or cost. The approach uses a range of tools, such as 'value stream mapping' (identifying and removing any unnecessary steps in a process) and 5S (a series of five steps to enable workforce teams to look at the environment they work in and to start to identify the blocks in current processes). Lean thinking approaches have been applied in healthcare settings with some success in reducing waste. The approaches appear to be particularly useful in streamlining processes in support departments, rather than mainstream clinical services. Successful wholesale application has not yet been demonstrated in healthcare settings. Cites numerous references. [Journal abstract]

Source: HMIC
Full Text: Available in fulltext at EBSCOhost

45. A critical look at lean thinking in healthcare
Author(s): Young, T P, McClean, S I
Citation: Quality of Safety in Health Care, 2008, vol./is. 17/5, 1475-3898
Publication Date: 2008
Abstract: With healthcare, Lean Thinking encounters a world, not devoid of value, but awash with sophisticated and mutually unconnected concepts of value. Given a shortage of systematic analysis in the literature, this paper provides a preliminary analysis of areas where the read-across from other sectors to healthcare is relatively well understood, based on a broad review of its impact on care delivery. It further proposes areas where conceptual development is needed. In particular, healthcare, with its many measures of value, presents an unusual challenge to the central Lean driver of value to the customer. The authors conclude that there is scope for methodological development, perhaps by defining three themes associated with value - the operational, the clinical and the experiential. Cites 55 references. [Journal abstract]
Source: HMIC
Full Text: Available in fulltext at National Library of Medicine

81. The use and benefits of Lean and Six Sigma in NHS Scotland.
Author(s): Antony, Jiju
Citation: Health Care Risk Report, 2008, vol./is. 15/1(16-18), 1356-0611
Publication Date: 2008
Abstract: In the second of two articles on Lean and Six Sigma in healthcare, Dr Jiju Antony describes a pilot study of their effect on service quality and safety in NHS trusts. 2 tables 10 refs. [Introduction]
Source: HMIC
Full Text: Available in print at a ULHT/non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

Specific Examples
21. Lean thinking transformation of the unsedated upper gastrointestinal endoscopy pathway improves efficiency and is associated with high levels of patient satisfaction.
Author(s): Hydes, Theresa, Hansi, Navjyot, Trebble, Timothy M.
Citation: BMJ Quality and Safety, 2012, vol./is. 21/1(63-69), 2044-5415
Publication Date: 2012
Abstract: BACKGROUND: Upper gastrointestinal (UGI) endoscopy is a routine healthcare procedure with a defined patient pathway. The objective of this study was to redesign this pathway for unsedated patients using lean thinking transformation to focus on patient-derived value-added steps, remove waste and create a more efficient process. This was to form the basis of a pathway template that was transferrable to other endoscopy units. METHODS: A literature search of patient expectations for UGI endoscopy identified patient-derived value. A value stream map was created of the current pathway. The minimum and maximum time per step, bottlenecks and staff-staff interactions were recorded. This information was used for service transformation using lean thinking. A patient pathway template was created and implemented into a secondary unit. Questionnaire studies were
performed to assess patient satisfaction. RESULTS: In the primary unit the patient pathway reduced from 19 to 11 steps with a reduction in the maximum lead time from 375 to 80 min following lean thinking transformation. The minimum value/lead time ratio increased from 24 per cent to 49 per cent. The patient pathway was redesigned as a 'cellular' system with minimised patient and staff travelling distances, waiting times, paperwork and handoffs. Nursing staff requirements reduced by 25 per cent. Patient-prioritised aspects of care were emphasised with increased patient-endoscopist interaction time. The template was successfully introduced into a second unit with an overall positive patient satisfaction rating of 95 per cent. CONCLUSION: Lean thinking transformation of the unsedated UGI endoscopy pathway results in reduced waiting times, reduced staffing requirements and improved patient flow and can form the basis of a pathway template which may be successfully transferred into alternative endoscopy environments with high levels of patient satisfaction. [Abstract]

