

Redesigning mental healthcare delivery: is there an effect on organizational climate?

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Abstract

Objective. Many studies have investigated the effect of redesign on operational performance; fewer studies have evaluated the effects on employees' perceptions of their working environment (organizational climate). Some authors state that redesign will lead to poorer organizational climate, while others state the opposite. The goal of this study was to empirically investigate this relation.

Design. Organizational climate was measured in a field experiment, before and after a redesign intervention. At one of the sites, a redesign project was conducted. At the other site, no redesign efforts took place.

Setting. Two Dutch child- and adolescent-mental healthcare providers.

Participants. Professionals that worked at one of the units at the start and/or the end of the intervention period.

Intervention(s). The main intervention was a redesign project aimed at improving timely delivery of services (modeled after the breakthrough series).

Main outcome measures. Scores on the four models of the organizational climate measure, a validated questionnaire that measures organizational climate.

Results. Our analysis showed that climate at the intervention site changed on factors related to productivity and goal achievement (rational goal model). The intervention group scored worse than the comparison group on the part of the questionnaire that focuses on sociotechnical elements of organizational climate. However, observed differences were so small, that their practical relevance seems rather limited.

Conclusions. Redesign efforts in healthcare, so it seems, do not influence organizational climate as much as expected.

Keywords: organizational climate, redesign, mental healthcare, psychiatry, field experiment

Introduction

There are severe deficiencies in the timely delivery of mental healthcare, despite best efforts of professionals to the contrary [1]. To solve these problems, many believe that simultaneous improvements in critical areas of performance, such as cost, quality and speed, are needed. 'Redesign' is the general term for a group of approaches that is being used to achieve some of these improvements [2]. In redesign, one implements multifaceted organizational interventions that lead towards more customer-focused and cost-effective care, by removing unnecessary steps and potential for errors [3, 4]. In a typical redesign project, operational improvements are accompanied by efforts to educate and activate the workforce, leadership support and other types of interunit coordination (sociotechnical improvements) [5].

The effects of redesign have been studied in various research papers [6, 7]. These papers frequently report improvements in the timely delivery of services. Some studies also report better patient outcomes after a redesign project. However, there are also various gaps in redesign literature [3, 8, 9]. One of these gaps is that very few research papers have investigated the effects of redesign on areas of performance outside the timely delivery of services or better patient outcomes. Such an area is the effect of redesign on employees' perception of their work environment, the so-called organizational climate [10]. Work processes are an important aspect of the work environment, so it is reasonable to assume that changes in work processes will also lead to changes in organizational climate. Despite this and other gaps, the use of redesign is actively promoted by increasing numbers of quality-improvement agencies and policy-makers [11, 12].

The goal of this research is to add onto the small evidence base in two ways. First, we investigate the relation between redesign and organizational climate in a mental healthcare setting. Second, we explore if changes are most likely caused by the redesign project or that similar changes also occur when no redesign intervention took place.

Methods

Researchers usually use questionnaires to measure organizational climate. Since it is a complex multilevel, multidimensional phenomenon [13], many different questionnaires have been described in the literature. Our first step therefore was finding an appropriate questionnaire for this research.

Climate questionnaires can be divided into two groups [14]. Some questionnaires measure organizational climate as a global construct with common core dimensions across different organizations. Other questionnaires measure specific facets of organizational climate in relation to certain parts of performance, for example safety [15]. Because there is little knowledge about the effects of redesign on specific facets of organizational climate, we found it inappropriate to limit our research to innovation, safety or another single aspect. Instead, we opted to use the global construct approach.

One such questionnaire is the organizational climate measure [10]. This questionnaire has a sound theoretical background, being based on Quinn and Rohrbaugh's competing values model [16]. The competing values model aims to provide a broad conceptual map, covering four dominant domains in the field of organizational effectiveness, all having a long research tradition in management and organizational psychology.

The organizational climate measure consists of questions addressing key points in each of these four theories (referenced to as 'models' in the questionnaire). The scores of all questions for a single model can then be added up to an overall score per model. The four models are [10]:

- Human relations model (HRM) emphasizes the importance of well-being, growth and commitment of workers within an organization, reflecting sociotechnical and human relations schools in organizational theory.
- Internal process model (IPM) reflects a Tayloristic concern with formalization and internal control of the system to ensure that resources are used efficiently.
- Open systems model (OSM) emphasizes interaction and adaption of the organization in the environment, with managers seeking resources and innovating in response to environmental (or market) demands.
- Rational goal model (RGM) reflects a rational economic model of organizational functioning in which the emphasis is upon productivity and goal achievement.

