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A nation-wide transition in patient safety culture: a multilevel analysis on two cross-sectional surveys

I. Verbeek-Van Noord¹, M. Smits², N.C. Zwijnenberg², P. Spreeuwenberg², C. Wagner^{1,2}

1. Department of Public and Occupational Health, EMGO Institute for Health and Care Research, VU University Medical Center, Van der Boechorststraat 7, 1081 BT Amsterdam, the Netherlands
2. Nivel, Netherlands Institute for Health Services Research, Otterstraat 118—124, 3513 CR Utrecht, the Netherlands

Abstract

Quality Problem or Issue: Patient safety is an important topic within healthcare systems. A favourable safety culture might promote safety. We examined whether a nation-wide patient safety programme (PSP) improved patient safety culture.

Initial Assessment: We initially measured patient safety culture among 3779 healthcare providers in 45 hospitals in the Netherlands, using the Hospital Survey on Patient Safety Culture.

Choice of Solution: A PSP based on two pillars: the implementation of a safety management system and the focus on 10 themes in which harm to patients appeared highly preventable. Elements of the safety management system were safety management, safety culture, risk assessments and continuous safety improvements.

Implementation: Implementation was nation-wide.

Evaluation: After implementation of the programme, we assessed patient safety culture among 6605 healthcare providers in 24 Dutch hospitals and compared the scores with the initial measurement. We hypothesized that after the programme (1) scores on safety culture dimensions improved, (2) safety culture became more homogeneous within and between hospitals and (3) relative influence of hospitals on safety culture increased. A three-level mixed model for continuous responses was fit for 11 safety culture dimensions. We calculated average individual means, between-department variances, between-hospital variances and total variances per dimension.

Lessons Learned: In general, a more favourable safety culture was seen after the PSP. However, hospitals and departments did not become more homogeneous, except for

‘frequency of event reporting’. The variety in responses amongst departments and hospitals increased for several dimensions, implying that not all of them improved.

Introduction

Patient safety is an important theme within national and international healthcare systems. In the Netherlands, a retrospective patient record review study with data of 2004 made clear that the safety of patients was a major concern [1]. As a result, four national committees initiated a nation-wide patient safety programme (PSP) in 2008, aimed at reducing avoidable harm and deaths with 50% within 5 years. Almost all public hospitals in the Netherlands committed themselves to implement the PSP. The PSP was based on two pillars; the implementation of a Safety Management System and the focus on 10 themes in which harm to patients appeared to be highly preventable. Examples of these themes are: postoperative pain management, postoperative wound infections, acute coronary syndrome and vulnerable elderly. Five years after the implementation of the PSP, potentially avoidable harm decreased from 2.9% to 1.6% of all admitted patients. Potentially avoidable hospital deaths decreased from 5.5% to 2.6% [2].

Dutch hospitals were obliged to have a Safety Management System by the end of 2012. Four elements are embedded in the Safety Management System, i.e. safety management, safety culture, risk assessments and continuous safety improvements. The Safety Management System implies that safety culture interferes with all the other elements of the system. For this reason, no explicit requirements for safety culture were formulated.

Various definitions of safety culture exist, which all underline the necessity that safety has top priority within an organization. It refers to the extent to which individuals and teams feel responsible for safety and act in such a way that they are preventing, redressing and communicating unsafe situations. One learns from mistakes and adjusts behaviour accordingly to the lessons learnt, both at the individual as well as the organizational level [3]. A favourable safety culture might thus promote safety. This assumption has been strengthened by a systematic review that found a relation between safety culture and patient outcomes such as a decrease in hospital mortality and length of admissions [4]. Components of safety culture, such as management support and staffing, have also been linked to improved patient outcome or fewer errors [5–7]. Safety culture is often assessed with questionnaires [8]. Safety culture assessment tools can have three perspectives, the managerial perspective, the staff perspective or a combination of both [9]. The Hospital Survey on Patient Safety Culture (HSOPS) of the Agency for Healthcare Research and Quality (AHRQ) measures safety from the staff perspective and is used worldwide [10–12]. The original questionnaire measures 12 safety culture dimensions (e.g. frequency of event reporting, teamwork within units and non-punitive response to error) [10]. The HSOPS has been translated into Dutch and validated for the Dutch language and setting [13, 14]. The Dutch version measures 11 dimensions of patients safety (see Methods section).