Source: HMIC
Full Text: Available in fulltext at Highwire Press

22. Improving the quality of Emergency Department care by removing waste using Lean Value Stream mapping.
Author(s): Cookson, David, Read, Colin, Mukherjee, Pro
Citation: International Journal of Clinical Leadership, 2011, vol./is. 17/1(25-30), 1757-207X
Publication Date: 2011
Abstract: Lean Thinking was originally developed by Toyota in the 1950s as an improvement approach to reducing non-value-adding activity and improving flow within a system. Its use in healthcare is becoming increasingly common although there is little published information on its formal application to Emergency Departments in the UK. With increasing financial pressures, high service demand and target pressures, Lean offers a potential approach to maintaining a high-quality efficient clinical service for patients and staff. Using Value Stream mapping, a tool originally developed for manufacturing, we identified over 300 instances of waste and potential improvements in processes within the majors area of our department. This work allowed us to reduce the time to initial assessment and has highlighted a number of projects that are now being taken forward with directorate backing. With the support of healthcare leaders and managers who embrace the Lean philosophy, Lean Thinking offers huge potential for identifying waste and Value Streams leading to improvements in quality of care in the emergency department. [Abstract]
Source: HMIC
Full Text: Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

4. Application of lean principles can reduce prescription dispensing times.
Author(s): Beard, Jon, Wood, Damian
Citation: Pharmaceutical Journal, 2010, vol./is. 284/7597(369-371), 0031-6873
Publication Date: 2010
Abstract: AIM: To reduce average inpatient prescription dispensing times to less than one hour without increasing staffing levels, dispensing error rates or adversely affecting patient safety in any way. DESIGN: Process and value mapping, capacity estimation and failure mode effect analysis of current processes. SETTING: Pharmacy department of Musgrove Park Hospital, part of the Taunton and Somerset NHS Foundation Trust. OUTCOME MEASURES: Reduced dispensing times, patient and nursing staff satisfaction. RESULTS: Median dispensing times fell from 188min to 27min (standard deviation, 7min) and were sustained thereafter. 65 per cent of daily work was completed before 1pm. The dispensary closed consistently at 5.30pm Monday to Friday. Reported dispensing error rates remained unchanged. CONCLUSION: Simple interventions designed to reduce wasteful activity and increase workflow can reduce dispensing times consistently without increasing staff or adversely affecting patient safety. 4 refs. [Abstract]
Source: HMIC
Full Text: Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

34. Lean implementation in primary care health visiting services in National Health
37. Effect of a lean intervention to improve safety processes and outcomes on a surgical emergency unit.

**Author(s):** McCulloch, Peter, Kreckler, Simon, New, Steve

**Citation:** BMJ, 2010, vol./is. 341/7781(1043-1047), 0959-8138

**Publication Date:** 2010

**Abstract:** PROBLEM: Emergency surgical patients are at high risk for harm because of errors in care. Quality improvement methods that involve process redesign, such as 'Lean', appear to improve service reliability and efficiency in healthcare. DESIGN: Interrupted time series. SETTING: The emergency general surgery ward of a university hospital in the United Kingdom. KEY MEASURES FOR IMPROVEMENT: Seven safety relevant care processes. STRATEGY FOR CHANGE: A Lean intervention targeting five of the seven care processes relevant to patient safety. EFFECTS OF CHANGE: 969 patients were admitted during the four month study period before the introduction of the Lean intervention (May to August 2007), and 1,114 were admitted during the four month period after completion of the intervention (May to August 2008). Compliance with the five process measures targeted for Lean intervention (but not the two that were not) improved significantly (relative improvement 28 per cent to 149 per cent; P<0.007). Excellent compliance continued at least 10 months after active intervention ceased. The proportion of patients requiring transfer to other wards fell from 27 per cent to 20 per cent (P<0.000025). Rates of adverse events and potential adverse events were unchanged, except for a significant reduction in new safety events after transfer to other wards (P<0.028). Most adverse events and potential adverse events were owing to delays in investigation and treatment caused by factors outside the ward being evaluated. LESSONS LEARNT: Lean can substantially and simultaneously improve compliance with a bundle of safety related processes. Given the interconnected nature of hospital care, this strategy might not translate into improvements in safety outcomes unless a system-wide approach is adopted to remove barriers to change. [Abstract]

**Source:** HMIC

**Full Text:** Available in fulltext at Highwire Press

60. Leading by example.
Author(s): Davies, Peter  
Citation: In View, 2010, vol./is. 24/(20-21), 1743-2340  
Publication Date: 2010  
Abstract: Royal Bolton Hospital NHS Foundation Trust, using Lean methodology, went from a 14 million cash deficit in 2004, to a potential annual income of 2.4 million in 2008-9. It is now one of three hospitals in the world that are Lean exemplars. [Introduction]  
Source: HMIC