Each model is measured using multiple scales. Each scale consists of multiple items, see Table 1.

The questionnaire has been validated [10] and used in healthcare before [14]. A complete English version of the questionnaire can be found in Patterson *et al.* [10]. We used a (translated) Dutch version of the questionnaire.

Table 1 Details about the organizational climate measure; number of questions per model and scales

Domain/model	Scales	Number of items
Human relations model (maximum score: 116)	Employee welfare	4
	Autonomy	5
	Involvement	6
	Emphasis on training	4
	Integration	5
	Supervisory support	5
Open systems model (maximum score: 64)	Innovation	6
	Outward focus	5
	Reflexivity	5
RGM (maximum score: 112)	Clarity of organizational goals	5
	Effort	5
	Efficiency	4
	Quality	4
	Pressure to produce	5
	Performance feedback	5
Internal process model (maximum score: 36)	Formalization	5
	Tradition	4

The full English version of the questionnaire can be found in Patterson *et al.* [12].

The organizational climate measure can be analyzed on several levels (scales, models and overall). Using the overall score was deemed inappropriate, because redesign is a multifaceted intervention that is likely to have a different effect on different parts of the organizational climate measure. Second, it is theoretically unlikely that organizations score high on every or most dimensions of organizational climate [10]. We chose the model rather than the scale level, because we wanted to compare the effect of redesign from different theoretical perspectives, rather than focusing on different elements of one single perspective.

Setting and design

Data were collected at two children- and adolescent-psychiatric units in the Netherlands. The sites were comparable in size and turnover. The largest groups of professionals at both sites were psychiatric nurses (42% versus 49%). Both sites employed similar numbers of other professionals, e.g. psychologists (18% versus 16%) or psychiatrist (5% versus 4%). Both sites treated patients with severe psychiatric disorders between 0 and 21 years. About 60% of the patients at each site were treated for pervasive developmental disorders or attention deficit and disruptive behavior disorders. Patients received a similar range of services.

The sites were situated in different regions, ~100 km apart and were part of different organizations. There was no formal cooperation between the sites and virtually no patients were referred.

At Site 1, a redesign project was conducted (Box 1). Site 2 was as a comparison site with no redesign interventions.

Box 1 Intervention

In 2007 and 2008, there were signals that timely delivery of services at the intervention site could be improved. On the *input* side, professionals felt that they were unable to help all patients that were referred in a timely matter. Research had demonstrated that complexity of the care process at the unit was high ('throughput' [17]). In response, care pathways had been developed for the two largest patient groups, but implementation stalled after a small pilot phase [18]. Finally, there were problems on the 'output' side, where professionals hesitated to finish treatments and de-register patients, because of long waiting times in case of a relapse.

In September 2009, the unit started a year-long redesign project modeled after the breakthrough series [19] to improve this situation. The goal of the project was to reduce waiting and throughput times, while maintaining similar outcome levels. Representatives of all teams participated in the central improvement team, which was led by local management. This team met three times in so-called learning sessions (face-to-face meetings with experts). In these learning sessions, participants presented and discussed various interventions to improve the timely delivery of services. These interventions were based on literature, mainly two publications on previous breakthrough projects in Dutch mental healthcare [20, 21]. The improvement team chose the interventions that they felt suited their specific situation best.

Interventions were implemented by working groups during (two) action periods: the time between learning sessions. These working groups redesigned care process via the large-scale implementation of care pathways and the supporting administrative processes, for example via caseload reviews, value stream mapping, capacity management. After the redesign project, delays during treatment had decreased by ~30%. Also, the number of patients that flowed out of treatment seemed to have increased. These changes did not come at the expense of outcomes of the treatment, which remained at a similar level as before the intervention period.

A more detailed description and discussion of the intervention and its results can be found in [22].

Design and measurement procedure

We used a controlled before–after design to study the effects of redesign on organizational climate. Respondents were the employees at both sites at $t = 0$ (spring 2009) and $t = 1$ (fall 2010). Respondent were approached via email to anonymously complete the questionnaire online. We sent three reminders at 2 weeks intervals to increase response rates.