Efforts to promote the development of a favourable culture are widely implemented [15] and evaluated and include teamwork interventions [16–19] and department-based programmes [20–24], multicomponent organizational programmes [25–27], and the implementation of specific tools like leadership walk rounds [28, 29], checklists [30] and physiological track and trigger systems [31]. We are not aware of evaluations of changes in safety culture related to nation-wide patient safety improvement programmes. The aim of this study is to examine if patient safety culture improved after the implementation of the nation-wide PSP by comparing safety culture data collected before and after the implementation of the PSP.

With nation-wide and hospital-wide attention for patient safety, we expect that hospitals and departments undertake action to improve patient safety and to develop a favourable safety culture. Our first hypothesis, therefore, is that average scores on patient safety culture dimensions will have improved after the PSP compared to before the start of the PSP. Secondly, because of the hospital-

wide commitment we hypothesize that patient safety culture will have become more homogeneous meaning that the department and hospital variances will have decreased as well as the total sum of variances. Our third hypothesis is that the relative influence of hospitals compared to departments with regard to the scores on various safety culture dimensions will have increased.

Methods

Participants

Although the sample selection for this study was not scheduled for a before–after study upfront, we however believe that it provides a good opportunity to evaluate a nation-wide improvement programme, provided a correction for the nested nature of the data and possible confounders was conducted (see Analyses below).

Before the start of the PSP, data on patient safety culture were collected between June 2005 and December 2007 [32]. Data were collected in a convenience sample of 171 departments of 45 Dutch hospitals. In each participating department, a random sample of 30 healthcare professionals was drawn. Inclusion criteria were: having worked at the department for at least 6 months, and working a minimum of 12 h a week. Between September and December 2012, data were collected in a convenience sample of 390 departments of 24 hospitals that participated in the PSP. Almost all of the 155 hospitals in the Netherlands participated in the PSP. In case of large departments, a random sample of 35 healthcare professionals was drawn. Inclusion criteria were: having worked at the department for at least 3 months and working a minimum of 2 days per week.

Measurement of patient safety culture

The Dutch validated version [14] of AHRQ's HSOPS [10, 11] was administered to all healthcare professionals in the participating hospital departments. The Dutch version of this questionnaire contains 40 items on a five-point Likert scale (1 = disagree strongly/never to 5 = agree totally/always). Some items are negatively worded (e.g. 'Staff are afraid to ask questions when something does not seem right') in these cases a low score means a positive response. The items in the questionnaire comprise eleven dimensions of safety culture, i.e. teamwork across departments, teamwork within departments, hospital handoffs and transitions, frequency of event reporting, non-punitive response to errors, communication openness, feedback on and learning from errors, supervisor/manager expectations about safety, management support, adequate staffing and general perceptions of patient safety. A self-reported patient safety grade (i.e. excellent, very good, acceptable, poor or failing) and the number of errors reported in the previous twelve months are regarded as two outcome measures of this questionnaire. Additionally, the questionnaire gathers background data about the respondent's type of profession, work experience, contact with patients and working hours a week.

Data collection

The baseline data were collected in the period between June 2005 and December 2007 for other research purposes. Distribution of the questionnaire was paper-based via the post boxes of the healthcare professionals at their department. Respondents could send back the questionnaire to the research team by means of a prepaid business reply envelope.

After the PSP, questionnaires were distributed between September and December 2012 for monitoring purposes. Four data collection modes were available: (1) online data collection coordinated by the hospital itself, (2) online data collection coordinated by the research institute, (3) paper version with prepaid business reply envelope and a link to the online questionnaire and (4) paper version with prepaid business reply envelope only. Participants were invited by e-mail (Modes 1 and 2) or via their post boxes at the department (Modes 3 and 4).

Local contact persons assigned a unique ID to each healthcare professional. In case of online data collection, the researcher provided a unique username and password for each healthcare professional. The research team kept track of the incoming IDs and reported these IDs to the contact persons every 3 weeks; individual answers to the questionnaires were not revealed. In case of online data collection, the research team sent one or two e-mail reminders to the non-responders. The hospital contact persons or department managers motivated non-responders to fill in the questionnaire by emphasising its importance. Some offered a group reward in case of a high response

Analyses

Descriptive analyses

Frequency data were obtained for profession, work experience and the two outcome measures of the HSOPS. In order to calculate average individual means for the 11 dimensions, negatively worded items were first reversely recoded so that for each item a high score corresponded with a positive response. The average individual means resulted in a dimension score between 1 and 5. One missing item was allowed per dimension. Averaging individual means has been found to give a higher precision than calculating the percentage of positive responses [33].

