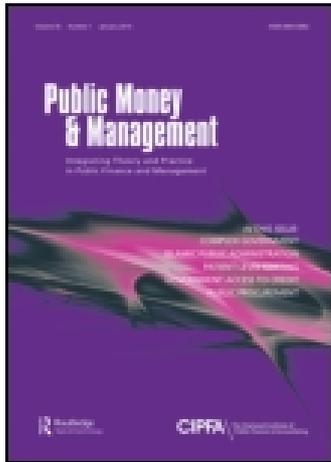


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Have process redesign methods, such as Lean, been successful in changing care delivery in hospitals? A systematic review

Sandra G. Leggat, Timothy Bartram, Pauline Stanton, Greg J. Bamber and Amrik S. Sohal

A systematic literature review identified 41 studies, including four reviews, reporting on process redesign interventions in hospitals. Success factors for the changes included mechanisms to facilitate participation throughout the process, clearly documented protocols and expectations for the health professionals which were supported by education, mechanisms to audit and provide feedback on behaviours and performance, as well as being able to hold the participating health professionals accountable. The success of process redesign methodologies is found to be highly dependent on these performance-based human resource management (HRM) practices.

Keywords: Health professionals; hospitals; Lean; process redesign; six sigma.

Governments around the world are grappling with escalating costs associated with the provision of healthcare, especially at a time when they are struggling with public finance problems and economic upheaval. Throughout the world, efficient and effective healthcare delivery has been subject to fierce debate and ambitious programmes of reform (Bartram and Dowling, 2013). As a result, public healthcare managers are increasing their attention to 'the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed' (Hammer and Champy, 1993, p. 32). Many of these methodologies, such as business process re-engineering (BPR), Lean and six sigma (SS) have been developed for use in manufacturing, with researchers exploring whether these methodologies can be successfully applied to service industries (Brandao de Souza and Pidd, 2011; Radnor and Osborne, 2013). While the academic literature contains a large and growing number of papers that suggest positive outcomes of process redesign in hospitals, reviews of the impact of process redesign are largely inconclusive, with unsatisfactory methodologies limiting the conclusions. Despite this lack of convincing evidence, public hospitals and health systems throughout the world

continue to make large investments in process redesign aiming to simultaneously reduce costs and improve care delivery and efficiency (Vest and Gamm, 2009; Dellifraire *et al.*, 2010; Radnor and Osborne, 2013).

Moreover, there has been little research on how process redesign methodologies, which have largely been designed for manufacturing production environments, translate to public sector service industries, such as public hospitals. In this paper we focus not only on verifying the success of the process redesign methodologies in hospitals, but expressly explore the management practices that contribute to the reported changes in employee practice. Our research question is as follows:

Is there evidence that process redesign methodologies can be used to change the care delivery practices of health professionals in public hospitals?

Method

The Cochrane systematic review method (Cochrane Collaboration, 2008) and the protocol outlined by Vanwersch *et al.* (2011) were followed. This included electronic searching of the Cochrane Register, Medline, PubMed, and CINAHL using the terms 'hospital' and 'process redesign' and/or 'process re-engineering' and/or 'Lean' and/or 'six sigma'.

Sandra G. Leggat is Professor of Health Services Management, La Trobe University, Australia.

Timothy Bartram is Professor of Management, La Trobe University, Australia.

Pauline Stanton is Professor of Management, Victoria University, Australia.

Greg J. Bamber is Professor of Human Resources, Monash University, Australia.

Amrik S. Sohal is Professor of Business Operations, Monash University, Australia.

A scan of Google Scholar resulted in around 4000 papers using these terms. We also searched several journals: *Health Services Research*; *Quality Management in Healthcare*; *Joint Commission Journal on Quality and Patient Safety*; *Implementation Science*; and the *Journal of Healthcare Quality*.