39. Improving the efficiency of a chemotherapy day unit: Applying a business approach to oncology  
Author(s): Lent, Wineke A M van, Goedbloed, N, Harten, W H van  
Citation: European Journal of Cancer, 2009, vol./is. 45/5, 0959-8049  
Publication Date: 2009  
Abstract: Record in progress. The aim of the study was to improve the efficiency of a hospital-based chemotherapy day unit (CDU). The CDU was benchmarked with two other CDUs to identify their attainable performance levels for efficiency, and causes for differences. Furthermore, an in-depth analysis using a business approach, called lean thinking, was performed. An integrated set of interventions was implemented, among them a new planning system. The results were evaluated using pre- and post-measurements. The results were, the authors observed 24% growth of treatments and bed utilisation, a 12% increase of staff member productivity and an 81% reduction of overtime. The conclusions were, the used method improved process design and led to increased efficiency and a more timely delivery of care. Thus, the business approaches, which were adapted for healthcare, were successfully applied. The method may serve as an example for other oncology settings with problems concerning waiting times, patient flow or lack of beds. Cites 21 references. [Journal abstract]  
Source: HMIC  
Full Text: Available in print at Lincoln County Hospital Professional Library

84. Organizational change through lean thinking.  
Author(s): Tsasis, Peter, Bruce-Barrett, Cindy  
Citation: Health Services Management Research, 2008, vol./is. 21/3(192-198), 0951-4848  
Publication Date: 2008  
Abstract: In production and manufacturing plants, lean thinking has been used to improve processes by eliminating waste and thus enhancing efficiency. In health care, lean thinking has emerged as a comprehensive approach towards improving processes embedded in the diagnostic, treatment and care activities of health-care organizations with cost containment results. This paper provides a case study example where lean thinking is not only used to improve efficiency and cost containment, but also as an approach to effective organizational change. 2 figs. 12 refs. [Abstract]  
Source: HMIC  
Full Text: Available in fulltext at EBSCOhost  
Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

Lean Six Sigma:

15. Sustaining Lean Six Sigma Projects in Health Care.  
Author(s): Murphree, Paul, Vath, Richard Robert, Daigle, Larry  
Citation: Physician Executive, 01 January 2011, vol./is. 37/1(44-48), 08982759  
Publication Date: 01 January 2011  
Abstract: The article focuses on the practical ways on sustaining Lean Six Sigma (LSS) Projects in health care. It notes the Malcolm Baldrige criteria, an approach and deployment model used among health care organizations in defining organizational problems, which is applied at the active phase of a project's life cycle with ADLI evaluation tool. As quality improvement projects are closed after an achievement, it is suggested to move the project into the control phase for a foreseeable future.  
Source: HEALTH BUSINESS ELITE  
Full Text: Available in fulltext at EBSCOhost  
Available in print at a non-ULHT hospital library. Click and complete an online form to
Model for Improvement:
None found.

Six Sigma:

17. Assessing the evidence of six sigma and lean in the health care industry
Author(s): DelliFraine, Jami L, Langabeer, James R, Nembhard, Ingrid M
Citation: Quality Management in Health Care, 2010, vol./is. 19/3, 1063-8628
Publication Date: 2010
Abstract: Popular quality improvement tools such as Six Sigma and Lean Systems (SS/L) claim to provide healthcare managers the opportunity to improve healthcare quality on the basis of sound methodology and data. However, it is unclear whether these two quality improvement tools actually improve healthcare quality. The authors conducted a comprehensive literature review to assess the empirical evidence relating SS/L to improved clinical outcomes, processes of care, and financial performance of healthcare organisations. The authors identified 177 articles on SS/L published in the last 10 years. However, only 34 of them reported any outcomes of the SS/L projects studied, and less than one-third of these articles included statistical analyses to test for significant changes in outcomes. The conclusions were, this review demonstrates that there are significant gaps in the SS/L healthcare quality improvement literature and very weak evidence that SS/L improve healthcare quality. Cites 53 references. [Journal abstract]
Source: HMIC
Full Text: Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