In the analyses, we took into account that safety culture can be seen as typical for hospital departments, as it exists in groups of people working together [13]. Therefore, a three-level model for continuous responses was fit wherein respondents were nested within departments and departments were nested within hospitals.

Hypotheses testing

To compare the average dimension scores before and after the introduction of the PSP, we added a term for time in the multilevel regression analysis. Models were adjusted for participants' profession (nurse versus others), years of work experience at department, and working hours per week. To decide whether hospitals and/or departments became more homogeneous over time, we calculated the between-department variance and the between-hospital variance and the total (sum of departmental and hospital) variances and compared these between the two measurement periods. Two-sided Wald tests were used to test the statistical differences between the variances over time. Statistical significance was set at $P < 0.05$. Trends were defined as $0.05 \leq P < 0.10$.

Changes in the relative influence of hospitals on dimensions scores were investigated by means of calculating the following Intra Class Correlation Coefficient: hospital variance divided by hospital variance plus department variance. A larger ICC then indicates more hospital influence. By multiplying the ICC by 100, a percentage score was calculated to indicate the magnitude. ICCs were compared before and after the start of the PSP programme. An increase of 10% was considered relevant by the researchers.

Results

Participants

Before the start of the PSP, the Dutch version of the HSOPS was filled in by 3779 respondents and in the second measurement by 6605 respondents. The average response rate of the second measurement was 62.2% (SD 12.7%) at hospital level and 60.1% (SD 22.7%) at department level. Response rates varied between 34.1% and 83.4% at hospital level and between 8% and 100% at department level. The response rate of the first measurement could not be calculated, because of the unrestricted distribution procedure. The level of experience of the professionals in the second

measurement was higher than in the first measurement. In both measurements, nurses were represented the most (Table 1).

Hypothesis 1. Differences pre- and post-PSP

Regarding the two outcome measures of the HSOPS, the self-reported patient safety grade improved significantly ($P < 0.001$, left side of Figure 1). More respondents graded patient safety as excellent and very good, less respondents judged patient safety as failing, poor or acceptable. Furthermore, self-reported incident reporting behaviour changed significantly ($P < 0.001$, right side of Figure 1). Significantly less respondents had not reported an incident in the last 12 months. The percentage of respondents filling in one or two reporting forms remained stable, but the percentage of respondents that filled in more than two forms increased significantly, from 23.5% to 34.8%.

After correction for clustering at the department and hospital level and respondents' characteristics, statistically significant improvements were found for all safety culture dimensions, except for 'adequate staffing' (Table 2). All statistically significant increases varied between 0.07 for 'communication openness' and 0.38 for 'hospital management support for patient safety' with an average increase of 0.18. In the post-PSP measurement, 'teamwork within departments' was valued the highest (3.99) and 'teamwork across departments' the lowest (3.11). This same pattern can be seen for the period before the implementation of the PSP (3.90 and 2.87, respectively).

[\[Table 1\]](#) [\[Figuur 1\]](#) [\[Table 2\]](#)

Hypothesis 2. Between department and hospital variances

The increases in dimension scores were mainly due to changes at the individual level, as results show that between-department variances of only four dimensions changed and there were no significant changes in between-hospital variances (Table 3). The between-department variance of 'frequency of event reporting' decreased and the between-department variances of 'non-punitive response to error', 'supervisor/management expectations and actions promoting safety' and 'communication openness' increased. Furthermore, a trend was seen for some hospitals variances, i.e. for 'supervisor/management expectations and actions promoting safety', 'hospital handoffs and transitions' and 'hospital management support for patient safety'; the variances at this level increased. Total variances decreased for 'frequency of event reporting', and increased for 'supervisor/manager expectations and actions promoting safety'. A trend was seen for 'communication openness', and 'hospital management support for patient safety'. Total variances of both dimensions showed an increase.

Hypothesis 3. Relative influence on patient safety culture dimensions scores of hospitals

Concerning the relative influence of hospitals on the patient safety dimension scores, results show that hospitals became of more influence with regard to 'hospital handoffs and transitions', 'frequency of event reporting', 'supervisor/manager expectations regarding patient safety', 'hospital management support for patient safety' and 'adequate staffing'. With regard to 'non-punitive response to error', 'communication openness' and 'overall perceptions of safety' the relative influence of departments became higher (Table 4).