The search uncovered a range of process redesign methodologies including: cross-functional teams; plan-do-check-act (PDCA); 5 Million Lives Campaign; FOCUS-PDSA, Lean management/Toyota production system; SS; Studer Group hardwiring; statistical process control; BPR; business process management (BPM); and clinical process innovations (CPI). While these were all considered as relevant for implementation of process redesign in a hospital setting, we focused on process redesign methods that had been largely developed outside of the public sector. These included: BPR (or BPM) with radical rethinking of all systems and processes (Hammer and Champy, 1993); Lean management, which aims to shorten the time between order placement and product delivery by eliminating waste by identifying and reducing non-value adding process steps (Womack and Jones, 2003); SS, which focuses on reducing process variation and the number of defective parts to six standard deviations from the mean (Adams *et al.*, 2003); and the combination of Lean and six sigma (LSS) (Arnheiter and Maleyeff, 2005). The inclusion criteria were:

- Study took place in a hospital, or if the study reported on system restructuring, there were identifiable hospital-based initiatives.

- Study included at least a sentence describing the process redesign method used.
- Study included at least one pre- and post-implementation measurement of a relevant performance indicator and used statistical methods to evaluate the effect.
- Study focused on improving processes of care (throughput, waiting times, error reduction).
- Study was published in English.
- Study was published between 1995 and April 2013.

Studies were excluded based on the following criteria:

- The paper reported on a simulation, not an implementation (such as Xie and Peng, 2012).
- The paper was conceptual (for example Kohlbacher and Gruenwald, 2011).
- The paper was descriptive with no reported objective results (such as Edwards *et al.*, 2012), and no statistical analysis was provided to confirm the reported effect (for example Willoughby *et al.*, 2010).

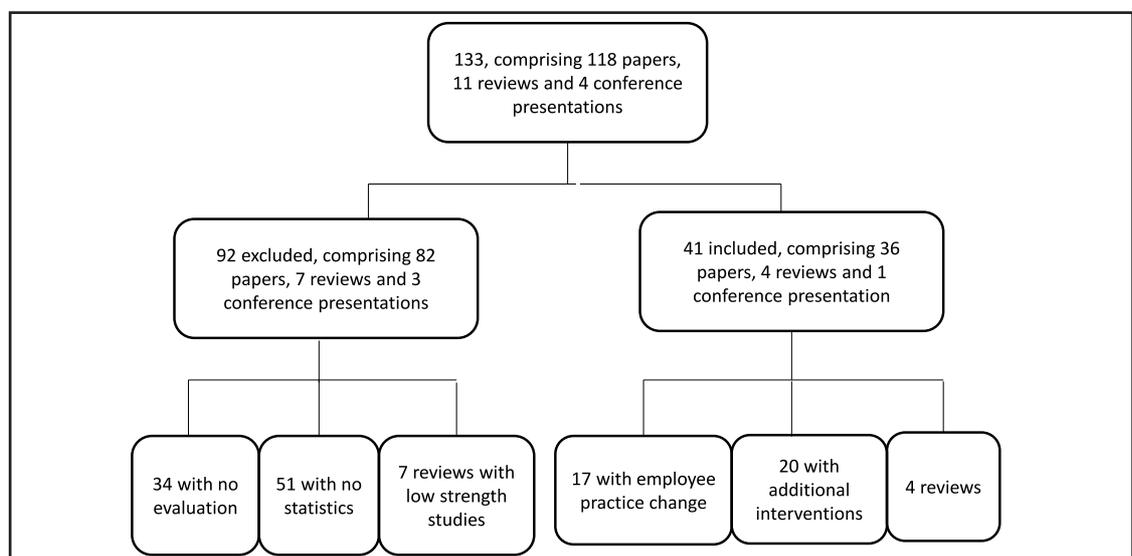
Findings

Figure 1 outlines how we identified 41 papers for inclusion in the review.

Reviews

Eleven relevant reviews were identified, but seven were excluded as they were not completed systematically or did not include only appropriately validated studies (Elkhuizen *et al.*, 2006; Glasgow *et al.*, 2010; Mazzocato *et al.*, 2010; Poksinska, 2010; van Sambeek *et al.*,

Figure 1. Published articles on process redesign interventions in hospitals identified and reviewed by the authors.