Hypotheses and analyses

This study was guided by two hypotheses:

- (1) For the intervention site, organizational climate after the intervention will differ from the organizational climate before the intervention.
- (2) There will be a significant difference in organizational climate between the intervention and comparison site at the end of the intervention, while controlling for their scores at the start of the intervention.

Hypothesis 1 was answered using an independent-sample t -test. For Hypothesis 2, we used a one-way between groups analysis of covariance (ANCOVA). ANCOVA requires that employees complete both the pre- and post-measurement. The t -test requires only one questionnaire to be finished. This means that sample sizes for both hypotheses differed, each with their own mean and standard deviation.

The independent sample t -test compares two groups of different people at two different moments in time ('before' and 'after' the intervention). The independent variable in Hypothesis 2 was site and the dependent variable was the model score of the organizational climate measure. The score before the intervention period was entered as a covariate in this analysis.

We conducted several preliminary checks (not included here). For both measurements, response rates were slightly higher for the intervention site. The main cause was a lower response rate of psychiatric nurses at the control site. Response rates for psychiatrists, psychologists, other therapists and supporting staff were similar. Other checks ensured no violations of the assumptions of normality, linearity, homogeneity of regression slopes and reliable measurement of the covariate. Homogeneity of variance for the human relations model was 0.041. However, the F statistic is quite robust against violations of this assumption [23, 24]. All other scales had non-significant scores.

Analyses were conducted in SPSS, version 19.

Results

Two hundred and thirty-seven respondents completed the pre-intervention questionnaire at the intervention site and 249 completed the postintervention questionnaire. The answers of these respondents were used to analyze Hypothesis 1. One hundred and two of these respondents (versus 96 at the comparison site) completed both measurements and could be used to analyze Hypothesis 2.

The two units had roughly similar baseline scores for OSM (intervention unit: 39.67, SD = 5.81, comparison unit: 39.59, SD = 4.71), HRM (72.72, SD = 10.07 versus 75.88, SD = 7.96), RGM (70.25, SD = 6.53 versus 73.27, SD = 5.74) and IPM (22.61, SD = 3.11 versus 22.61, SD = 2.57).

Table 2 presents all descriptive statistics for both sites and hypotheses.

The t -test used to answer our Hypothesis 1 showed that the RGM increased significantly over the intervention period (before: 70.15, SD = 6.01, after: 71.72, SD = 6.44, $P = 0.02$).

Table 2 Descriptive statistics

	Pre-measurement						Post-measurement						<i>t</i> -Test		
	Intervention site			Comparison site			Intervention site			Comparison site					
	<i>N</i>	Mean	SD	<i>N</i>	Mean	SD	<i>N</i>	Mean	SD	<i>N</i>	Mean	SD	d.f.	<i>t</i>	Sig.
Hypothesis 1															
HRM	162	73.56	9.85	—	—	—	174	72.00	9.45	—	—	—	334	1.48	0.139
OSM	162	39.83	5.31	—	—	—	173	39.78	5.27	—	—	—	333	0.071	0.943
RGM	160	70.15	6.01	—	—	—	172	71.72	6.44	—	—	—	330	−2.29	<i>0.023</i>
IPM	176	22.50	2.97	—	—	—	172	22.49	2.98	—	—	—	346	0.036	0.971
Total <i>n</i>	237						249								
Hypothesis 2															
HRM	102	72.72	10.07	96	75.88	7.96	102	70.94	9.31	96	74.59	7.24	—	—	—
OSM	102	39.67	5.81	96	39.59	4.71	102	39.39	5.24	96	39.43	5.23	—	—	—
RGM	102	70.25	6.53	96	73.27	5.74	102	70.90	6.41	96	73.21	6.08	—	—	—
IPM	102	22.61	3.11	96	22.66	2.57	102	22.46	3.13	96	22.76	2.53	—	—	—
Total <i>n</i>	185						188								

Mean and standard deviation per model of the OCM. Also the results of the *t*-test for Hypothesis 1 are presented. Scores are presented per site and per hypothesis. The number of respondents for the two hypotheses differs. This is because respondents only had to complete one questionnaire (before or after) to be entered in the analysis for Hypothesis 1. Under Hypothesis 2, respondents had to finish both questionnaires (before and after). Significance values < 0.05 are displayed in *italic*.

The average scores of the other models were similar to their preintervention scores.