Discussion

This study aimed to explore whether patient safety culture in hospitals in the Netherlands has improved after the implementation of a nation-wide PSP. Therefore, two cross-sectional safety culture survey databases were compared. We proposed three hypotheses of which two were not entirely confirmed. First, our results showed that all patient safety culture dimensions scores increased significantly except for 'adequate staffing'. This could be related to the low reliability of

this dimension (Cronbachs alpha (α) = 0.49; for the other dimensions $0.64 \leq \alpha \leq 0.79$) [14]. Furthermore, the valuation of patient safety by health professionals as well as reporting behaviour of professionals improved over the years. This is in line with our expectations. Second, we expected that safety culture would have become more homogeneous throughout hospitals and departments. However, we only saw a decrease in total variance of the 'frequency of event reporting', which seems due to a decrease in the between-department variance. This indicates that the hospital population became more homogeneous over time with regard to error reporting. A possible explanation for this result may be that a profound focus on error reporting exists in the Safety Management System. It is one of the concrete improvements departments and hospitals can implement and error reporting is relatively easy to change. Internal health system leadership and external healthcare regulatory agencies are perceived to influence professionals' decision to report [34]. The fact that most differences in variances existed in the opposite direction of what we had expected is in line with the findings of an evaluation study of the ten themes from the PSP. That evaluation study concluded that departments differ concerning the implementation of the themes [35]. Our results seem to imply that not in all departments and hospitals safety culture improved. Third, we saw that the relative influence of hospitals became larger over time on five dimensions. With respect to 'frequency of event reporting' and 'hospital management support for patient safety' results are in line with what one might expect from a nation-wide PSP aiming specifically at the implementation of a hospital-wide safety management system with a profound focus on learning from incidents and incident reporting. Influence of departments on 'non-punitive response to errors', 'communication openness', and 'overall perceptions of safety' became larger, which was not in line with our expectations. This indicates that these dimensions seem to be more department-specific and under less influence of hospitals.

[\[Table 3\]](#) [\[Table 4\]](#)

There are several limitations to this study. First, there is a possibility of local co-interventions alongside the implementation of the national PSP. However, since nearly all hospitals in the Netherlands committed to the PSP, and the local initiatives were often spin-offs of the programme, we do believe that the PSP promoted a favourable patient safety culture. Another limitation is the possibility of response bias for those departments with small responses. In the second measurement, 34% of the departments had a response rate lower than 50%. Departments with responses lower than 50% scored statistically significantly lower on five out of 11 dimensions, indicating that more unsatisfied people responded. This could have had an impact on the magnitude of the average change in dimensions that we have found, resulting probably in an underestimation of the effect of the PSP. Furthermore, in our study design we have compared two different samples. Comparisons of respondents, however, showed that only work experience differed among the two samples and we corrected for that in the analyses. In the post-PSP time period, more different types of hospital departments were selected. Adjustments for profession and clustering for responses at unit level were made to prevent the influence of this form of selection bias.

The measurement tool for patient safety culture involved self-reported perceptions of individual healthcare professionals. Future studies should add qualitative research in the form of in-depth interviews or observations as this will complement self-reported survey data. Triangulation also makes it possible to verify or falsify results.

To conclude, this study shows that the patient safety movement in the Netherlands developed in the right direction over time, but possibly not at all departments and hospitals. Safety culture is known to vary between departments and hospitals and it takes time to change culture. The results are a promising indicator of the ability of a nation-wide PSP to instil a favourable development of

patient safety culture. Especially the positive change in reporting behaviour can be attributed to the programme since the PSP stimulated the implementation of a reporting system.