2010; Brackett *et al.*, 2011; Vos *et al.*, 2011). Of the remaining four, a 2009 review identified suitable papers on SS and Lean/Toyota production system. This review concluded only that these process redesign strategies were frequently used in hospitals, with insufficient evidence to demonstrate an effect (Vest and Gamm, 2009). A 2010 review of SS and Lean in healthcare also concluded that there was insufficient evidence of the effectiveness of these methods (Dellifraigne *et al.*, 2010). Another 2010 review was not solely confined to healthcare organizations, but included four healthcare studies among the 167 papers reviewed (Tjahjono *et al.*, 2010). The authors concluded that while the effect of SS was well documented in manufacturing, further research was required on the impact in the service sector. A 2012 systematic review on process redesign methodologies in surgical care, covering 34 articles, concluded that there was evidence that these methodologies could be used to improve surgical care, suggesting they were most effective for processes that 'are repetitive and can be standardised' (Nicolay *et al.*, 2012, p. 333).

All of the reviews identified a lack of rigorous research on the outcomes of process redesign, with one study finding 'an average evidence score of 6.1 on a scale for which 7 indicates the lowest level of scientific evidence' for these studies (Dellifraigne *et al.*, 2010, p. 22). Authors commented on the poorly-validated measurement instruments (Kaplan *et al.*, 2010), the use of subjective measures of success (Kaplan *et al.*, 2010; Poksinska, 2010) and the lack of any control or comparison groups or sufficient timeframe to confirm the effects (Elkhuizen *et al.*, 2006; Vest and Gamm, 2009; Nicolay *et al.*, 2012).

Studies with limited evidence of health professional practice change

Given that our focus was on health professional practice changes, we included papers that had been included in the previous general reviews. After detailed review of the 41 papers, we identified 20 studies where the process redesign programme included the injection of resources (financial, physical and human) and therefore the results achieved were not solely related to changes in health professional practice. In some of these studies, process redesign was accompanied by additional physical resources or technology. Examples of this were a telephone hotline for community

doctors (Kossovsky *et al.*, 2002); an emergency department (ED) information system (Baumlin *et al.*, 2010), and additional administrative technology (Hummer and Daccarett, 2009). In others the successful process redesign was accompanied by additional staff or service resources such as a dedicated inpatient team (Collymore *et al.*, 1997), addition of an IT engineer to assist in reduction in errors in diagnostic imaging (Taner *et al.*, 2012) and increased weekend cover and dedicated transporters (Grossman *et al.*, 2012).

We also identified five process redesign achievements that appeared to be largely associated with structural realignment. Practice changes were required only to adapt to the new structures. These included two studies in EDs of Australian public hospitals where process redesign was successful in significantly reducing waiting time for emergency patients in the least urgent triage categories (Kelly *et al.*, 2007) and reducing time to treatment (King *et al.*, 2006). In both projects ED patients were triaged into two groups: those likely to be admitted and those likely to be discharged, with staff teams organized to respond to the different care requirements of these two groups.

There were two studies with mixed results. Implementation of Lean in a New York City public hospital resulted in significant improvement in time from registration to treatment and to final disposition, as well as a significant increase in the number of emergency patients treated per hour (Naik *et al.*, 2011). While the overall beneficial results were achieved, a number of projects within the intervention were not successful. The reasons for the lack of success were impractical targets, lack of data for monitoring and doctors not being included. In addition, 'during times when ED census exceeded maximum capacity or a high velocity of patients was arriving, staff often reverted to the older, familiar work flows' (Naik *et al.*, 2011 p. 95). Where successful, health professionals' practices were changed with executive support for revised policies and procedures and operationalization through new position descriptions and clear expectations. In the second study with mixed results, Lean was used to improve the cataract surgery pathway in the Rotterdam Eye Hospital (van Vliet *et al.*, 2010). However, this study also found that, despite the specification of the care pathway, staff did not follow the pathway and a gap remained

between the actual care delivered and the expected care in the pathway.