The ANCOVA used to answer our second hypothesis showed a difference for the human relations model ($P = 0.03$, partial $\eta^2 = 0.023$), indicating that scores at the intervention site had declined more over the course of the intervention period, while controlling for preintervention scores. The other models did not show a statistically significant difference in the development of scores.

Discussion

In Introduction, we identified a gap in the literature with regard to the effects of redesign on organizational climate. To make matters more confusing, studies that have investigated this relation found opposing results. In some studies, employees' perceptions were positively influenced by redesign efforts. Pronovost and Berenholtz [15], for example, found an increase in safety culture scores before and after a quality-improvement/redesign intervention. Others, like Jackson and Mullarkey [25] found both positive and negative effects, depending on the specific aspect of organizational climate being measured. Finally, authors like Gibbon and Watkins [26] who measured team climate before and after the introduction of a care pathway in stroke care found no differences at all.

Despite this lack of definitive evidence, several authors have voiced strong opinions about the direction of this relation. For example, since standardization and increased efficiency are important goals of redesign, some authors have argued that redesign leads to higher pressure on employees to meet targets,

less autonomy and reduced attention for employee well-being [27, 28]. In our research, such differences would be measured in three models. The RGM and the IPM measure aspects like standardization and rationalization and were expected to increase. The HRM, which focuses on aspects like pressure to produce and employee well-being, was expected to decrease. The influence of redesign on the OSM was less easy to predict [29–31].

Our analysis showed a change that was in line with our expectations in only one out of the three models. This means that Hypothesis 1 is largely rejected.

We feel that an important explanation for the lack of deterioration in the HRM was the use of the breakthrough model during our intervention period [19]. This model is characterized by high degrees of employee involvement and communication. In our case, employees were actively involved in the selection and implementation of interventions during the intervention period. During the project, employees had high autonomy and could actively influence decision making and their job design. This might have mitigated some of the adverse effects of increased standardization and rationalizing that we expected in the HRM.

The second model in which we expected, but did not find a difference was the IPM. Some authors on lean thinking (one of the approaches that underlies many redesign efforts) have described that it took exemplar organizations' years before changes were regarded as the 'established way of doing things around here' [32], while our intervention lasted only a single year. It is quite possible that this shorter time span explains the lack of change we found.

The RGM was the only model that changed as expected. This model consists of scales like feedback, clarity of

organizational goals and efficiency. At the start of the intervention period, much attention was given to emphasizing the goal of the intervention: reducing waiting times and improving throughput. During the intervention, regular feedback sessions were organized. Finally, many interventions were aimed at increasing efficiency. All these aspects are measured under the RGM and could explain the increased score.

There are many factors other than our redesign project that could have led to the rejection of Hypothesis 1. To control some of these factors, we added a comparison group to this research and analyzed their differences under Hypothesis 2. Because of the similarities between the units and because both units are part of the same healthcare delivery system, we started from the premise that outside factors would influence employees' perceptions at the intervention site as much as they influence these perceptions at the comparison site. By comparing changes in organizational climate at both sites, we tried to distinguish between the effects of the redesign study on employees' perception from the effect of external initiatives on employees' perceptions.

The results of this analysis showed no difference for three models between the scores at the sites, while controlling for their score at the start of the intervention period. The only model that showed a difference was the HRM. Scores in this model decreased at both sites, but the reduction was larger at the intervention site. However, site explained only 2.3% of the difference. This means that the magnitude of the effect was small.

This means that our results show a change in the scores on the HRM under Hypothesis 2, but no such change in the same model under Hypothesis 1. Given the differences between hypothesis, samples and probably power to detect differences, it would however be unrealistic to expect exactly the same result in both analyses.

It is striking that the two models on which we found a difference were based on the sociotechnical school and the economic-rational goal school of management, the schools that have the most outspoken visions on redesign. Concepts measured in the RGM (like efficiency and quality) are among the most frequently cited reasons to start a redesign project. This observation is strengthened by the direction of the difference in the score 'before' and 'after' the intervention. Closer inspection of individual scales in this model revealed that performance feedback, pressure to produce, efficiency and effort had a higher average score 'after' the intervention period, while quality decreased and clarity of organizational goals remained virtually unchanged over the course of the intervention period.