74. Effective quality improvement : Six Sigma.
Author(s): Powell, Alison, Davies, Huw, Rushmer, Rosemary
Citation: British Journal of Health Care Management, 2009, vol./is. 15/7(322-326), 1358-0574
Publication Date: 2009
Abstract: Developed in industry in the 1980s, and applied in a limited way in health care from the 1990s, Six Sigma uses a range of statistical and other tools to reduce variations in processes. Although Six Sigma is a particularly challenging quality improvement approach to use in healthcare settings, some process improvements have been reported and there is growing interest in using a combination of lean thinking and Six Sigma approaches in the NHS. 3 tables 22 refs. [Abstract]
Source: HMIC
Full Text: Available in fulltext at EBSCOhost Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

Statistical Process Control:

51. Results of a multicentre randomised controlled trial of statistical process control charts and structured diagnostic tools to reduce ward-acquired meticillin-resistant Staphylococcus aureus: the CHART Project
Author(s): Curran, E, Harper, P, Loveday, H, Gilmour, H, Jones, S
Citation: Journal of Hospital Infection, 2008, vol./is. 70/2, 0195-6701
Publication Date: 2008
Abstract: Statistical process control (SPC) charts have previously been advocated for infection control quality improvement. To determine their effectiveness, a multicentre randomised controlled trial was undertaken to explore whether monthly SPC feedback from infection control nurses (ICNs) to healthcare workers of ward-acquired methicillin-resistant Staphylococcus aureus (WA-MRSA) colonisation or infection rates would produce any reductions in incidence. Seventy-five wards in 24 hospitals in the UK were randomised into three arms: (1) wards receiving SPC chart feedback; (2) wards receiving SPC chart feedback in conjunction with structured diagnostic tools; and (3) control wards receiving neither type of feedback. Twenty-five months of pre-intervention WA-MRSA data were
compared with 24 months of post-intervention data. Statistically significant and sustained decreases in WA-MRSA rates were identified in all three arms (P<0.001; P = 0.015; P<0.001). The mean percentage reduction was 32.3% for wards receiving SPC feedback, 19.6% for wards receiving SPC and diagnostic feedback, and 23.1% for control wards, but with no significant difference between the control and intervention arms (P = 0.23). There were significantly more post-intervention 'out-of-control' episodes (P = 0.021) in the control arm (averages of 0.60, 0.28, and 0.28 for Control, SPC and SPC + Tools wards, respectively). Participants identified SPC charts as an effective communication tool and valuable for disseminating WA-MRSA data. Cites 26 references. [Journal abstract]

**Total Quality Management/Continuous Quality Improvement:**

10. **Advance mathematical model to study and analyse the effects of total quality management (TQM) and operational flexibility on hospital performance.**

**Author(s):** Alolayyan, Main Naser Fady, Mohd Ali, Khairul Anuar, Idris, Fazli, Ibrehem, Ahmmed Saadi

**Citation:** Total Quality Management & Business Excellence, 01 December 2011, vol./is. 22/12(1371-1393), 14783363

**Publication Date:** 01 December 2011

**Abstract:** Total quality management (TQM) and operational flexibility are powerful and evolving management tools that are being implemented in many organisations worldwide, particularly in healthcare services. However, such implementation is yet to be seen in developing nations, particularly in health care. In an attempted response to such a gap, this paper provides a literature review on the principles and scope of TQM and operational flexibility in the healthcare industry and proposes a mathematical model, employing artificial neural networks, to study and analyse the implementation of TQM and operational flexibility dimensions towards improving hospital performance and reducing costs and medical errors. This study is the first of its kind in the field. The results yielded a very high degree of accuracy (more than 99.2%) in relating TQM variables and operational flexibility dimensions (inputs) to hospital performance (output), implying a highly accurate and strong model that can exactly determine the weaknesses in a hospitals performance and can define and pinpoint poor application of TQM and operations flexibility, particularly upon the development of system identification for this model.

**Source:** HEALTH BUSINESS ELITE

10. **Keys for successful implementation of total quality management.**

**Author(s):** Carman, James M., Shortell, Stephen M., Foster, Richard W.

**Citation:** Health Care Management Review, 2010, vol./is. 35/4(283-293), 0361-6274

**Publication Date:** 2010

**Abstract:** This article reports the findings of an analysis of the implementation of continuous quality improvement (CQI) or total quality management (TQM) programs in ten hospitals. This analysis is the result of a two-year study designed to identify and assess the ingredients that lead to the successful implementation of CQI programs in acute care hospitals. [Editor's note]

