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Evaluation of the association between Nursing Home Survey on Patient Safety culture (NHSOPS) measures and catheter-associated urinary tract infections: results of a national collaborative

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Abstract

Background—Recent efforts to reduce patient infection rates emphasise the importance of safety culture. However, little evidence exists linking measures of safety culture and infection rates, in part because of the difficulty of collecting both safety culture and infection data from a large number of nursing homes.

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Objective—To examine the association between nursing home safety culture, measured with the Nursing Home Survey on Patient Safety Culture (NHSOPS), and catheter-associated urinary tract infection rates (CAUTI) using data from a recent national collaborative for preventing healthcare-associated infections in nursing homes.

Methods—In this prospective cohort study of nursing homes, facility staff completed the NHSOPS at intervention start and 11 months later. National Healthcare Safety Network-defined CAUTI rates were collected monthly for 1 year. Negative binomial models examined CAUTI rates as a function of both initial and time-varying facility-aggregated NHSOPS components, adjusted for facility characteristics.

Results—Staff from 196 participating nursing homes completed the NHSOPS and reported CAUTI rates monthly. Nursing homes saw a 52% reduction in CAUTI rates over the intervention period. Seven of 13 NHSOPS measures saw improvements, with the largest improvements for ‘Management Support for Resident Safety’ (3.7 percentage point increase in facility-level per cent positive response, on average) and ‘Communication Openness’ (2.5 percentage points). However, these increases were statistically insignificant, and multivariate models did not find significant association between CAUTI rates and initial or over-time NHSOPS domains.

Conclusions—This large national collaborative of nursing homes saw declining CAUTI rates as well as improvements in several NHSOPS domains. However, no association was found between initial or over-time NHSOPS scores and CAUTI rates.

Introduction

Approximately two million healthcare-associated infections (HAI) occur among nursing home residents every year,¹² leading to hospitalisations for nearly one-quarter of nursing home residents.³ Urinary tract infections remain the most common HAI in nursing home residents, occurring at significantly higher rates among the 5%–10% of residents with indwelling urinary catheters,^{4–10} and at significant morbidity and cost, with up to 50% of sepsis episodes and 30% of hospital readmissions among nursing home residents originating from urinary tract infections.¹¹ As such, reducing catheter-associated urinary tract infections (CAUTI) has become a top priority, prompting a recent large national collaborative engaging nursing home teams to improve both general and CAUTI-specific infection prevention strategies, known as the ‘AHRQ Safety Program for Long-term Care: HAIs/CAUTI’.¹²¹³

Successful efforts to reduce HAI rates, including CAUTI, are theorised to require improvement in two different aspects of care: ‘socio-adaptive’ components, including staff and leadership habits, willingness to change and teamwork; and ‘technical’ components, including infection prevention education that emphasises foundational principles and use of evidence-based checklists for catheter insertion and maintenance.¹⁴¹⁵ Facility ‘safety culture’ is identified by organisation-wide aggregated attitudes, expectations and behaviours relating to safety within a facility,^{16–21} which can improve both technical and socioadaptive aspects of care. Efforts to reduce infections often target improvement in safety culture, as implementation of effective strategies requires changes in healthcare worker practices such as avoiding unnecessary catheter placement and optimising meticulous catheter care, which may be facilitated by broader facility attitudes and expectations.¹³²²

Literature on nursing home safety culture is emerging,^{23–25} and is noteworthy given common adverse events and a vulnerable, medically complex population.²⁶ Compared with hospitals, nursing homes have reported significantly lower safety culture scores.^{27–29} Nursing home barriers to strong safety culture include a tough regulatory environment and punitive medication error policies,^{30,31} tight budgets, unease with discussing and reporting errors, and a general environment of fear and distrust.^{26,32–34} Recent work supports a need to operationalise, measure and improve safety culture in nursing homes,^{24,26,35} and has found association between strong safety culture and lower nursing home fall rates.³⁶ However, studies have yet to empirically examine associations between safety culture and infection outcomes.

Using CAUTI as an example, we address this gap by combining safety culture and clinical outcome data from the recently completed Agency for Healthcare Research and Quality (AHRQ) Safety Program for Long-term Care: Preventing CAUTI and Other HAIs.^{12,13} Specifically, we examined the relationships between facility-level reports of safety culture, as measured by the AHRQ-developed Nursing Home Survey on Patient Safety Culture (NHSOPS) instrument, and CAUTI rates both prior to the delivery of prevention interventions and over time. This study tests the hypothesis that nursing homes with higher initial safety culture or larger improvements in safety culture as measured by NHSOPS have greater success in implementing the technical and socioadaptive interventions, enabling larger decreases in CAUTI rates over the course of the collaborative.