Criticism on redesign and lean thinking mostly focuses on aspects related to employee well-being and autonomy. These aspects are measured in the HRM. This observation is strengthened by differences between the two sites. On the subscale level, three of the six subscales deteriorated more at the intervention site (employee welfare, involvement and integration). Based on these findings, some researchers might conclude that redesign indeed has a negative influence on employees.

While these findings are of interest to scholars from either school of management, the observed differences were so small

that their practical relevance seems limited. The redesign efforts in this study did not influence organizational climate as much as some scholars expected. This might be explained by the fact that mental healthcare has long been at the center of attention for policy-makers and other stakeholders. Healthcare organizations have witnessed an enormous amount of change in areas like policy, legislation and quality. These changes have to a great deal shaped processes and employees' perceptions of these healthcare processes. As a result, healthcare professionals might be accustomed to working in an environment where processes are constantly changing. Redesign efforts could be regarded as just one of the many changes they deal with, with small effects on organizational climate (OC) as a consequence.

On aspects like size, patient groups and type of professionals employed, the units in this research are quite typical for Dutch mental healthcare. The same goes for the design of our main intervention, since redesign and the breakthrough method are used on a global scale to improve (mental) healthcare delivery [7, 19, 20, 33, 34]. For these reasons, we feel that our findings are also relevant for other units and healthcare practitioners, although more research is needed in the light of the limited number of papers that focus on the relation between redesign and OC. This research should take into account the limitations of this study.

Limitations

This study has two main limitations from a methodological point of view. The first is a lack of randomization. Existing pre-conditions (e.g. leadership style, the degree of IT support) could have influenced our results. Second, we did not analyze if non-responders had a systematically different opinion from people that did return the questionnaire (non-response bias). Both issues should receive additional attention in future research.

Future studies should also take into account that some authors [32] suggest that achieving the full benefits of redesign takes multiple years. Our intervention period only lasted 1 year. This suggests that some effects of redesign on OC might only show up after our intervention period. However, others found that the timeframe we chose is sufficient to achieve measurable results [19].

Conclusions

Relatively, few studies have evaluated the effects of redesign efforts on OC in a healthcare setting. In this study, we evaluated these effects in a year-long redesign project at two units in Dutch child- and adolescent-mental healthcare. Some suggest that redesign achieves improvements in the timely delivery of services at the expense of employees' working conditions. Advocates of redesign on the other hand suggest that redesign not only leads to better outcomes but respects and even improves working conditions.

Our findings suggest a middle ground. We did find a statistically significant difference on some aspects of employees'

perceptions, but these differences were very small. It seems from this research that redesign neither deteriorates nor improves OC to a large extent, at least not in the time frame used in this study.