**Source:** HMIC

19. **Effective quality improvement: TQM and CQI approaches**

**Author(s):** Powell, Alison, Rushmer, Rosemary, Davies, Huw

**Citation:** British Journal of Healthcare Management, 2009, vol./is. 15/3, 1358-0574

**Publication Date:** 2009

**Abstract:** Developed in Japan in the 1950s, Total Quality Management/Continuous Quality Improvement (TQM/CQI) approaches have been taken up in a variety of forms by many
healthcare organisations since the early 1990s. Although TQM/CQI has several strengths, including a strong customer focus and the use of data to analyse variations in quality, its use in healthcare has encountered a range of practical and cultural obstacles. In the first of five articles looking at major approaches to quality improvement that have been used in healthcare organisations in the past two decades, the authors review the potential of TQM/CQI and the challenges of using this approach to improve patient care. Cites numerous references. [Journal abstract]

**Source:** HMIC

**Full Text:** Available in fulltext at EBSCOhost. Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

22. Continuous quality improvement program and major morbidity after cardiac surgery

**Author(s):** Stamou, Sotiris C, Camp, Sara L, Reames, Mark K, Skipper, Eric, Stiegel, Robert M

**Citation:** American Journal of Cardiology, 2008, vol./is. 102/6, 0002-9149

**Publication Date:** 2008

**Abstract:** The aim of this study was to investigate how a continuous quality improvement (CQI) program affected major morbidity and postoperative outcomes after cardiac surgery. Patients were divided into two groups: those who underwent surgery (coronary artery bypass grafting, isolated valve surgery, or coronary artery bypass grafting and valve surgery) after the establishment of a CQI program (from January 2005 to December 2006, n = 922) and those who underwent surgery beforehand (from January 2002 to December 2003, n = 1,289). Patients who had surgery in 2004, when the system and processes were reengineered, were not included in the analysis. Outcomes compared between the two groups included (1) acute renal failure, (2) stroke, (3) sepsis, (4) hemorrhage-related reexploration, (5) cardiac tamponade, (6) mediastinitis, and (7) prolonged length of stay. Logistic regression analysis and propensity score adjustment were used to adjust for imbalances in the patients' preoperative characteristics. After propensity score adjustment, CQI was found to decrease the rate of sepsis (odds ratio (OR) 0.5, 95% confidence interval (CI) 0.3 to 0.9, p = 0.02) and cardiac tamponade (OR 0.2, 95% CI 0.04 to 0.8, p = 0.02) but to only marginally decrease the rate of acute renal failure (OR 0.7, 95% CI 0.5 to 1.0, p = 0.07). CQI did not emerge as an independent risk factor for hemorrhage-related reexploration, prolonged length of stay, mediastinitis, or stroke in either multivariate logistic regression analysis or propensity score adjustment. In conclusion, the systematic implementation of a CQI program and the application of multidisciplinary protocols decrease sepsis and cardiac tamponade after cardiac surgery. Cites seven references. [Journal abstract]

**Source:** HMIC

**Full Text:** Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

Non-UK results

14. ThedaCare's business performance system: sustaining continuous daily improvement through hospital management in a lean environment.

**Author(s):** Barnas, Kim

**Citation:** Joint Commission Journal on Quality and Patient Safety, 2011, vol./is. 37/9(387-399), 1553-7250

**Publication Date:** 2011

**Abstract:** BACKGROUND: For 2003-2008, ThedaCare, a community health system in Wisconsin, achieved significant improvements in quality and the elimination of waste through the development of an improvement system, which included Value Stream analysis, rapid improvement events, and projects applied to specific processes. However, to meet its continuous daily improvement goals, particularly the goal of increasing productivity by 10 per cent annually, ThedaCare needed to change the way its managers and leaders (in its hospital division) conduct and manage their daily work. Accordingly, it developed its Business Performance System (BPS) to achieve and sustain continuous daily improvement. BUILDING THE BPS: ThedaCare devised a multipart pilot project, consisting of "learning to see" and then, "problem solving." On completion of the 15-week alpha phase (6 units) in July 2009, the BPS was spread to the beta pilot (12 units; September 2009-
January 2010) and then to cohort 3 (10 units; September 2010-January 2011). RESULTS: Each alpha unit improved performance on (1) the key driver metric of increasing productivity from 2008 to year-end 2009 (by 1 per cent -11 per cent) and (2) its respective safety/quality drivers over the respective 2008 baselines. For 2010, improvements across the alpha, beta, and cohort 3 units were found for 11 of the 14 safety/quality drivers-85 per cent of the 11 customer satisfaction drivers, 83 per cent of 6 people engagement drivers; and 48 per cent of 23 financial stewardship drivers. CONCLUSIONS: The tools developed for the BPS have enabled teams to see, prioritize, and pursue continuous daily improvement opportunities. Unit leaders now have a structured management reporting system to reduce variation in their management styles. Leaders all now follow leadership standard work, and their daily work is now consistently aligned with the hospital and system strategy. [Abstract]