Methods

Design and intervention

This collaborative was a prospective cohort study wherein nursing homes implemented interventions to reduce HAIs overall, with a focus on CAUTI. Details on the collaborative goals, methods for recruiting and survey collection have been published elsewhere.¹³ The collaborative included both technical and socioadaptive intervention components designed to enhance safety culture and reduce CAUTI. The technical components emphasised professional development in catheter utilisation, catheter care and maintenance, and antimicrobial stewardship. Socioadaptive components focused on enhancing the process, structure and practice of infection prevention through leadership engagement, empowering staff to implement change and promoting effective team communication for supporting and implementing infection prevention activities. Improved safety culture was a target of socioadaptive intervention components. Socioadaptive components were also designed to facilitate implementation of technical components.

Nursing home staff reported their perceptions of facility safety culture using the NHSOPS both prior to intervention start and at a follow-up date approximately 11 months later. Staff-level NHSOPS responses were aggregated to assess facility-level safety culture at nursing homes in the collaborative.^{29,37,38} Nursing home CAUTI rates were tracked monthly. This project was reviewed by the University of Michigan Institutional Review Board and determined to be non-regulated research.

Study participants and data sources

Analyses include all participating community-based facilities from the first four cohorts of the collaborative. Data were collected between June 2014 and June 2016. Cohort entry was rolling during this period. Cohorts 1–3 had a 12-month intervention phase. Cohort 4 had a compressed timetable of 10 months. Our analyses use three different sources of data: nursing home-level responses to the NHSOPS, generated from aggregated staff responses; monthly CAUTI rates reported to the collaborative; and nursing home facility characteristic data from the Centers for Medicare and Medicaid Services' (CMS) Certification and Survey Provider Enhanced Reporting (CASPER) database in 2012 or 2013. Inclusion in analyses required nursing homes to have (1) not dropped from study participation; (2) at least two valid CAUTI rate reports; (3) available facility characteristic data from CASPER; and (4) NHSOPS surveys from 10 or more staff members at both study start and follow-up, following NHSOPS guidance to users implemented to protect anonymity.³⁹

Measures

Patient outcome measures—Our primary outcome of interest was monthly facility-level CAUTI rate as measured by the National Healthcare Safety Network, defined as the number of symptomatic CAUTI per 1000 catheter days.^{40–42} Aggregate nursing home-level CAUTI rates were collected monthly over the course of the 12-month (cohorts 1–3) or 10-month (cohort 4) collaborative.

NHSOPS components—The NHSOPS is a survey instrument tailored to assess safety culture among nursing home staff and providers.²⁹³⁷³⁸ NHSOPS was refined using pilot data from 40 nursing homes, and its psychometric properties have been previously reported.⁴³⁴⁴ NHSOPS intended uses include assessing current nursing home patient safety culture, examining over-time trends in safety culture, evaluating the impact of patient safety initiatives and interventions, and comparing culture within and across organisations.³⁹ Prior studies have used NHSOPS to assess patient safety culture across nursing homes²⁹³⁰, compare nursing home safety culture with hospital safety culture³⁰⁴⁵; and examine associations with organisational characteristics⁴⁵ and patient outcomes, including fall rates and pressure ulcers using managerial and staff ratings of safety culture.³⁶⁴⁴⁴⁶

Like its predecessor, the Hospital Survey on Patient Safety Culture (HSOPS),⁴⁷ NHSOPS includes 43 items aligned with 12 dimensions of safety culture, answered using 5-point Likert scale response categories, as well as an overall staff rating of resident safety. NHSOPS was employed in the collaborative rather than other patient safety measures validated for use in long-term care settings, such as the Safety Attitudes Questionnaire,^{2448–53} as it has been more widely used in nursing homes, is available at no cost from AHRQ, and echoes prior experience using HSOPS to examine patient safety culture and relationships with infection rates in acute care collaboratives.²²

The full NHSOPS instrument is included in online supplementary appendix 1. Staff at all participating facilities were encouraged to complete the NHSOPS survey at study start and study end, approximately 11 months (cohorts 1–3) or 8 months (cohort 4) later. Thirteen nursing home facility-level measures were constructed following instructions publicised by

AHRQ and provided to participating facilities³⁹: the percentage of staff responding positively to each of the 12 composite NHSOPS dimensions, and the percentage of staff rating the overall nursing home grade as either 'Very Good' or 'Excellent'. The 12 composite facility-level measures are an average of item-level per cent positive responses received for each dimension. Item-level per cent positive responses are computed by dividing the number of positive responses recorded for each item (eg, *agree* or *strongly agree* for positively worded items; *disagree* or *strongly disagree* for negatively worded items) by the total number of responses that facility received. An example of how these per cent-positive measures were constructed is provided in online supplementary appendix 2. Participating nursing homes received these facility-level composite safety culture scores as part of their performance feedback, which also highlighted for each nursing home their strong safety culture dimensions and those in need of improvement, and provided guidance for developing action plans for improvement.