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References

1. IOM. *Improving the Quality of Health Care for Mental and Substance Use Conditions*. IOM (ed). Washington, DC: IOM, 2005.
2. Nave D. How to compare six sigma, lean and the theory of constraints. *Qual Prog* 2002;**35**:73–8.
3. Elkhuizen S, Limburg M, Bakker P *et al*. Evidence-based re-engineering: re-engineering the evidence. *Int J Health Care Qual Assur* 2006;**19**:477–99.
4. Locock L. Healthcare redesign: meaning, origins and application. *Qual Saf Health Care* 2003;**12**:53–8.
5. Joosten T, Bongers I, Janssen R. Application of lean thinking to health care: issues and observations. *Int J Qual Health Care* 2009;**21**:341–7.
6. McCulloch P, Kreckler S, New S *et al*. Effect of a “lean” intervention to improve safety processes and outcomes on a surgical emergency unit. *Br Med J* 2010;**341**:1043–9.
7. Ben-Tovim D, Bassham J, Bennett D. *et al*. Redesigning care at the Flinders Medical Centre: clinical process redesign using ‘lean thinking’. *Med J Aust* 2008;**188**:S27–31.
8. Mazzocato P, Savage C, Brommels M. Lean thinking in health-care: a realist review of the literature. *Qual Safety Health Care* 2010;**19**:376–82.
9. Vest J, Gamm L. A critical review of the research literature on six sigma, lean and studer group’s hardwiring excellence in the United States: the need to demonstrate and communicate the effectiveness of transformation strategies in healthcare. *Implement Sci* 2009;**4**:35–43.
10. Patterson M, West M, Shackleton V *et al*. Validating the organizational climate measure: links to managerial practices, productivity and innovation. *J Org Behav* 2005;**26**:379–408.
11. Jones D, Mitchell A. *Lean Thinking for the NHS*. London: NHS Confederation, 2006.
12. Miller D. *Going Lean in Health Care*. Cambridge, MA: Institute for Health Care Improvement, 2005.
13. Glick W. Conceptualizing and measuring organizational and psychological climate: pitfalls in multilevel research. *Acad Manage Rev* 1985;**10**:601–16.
14. Dawson J, Gonzalez-Roma V, Davis A *et al*. Organizational climate and climate strength in UK hospitals. *Eur J Work Org Psychol* 2008;**17**:89–111.
15. Pronovost P, Berenholtz S, Goeschel C *et al*. Improving patient safety in intensive care units in Michigan. *J Crit Care* 2008;**23**:207–21.
16. Quinn R. *Beyond Rational Management: Mastering the Paradoxes and Competing Demands of High Performance*. San Francisco, CA: Josse-Bass, 1988.
17. Van der Zanden L. *Analysis, (re)Design, Planning and Control of Mental Healthcare Processes [Literature study]*. Eindhoven: University of Technology Eindhoven, 2009.
18. Linskens N. *Process Analysis and Improvement at GGZ Eindhoven/Maastricht*. Maastricht University, 2009.
19. IHI. *The Breakthrough Series: IHI’s Collaborative Model for Achieving Breakthrough Improvement*. Cambridge: Institute for Healthcare Improvement, 2003.
20. Schouten L, Minkman M, de Moel J *et al*. (eds). *Doorbreken met Resultaten in de Gezondheidszorg*. Assen: Van Gorcum, 2007.
21. Diephuis K, Dronkers F, Janssen I *et al*. *Slimmer organiseren: handboek sneller zorg voor jeugd*. Utrecht: Partners in Jeugdbeleid/CBO, 2009.
22. Joosten T. *Redesign in Mental Healthcare: an Exploratory Study Into the Effects of Redesign on Multiple Areas of Performance in Mental Healthcare*. Tilburg: Tilburg University, 2012.
23. Statsoft Inc. *Electronic Statistics Textbook*. Tulsa, OK: StatSoft, 2012. <http://www.statsoft.com/textbook/> (26 June 2012, date last accessed).
24. Lindman H. *Analysis of Variance in Complex Experimental Designs*. San Francisco: W. H. Freeman & Co, 1974.
25. Jackson P, Mullarkey S. Lean production teams and health in garment manufacture. *J Occupat Health Psychol* 2000;**5**:231–45.
26. Gibbon B, Watkins C, Barer D. *et al*. Can staff attitudes to team working in stroke care be improved? *J Adv Nurs* 2002;**40**:105–11.
27. Dankbaar B. Lean production: denial, confirmation or extension of Sociotechnical Systems Design. *Hum Relat* 1997;**50**:567–84.
28. Niepce W, Molleman E. Work design issues in lean production from a sociotechnical systems perspective: neo-Taylorism or the next step in sociotechnical design. *Hum Relat* 1998;**51**:259–87.
29. De Haan J, Overboom J, Naus F. Discipline and creativity in lean production: contradiction in terms? In Pawar KS, Lalwani CS, Banomyong R (eds.). *Proceedings of the 13th International Symposium on Logistics (ISL 2008): Integrating the Global Supply Chain*. Nottingham: Nottingham University pp. 77–84.
30. Takeuchi H, Osono E, Shimizu N. The contradictions that drive Toyota’s success. *Harvard Bus Rev* 2008;**86**:96–104.
31. Osono E, Shimizu N, Takeuchi H *et al*. Extreme Toyota: Radical Contradictions That Drive Success at the World’s Best Manufacturer. Hoboken, NJ: John Wiley, 2008.
32. Liker J. *The Toyota Way - 14 Management Principles From the World’s Greatest Manufacturer*. New York: McGraw-Hill, 2004.
33. Yngström D, Lindström K, Nyström K. *et al*. Healthcare-associated infections must stop: a breakthrough project aimed at reducing healthcare-associated infections in an intensive-care unit. *BMJ Qual Saf* 2011. doi:10.1136/bmjqs.2007.023846
34. Bush S, Lao M, Simmons K *et al*. Patient access and clinical efficiency improvement in a resident hospital “based women’s” medicine center clinic. *Am J Manage Care* 2007;**13**:686–90.