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23. Hospital applies Six Sigma method and cuts wait time for its ED patients.
Author(s): Towne, Jennifer
Citation: AHA News, 08 February 2010, vol./is. 46/3(5), 08916608
Publication Date: 08 February 2010
Abstract: The article reports on the employment of the Six Sigma methodology at St. Vincent's Medical Center in Jacksonville, Florida in an aim to improve the quality of process outputs and minimize the waiting period for patients at its emergency department (ED). Through this method, various processes that affect length of stay at the ED are analyzed. Six Sigma master black belt Beckie Watson vouched for the strategy's immediate results through rapid-cycle interventions. It became a hospital-wide effort due to the impact of ED wait times.
Source: HEALTH BUSINESS ELITE
Full Text: Available in fulltext at EBSCOhost
Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

36. Statistical process control as a tool for controlling operating room performance: retrospective analysis and benchmarking.
Author(s): Tsung-Tai, Chen, Chang, Yun-Jau, Ku, Shei-Ling
Citation: Journal of Evaluation in Clinical Practice, 2010, vol./is. 15/5(905-910), 1356-1294
Publication Date: 2010
Abstract: BACKGROUND: There is much research using statistical process control (SPC) to monitor surgical performance, including comparisons among groups to detect small process shifts, but few of these studies have included a stabilization process. This study aimed to analyse the performance of surgeons in operating room (OR) and set a benchmark by SPC after stabilized process. METHODS: The OR profile of 499 patients who underwent laparoscopic cholecystectomy performed by 16 surgeons at a tertiary hospital in Taiwan during 2005 and 2006 were recorded. SPC was applied to analyse operative and non-operative times using the following five steps: first, the times were divided into two segments; second, they were normalized; third, they were evaluated as individual processes; fourth, the ARL(0) was calculated; and fifth, the different groups (surgeons) were compared. Outliers were excluded to ensure stability for each group and to facilitate inter-group comparison. RESULTS: The results showed that in the stabilized process, only one surgeon exhibited a significantly shorter total process time (including operative time and non-operative time). CONCLUSION: In this study, we use five steps to demonstrate how to control surgical and non-surgical time in phase I. There are some measures that can be taken to prevent skew and instability in the process. Also, using SPC, one surgeon can be shown to be a real benchmark. [Abstract]
Source: HMIC
Full Text: Available in fulltext at EBSCOhost
Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

24. Performance improvement programs fighting a loss cause.
The article discusses the use of continuous quality improvement (CQI) and total quality management (TQM) in comparison with lean management and Six Sigma practices in the U.S. health care industry. It explores the opinion of various health care management professionals who prefer lean management and Six Sigma practices because they produce more quantifiable results, as opposed to CQI and TQM, which are seen as being more of a philosophy, rather than a practice. The cost savings from use of Six Sigma and lean management are cited as being more measurable.

Source: HEALTH BUSINESS ELITE

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Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

40. The business case for TCAB
Author(s): Burns Bolton, Linda, Udin Aronow, Harriet
Citation: American Journal of Nursing, 2009, vol./is. 109/11, 0002-936X
Publication Date: 2009
Abstract: The authors used the Model for Improvement of the Institute for Healthcare Improvement (IHI) at Cedars-Sinai Medical Centre (CSMC) in Los Angeles to engage frontline staff and launch more than 300 tests of change aimed at improving the authors performance on the Transforming Care at the Bedside (TCAB) themes of safe and reliable care, teamwork and staff vitality, patient-centred care, and value-added care processes (lean systems). The Model for Improvement asks three questions: What are we trying to accomplish? How will we know that a change is an improvement? What changes can we make that will result in improvement? The Plan-Do-Study-Act-cycle was used to test changes. These tests of change have resulted in numerous and cumulative improvements at CSMS. Cites three references. [Journal abstract]
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Available in print at a non-ULHT hospital library. For articles outside fulltext dates, click and complete an online form to request them.
Available in fulltext at the ULHT Library and Knowledge Services’ eJournal collection