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Tables and figures

Table 1 Characteristics of respondents and hospitals

| Characteristic | Pre-PSP | | Post-PSP | |
|------------------------------------------|-------------|--------------|-------------|--------------|
| | N | (%) | N | (%) |
| Profession | | | | |
| Patient-care assistant | 7 | (0.2) | 24 | (0.4) |
| Undergraduate nurse | 82 | (2.2) | 56 | (0.8) |
| Registered nurses | 1859 | (49.2) | 3480 | (52.7) |
| Physician assistant/Nurse practitioner | 18 | (0.5) | 52 | (0.8) |
| Resident physician/Physician in training | 154 | (4.1) | 58 | (0.9) |
| Medical specialist | 309 | (8.2) | 358 | (5.4) |
| Pharmacist | 9 | (0.2) | 12 | (0.2) |
| Department assistant/Clerk/Secretary | 121 | (3.2) | 401 | (6.1) |
| Physical/Occupational/Speech therapist | 29 | (0.8) | 122 | (1.8) |
| Analyst | 48 | (1.3) | 219 | (3.3) |
| Radiotherapeutic analyst | 23 | (0.6) | 24 | (0.4) |
| Technician (e.g. lab, radiology) | 3 | (0.1) | 114 | (1.7) |
| Management | 120 | (3.2) | 105 | (1.6) |
| Other ^a | 799 | (21.1) | 1440 | (21.8) |
| Unknown | 198 | (5.2) | 140 | (2.1) |
| <i>Total</i> | <i>3779</i> | <i>(100)</i> | <i>6605</i> | <i>(100)</i> |
| Work experience in years | | | | |
| <1* | 442 | (11.9) | 444 | (6.9) |
| 1–5* | 1474 | (39.5) | 2173 | (33.7) |
| 6–10* | 789 | (21.2) | 1237 | (19.2) |
| 11–15* | 389 | (10.7) | 1129 | (17.5) |
| 16–20 | 316 | (8.5) | 523 | (8.1) |
| >20* | 310 | (8.3) | 947 | (14.7) |
| Hospital type | | | | |
| Teaching | 20 | (44.4) | 8 | (33.3) |
| Non-teaching | 25 | (55.6) | 16 | (66.7) |

* $P < 0.05$.

^aPredominantly specialized nurses.

Figure 1 Outcome measures of the HSOPS: self-reported patient safety grade (left side) and number of reported incidents (right side) before and after the PSP.

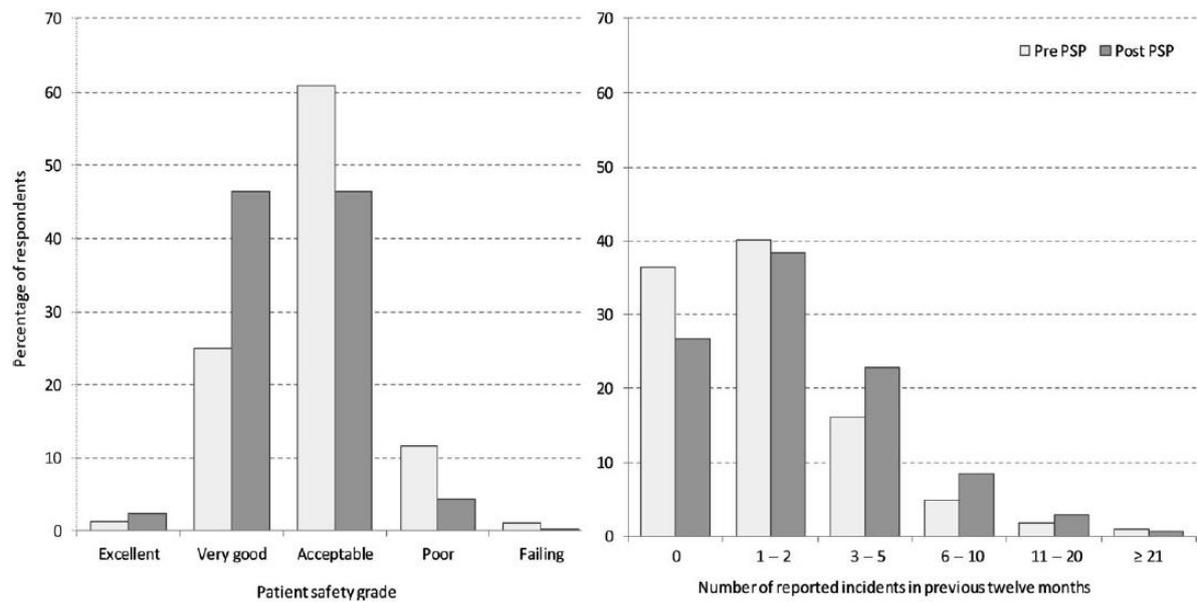


Table 2 Differences in average dimension scores before and after the PSP, corrected for respondents' profession, years of work experience on department and working hours per week