Studies with acceptable evidence of health professional practice change

We identified 17 studies where practice change was clearly associated with the outcomes achieved. While most of the papers presented initiatives in a single hospital, one study took a systems approach. An American survey of large general hospitals, with a 29% response rate, illustrated that those hospitals that had not completed BPR had lower costs per adjusted patient day than those hospitals that had implemented BPR (Walston *et al.*, 2000). This was an unexpected finding, suggesting that BPR had a detrimental effect on hospital financial performance. However, this study also found that if the hospitals used integrative mechanisms in their BPR implementation, such as codification of the process, use of cross-functional internal teams and management support, the process redesign had lower costs than those hospitals without BPR (Walston *et al.*, 2000). Process redesign was not sufficient in improving hospital performance; the redesign process needed to be consistently applied across the organization with visible management support, documented expectations and employee involvement.

Two studies documented a hospital-wide approach with many process redesign initiatives completed in two Dutch public hospitals. The University Medical Centre Groningen implemented LSS in 2007. Through 90 projects directed to patient care processes and 73 projects directed to management and organization, the hospital achieved significant decreases in inappropriate hospital stays and redundant diagnostic tests, reduction in costs for trauma patients and reduction in length of stay for elderly patients with hip fractures (Niemeijer *et al.*, 2012). The success of these projects was attributed to encouraging staff to experience the problems and design their own solutions. The authors suggested that improvements in hospital processes required changes in staff behaviours, ultimately instituting new habits, and this could only be achieved by making each of the areas repeat the entire LSS process. The behaviour changes were achieved because internal expertise was successful in problem identification and resolution in each area and senior management was able to hold the doctors accountable for the procedure changes. Similarly, the Red Cross Hospital achieved operating savings through 50 SS projects. The hospital's operating costs

were 8.3% lower than the Dutch average for comparable hospitals while maintaining patient satisfaction and staff levels of absenteeism (van den Heuvel *et al.*, 2006). In this hospital, the changes in health professional practices were achieved largely through quality control mechanisms, including detailed protocols and regular internal audits.

Moreover, three studies tackled infection control and one study improved the rounding processes throughout the hospital. One of the infection control studies took place in a public hospital in The Netherlands, another in a not-for-profit American Episcopalian paediatric hospital and the other in a public hospital in the UK. The rounding study took place in a not-for-profit American paediatric hospital. All of these studies have relevance to public sector hospitals.

Ten studies were found that provided evidence of employee practice change through process redesign in specific programmes or services. The majority of these studies (six) took place in an intensive care unit (ICU) and addressed infection control or pain management. Of the remaining studies, one addressed telemetry monitoring in an ED, one focused on improving a surgical pathway, one improved discharge documentation and one study improved the outpatient appointment process.

The authors of the 17 studies identified similar implementation characteristics that were seen to lead to the success of the project. These characteristics comprised participation in the process, the establishment of protocols detailing expectations for the health professionals, training and education initiatives, audit of behaviour with feedback of results to the participating health professionals, and mechanisms to hold staff accountable for the changes.

Discussion

In this review we found 41 eligible studies. Of these, more than half of the process redesign projects included additional resources, new technology or structural change that was likely to have had a positive influence on the reported results. Although there may have been changes in health professional practices, it was unclear whether these changes could have been achieved solely through the redesign of processes or whether the practice changes were conditional upon the additional support. Forty-one per cent of the eligible studies reported success in changing employee practices to improve care processes without additional resources or structural change. These studies

were completed in public or not-for-profit hospitals. This may suggest that in competitive healthcare environments private for-profit hospitals are reluctant to grant research access to or to publish the details of process redesign initiatives, but ensures our results are relevant to the public sector.

In the studies with a demonstrated effect on employee practices, there was consistent identification of factors that were thought to influence the achievement of the results. These factors included participation in the process, the establishment of protocols detailing health professionals' practice expectations, training and education initiatives, audit of the behaviour of the participating health professionals with feedback of the results to them, and mechanisms to hold the health professionals accountable for the changes. These factors are human resource management (HRM) practices that have been consistently identified in the management literature as high performance work systems (HPWS) that are associated with improved organizational performance (Bartram *et al.*, 2007). Certain HRM practices are considered to be performance enhancing, such as participation, training and performance monitoring, as they influence employee attitudes and behaviours which ultimately impact individual and organizational performance (Bamber *et al.*, 2009).