26. A Community Hospital’s Journey into Lean Six Sigma.
Author(s): Stuenkel, Kurt, Faulkner, Taunya
Citation: Frontiers of Health Services Management, 01 September 2009, vol./is. 26/1(5-13), 07488157
Publication Date: 01 September 2009
Abstract: The implementation of Lean Six Sigma and 100-day workouts throughout the 304-bed Floyd Medical Center community hospital organization has led to sustainable results and a marked change in culture. The organization-wide learning of such an effort is deep and intense, and to remain focused and successful it must be a priority of top management. The workout methodology can assist the organization to carry projects to completion and to achieve rapid implementation of desired improvements.
Source: HEALTH BUSINESS ELITE
Full Text:
Available in fulltext at EBSCOhost
Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

48. Six Sigma plan delivers stellar results.
Author(s): Germaine, John
Citation: Materials Management in Health Care, 01 April 2007, vol./is. 16/4(20-24), 10594531
Publication Date: 01 April 2007
Abstract: The article focuses on the benefits offered by the use of Six Sigma at Covenant HealthCare in Saginaw, Michigan. It notes that Six Sigma has helped the tertiary referral center to improve its operating room (OR) turnaround and reduce infection rates. It adds that the business methodology was used in addressing scheduling and start times, room
turnover, instrument handling, and cleaning protocols and it has offered positive results.

Source: HEALTH BUSINESS ELITE

Full Text:
Available in fulltext at EBSCOhost
Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

92. Implementing Six Sigma in the Netherlands.
Author(s): van den Heuvel, Jaap
Citation: Joint Commission Journal on Quality and Patient Safety, 2006, vol./is. 32/7(393-399), 1553-7250
Publication Date: 2006
Abstract: BACKGROUND: Six Sigma, a process-focused strategy and methodology for business improvement, can be used to improve care processes, eliminate waste, reduce costs, and enhance patient satisfaction. EXPERIENCE WITH SIX SIGMA IN THE NETHERLANDS: Six Sigma was introduced in 2001 at the 384-bed Red Cross Hospital (Beverwijk). During the Green Belt training, every participant was required to participate in at least one Six Sigma project. The hospital's total savings in 2004 amounted to $1.4 million, for an average savings of $67,000 for each of the completed 21 projects. THREE EXAMPLES OF SUCCESSFUL PROJECTS: In one project, the team designed a new admission process for the operating rooms, resulting in an average starting time nine minutes earlier. This relatively minor improvement made it possible to operate on an additional 400 patients a year and to achieve a net savings of > $273,000. A second project reduced the number of patients receiving intravenous (IV) antibiotics by switching to oral administration, yielding an annual savings, based on medication costs alone, of > $75,000. A third project reduced the length of stay in the delivery room from 11.9 to 3.4 hours, yielding an annual savings of $68,000. THE "ULTIMATE CURE?": Six Sigma, which entails involvement of health care workers; use of improvement tools (from industry); creation of trained project teams to tackle complex, often cross-departmental processes; data analyses; and investment in quality improvement may prove the "ultimate cure" to the current cost, quality, and safety issues that challenge health care. 1 table 28 refs. [Abstract]
Source: HMIC
Full Text: Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.
Conclusions.

Assessing the evidence of Six Sigma and Lean in the health care industry [PDF] from appstate.edu
JL DelliFraine, JR Langabeer... - Quality Management in ..., 2010 - journals.lww.com
... Background: Popular quality improvement tools such as Six Sigma and Lean Systems (SS/L ... it is unclear whether these 2 quality improvement tools actually improve health care quality. Methods: The authors conducted a comprehensive literature review to assess the empirical ...

Six Sigma: literature review and key future research areas
P Nonthaleerak... - International Journal of Six Sigma and ..., 2006 - Inderscience
... Six Sigma: literature review and key future research areas 119 ... Health care services are one of the major active non-manufacturing contexts in which Six Sigma has been adopted, with the majority of papers studying implementation ... (2003) propose an assessment framework to ...

Lean thinking in emergency departments: a critical review
Lancashire Teaching Hospitals
RJ Holden - Annals of emergency medicine, 2011 - Elsevier
... medicine OR accident & emergency OR emergency department AND Lean production OR Lean thinking." Twelve specific ... projects not identified as Lean [44], [45] and [46] were excluded from the review.