| Dimension | Pre-PSP N = 3,779 Mean | Post-PSP N = 6,605 Mean | Chi ² |
|----------------------------------------------------------------|------------------------------|-------------------------------|------------------|
| Teamwork across departments*** | 2.87 | 3.11 | 39.4 |
| Teamwork within department*** | 3.90 | 3.99 | 15.0 |
| Hospital handoffs and transitions*** | 3.46 | 3.61 | 26.9 |
| Frequency of event reporting*** | 3.05 | 3.33 | 40.3 |
| Non-punitive response to error* | 3.63 | 3.72 | 5.4 |
| Communication openness* | 3.76 | 3.83 | 4.9 |
| Feedback and learning from errors*** | 3.37 | 3.58 | 25.7 |
| Supervisor/manager expectations and actions promoting safety** | 3.51 | 3.60 | 8.1 |
| Hospital management support for patient safety*** | 3.00 | 3.38 | 44.2 |
| Adequate staffing | 3.51 | 3.53 | 0.1 |
| Overall perception of patient safety*** | 3.33 | 3.52 | 18.1 |

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Table 3 Between department, hospital and total (department + hospital) variances before and after the PSP corrected for respondents' profession, years of work experience on department and working hours per week

| Dimension | Department level | | Hospital level | | Total variance | |
|---------------------------------------------|--------------------------|---------------------------|----------------------------|----------------------------|---------------------|----------------------|
| | Pre-PSP Variance (SE) | Post-PSP Variance (SE) | Pre-PSP Variance (SE) | Post-PSP Variance (SE) | Pre-PSP Variance | Post-PSP Variance |
| Teamwork across departments | 0.014 (0.004) | 0.021 (0.003) | 0.010 (0.004) | 0.017 (0.006) | 0.025 | 0.038 |
| Teamwork within department | 0.026 (0.004) | 0.033 (0.004) | 0.001 (0.002) | 0.002 (0.002) | 0.027 | 0.035 |
| Hospital handoffs and transitions | 0.037 (0.007) | 0.032 (0.004) | – (–) | 0.004 [¶] (0.003) | 0.037 | 0.036 |
| Frequency of event reporting | 0.120* (0.019) | 0.071* (0.009) | 0.006 (0.009) | 0.010 (0.005) | 0.125* | 0.081* |
| Non-punitive response to error | 0.023* (0.005) | 0.038* (0.005) | 0.014 (0.006) | 0.009 (0.004) | 0.037 | 0.046 |
| Communication openness | 0.018* (0.004) | 0.031* (0.004) | 0.005 (0.003) | 0.004 (0.002) | 0.023 [¶] | 0.035 [¶] |
| Feedback and learning from errors | 0.068 (0.011) | 0.060 (0.006) | 0.016 (0.009) | 0.010 (0.005) | 0.085 | 0.070 |
| Supervisor/manager expectations and actions | 0.043* (0.007) | 0.078* (0.008) | – (–) | 0.008 [¶] (0.004) | 0.043* | 0.086* |
| Hospital management support | 0.037 (0.007) | 0.044 (0.005) | 0.018 [¶] (0.008) | 0.047 [¶] (0.016) | 0.054 [¶] | 0.091 [¶] |
| Adequate staffing | 0.166 (0.022) | 0.184 (0.016) | 0.009 (0.012) | 0.021 (0.011) | 0.175 | 0.205 |
| Overall perceptions of patient safety | 0.055 (0.009) | 0.0689 (0.007) | 0.023 (0.010) | 0.009 (0.005) | 0.077 | 0.078 |

* $P < 0.05$; [¶] $0.05 \leq P < 0.10$.

Table 4 Relative influence of hospitals on patient safety culture dimension score (% of total variance attributable to between-hospital differences) before and after the PSP

| Dimension | Pre-PSP | Post-PSP |
|--------------------------------------------------------------|-------------------|-------------------|
| Teamwork across departments | 37.8 | 40.7 |
| Teamwork within department | 37.1 | 43.9 |
| Hospital handoffs and transitions | | 53.9 ^a |
| Frequency of event reporting | 37.4 ^a | 62.7 ^a |
| Non-punitive response to error | 61.6 ^a | 37.4 ^a |
| Communication openness | 53.7 ^a | 37.7 ^a |
| Feedback and learning from errors | 61.8 | 53.2 |
| Supervisor/manager expectations and actions promoting safety | | 35.7 ^a |
| Hospital management support for patient safety | 27.2 ^a | 45.5 ^a |
| Adequate staffing | 29.5 ^a | 47.4 ^a |
| Overall perception of patient safety | 70.9 ^a | 44.3 ^a |

^aRelevant change >10%.