Our review suggests that the health professional practice change that is accomplished through process redesign in public hospitals is achieved through basic HRM practices. Robbins *et al.* (2012) and Steed (2012) similarly found strong relationships among HPWS and LSS process improvement strategies. However, there is consistent evidence of the lack of attention paid to high performance HRM among hospitals (Brunetto *et al.*, 2011; Leggat *et al.*, 2011). What this review has highlighted is that the mechanics of process redesign induce hospital managers to use performance enhancing HRM practices that should have already been in place, such as participatory processes, employee accountability and measurement of performance. Radnor and Osborne (2013, p. 279) suggest that the main benefit of Lean initiatives in public sector hospitals has been to 'address the prior poor design of the public service'. We suggest that the lack of performance-based HRM practices in hospitals (Stanton *et al.*, 2010) has made organizational change and improvement initiatives difficult (Leggat *et al.*, 2007; 2011), with many hospitals relying on expensive and time consuming

process redesign initiatives to effect such change.

There were studies that explored the lack of achievement of process redesign. These studies did not meet the inclusion criteria, but provide useful insights. The failure of the redesign of the booking processes in the National Health Service was attributed to the power of physicians, inertia in established ways of working, and the inherent difficulties in sustaining the changes (Ham *et al.*, 2003). Robertson *et al.* (2002) suggested that efforts to change behaviours had not been successful when the doctors and team leaders were not held accountable. It was clear from the review that process redesign was only successful when health professionals were motivated to reduce their professional autonomy for the 'greater good' of the hospital processes. This is consistent with the long-standing notion of power, whereby those with power aim to maintain the status quo (Blau, 1964), with recent studies showing that, despite the acceptance of the need for collaboration in patient care, competitive power remains a strong factor in hospitals (Nugus *et al.*, 2010). Unlike the situation in other public sector enterprises, health professionals have a high degree of control over their clinical practice (Nembhard *et al.*, 2009). The health professions are largely self-regulated, many of the health professionals do not have an employment relationship with the public hospital and existing governance structures have had difficulty in challenging clinical practice (Jha and Epstein, 2010).

This review suggests that effectively implemented process redesign can bridge clinical and managerial perspectives in the public sector. While the management literature has long supported clear job descriptions, supervision and regular performance feedback as key elements of HRM, the importance of practitioner-defined protocols, the auditing of adherence to the protocols and the provision of relevant feedback to improve clinical practice has been identified in the clinical literature only relatively recently (see Nelson *et al.*, 2002). Process redesign may be a mechanism to foster change in work practices by challenging intractable power patterns in hospitals where there is insufficient organizational HRM or HRM practices have had limited impact.

These findings could also be seen to lend further support to the importance of social exchange in organizational change. Earlier researchers have found that public sector nurses in particular report poor leader-member relationships (Brunetto *et al.*, 2011). Process

redesign methodologies require staff to work closely together in cross-functional groupings which may provide the social relationships that may be lacking in line management structures. However, the studies reviewed did not consider social exchange and further research is required.

Conclusion

Process redesign methodologies are an important and potentially fruitful approach to improving the efficiency and effectiveness of hospitals and addressing the broader challenges facing public management in difficult economic times. Emerging from this systematic review is the centrality of performance-based HRM. There are challenges in HRM in an industry with self-regulated health professionals and independent contractors who exert strong control in how they practice their craft. This review provides evidence to encourage change management processes for public hospitals that focus on participation in the design, monitoring and evaluation of protocols for clinical practice that detail health professional behaviours. Nevertheless, there is a clear need for more empirical research that unpacks the complex linkages between process redesign, people management and the impact on quality of patient care as an important way to improve the cost effective management of healthcare organizations around the world.

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