In line with prior work on HSOPS in the acute care setting,²² our analyses examine associations between the 12 NHSOPS dimensions and the overall facility grade and CAUTI rates. However, six dimensions were hypothesised a priori as most likely to impact shortterm care processes and reduce CAUTI in the nursing home setting: teamwork, training and skills, communication openness, supervisor expectations and organisational learning.

Statistical analyses

CAUTI rates were modelled as a function of nursing home-level NHSOPS scores or grades using negative binomial models to adjust for overdispersion of the outcome. Models adjusted for nursing home bed size and non-profit versus for-profit status. Initial models tested the hypothesis that higher facility-level safety scores were associated with lower CAUTI rates at study start. These models examined the 13 facility-level safety culture and overall grade measures as predictive of initially reported CAUTI rates. Over-time models tested the hypothesis that sites with greater improvements in facility-level safety culture or grade would see larger reductions in CAUTI rates over the course of the study. These models include an interaction between time and safety culture measures. Time was coded in days as a proportion of each nursing home's total time to collaborative completion. As such, corresponding incident rate ratio (IRR) coefficients represent the IRR for the full collaborative period for all facilities. Over-time models are also multilevel to account for clustering of per cent-positive responses within facilities over time. Sensitivity analyses examined the same models for the subset of nursing homes that reported all possible monthly CAUTI rates and had NHSOPS response rates of 50% or higher for both initial and follow-up surveys.

As our interest is in evaluating the overall hypothesis that NHSOPS culture dimensions are associated with change in CAUTI rates, we use a conservative significance testing criteria of $p < 0.01$ for all models to account for the higher likelihood of significant association due to chance given 13 NHSOPS dimensions.⁵⁴ All analyses were performed using Stata/MP V14.1.⁵⁵

Results

Nursing home participant characteristics

Compared with non-participating nursing homes nationwide ($n=14\,652$), nursing homes participating in the collaborative ($n=387$) were slightly larger on average (120.7 vs 107.5 beds; $p<0.001$) and had a significantly higher mean CMS Nursing Home Compare five-star rating (3.51 vs 3.24; $p<0.001$), driven by better staffing and health inspection ratings at participating facilities. Differences in nursing home ownership and patient composition were not significant.¹²

Figure 1 details the analysis-specific inclusion and exclusion criteria, resulting in a final analytic sample of 196 nursing homes for this study specifically. For these 196 nursing homes, the mean bed size was 123.3 (SD=65.5), 129 (65.8%) were for-profit as opposed to non-profit nursing homes, and 182 (93.8%) provided subacute care. Compared with nursing homes participating in the collaborative but not in the analytical sample, there were no significant differences in size ($t=-0.54$, $p=0.59$), ownership ($X^2(2)=3.99$, $p=0.14$), provision of subacute care ($X^2(1)=0.10$, $p=0.98$) or CMS star rating ($t=0.91$, $p=0.36$).

NHSOPS Components

Of 400 facilities with CAUTI outcomes for a minimum of two time points and facility demographic data, 317 (79%) had complete NHSOPS data from 10 or more employees at study start, and 196 facilities (49%) had complete NHSOPS data from 10 or employees at both study start and follow-up. Of these facilities, the median number of staff who completed the initial NHSOPS was 75 (IQR: 54–100) and 62.5 at follow-up (IQR: 43–83.5). Although the national collaborative team set a goal of 60% of nursing home staff submitting the NHSOPS at both baseline and follow-up (in line with accepted survey best practice),⁵⁶⁵⁷ only 46% of nursing homes participating in the collaborative met this goal at baseline, and 24% met it at follow-up.¹² In our analytical sample, 155 nursing homes (79%) had a response rate of at least 60% at study start, and 112 nursing homes (57%) had at least a 60% response rate at follow-up. The median response rate at study start was 67% (IQR: 61%–89%) and 62% at follow-up (IQR: 39%–78%).

Table 1 shows summary statistics for the 13 NHSOPS measures (12 dimensions and overall grade) at both study start and follow-up, and change from study start to follow-up. Six safety culture dimensions and the overall grade increased over time, with increases ranging from 0.2 to 3.7 percentage points. The largest increases were seen in ‘Management Support for Resident Safety’, which increased by 3.7 percentage points on average, and ‘Communication Openness’, which increased by 2.5 points on average. However, none of these increases were significant at the $p<0.01$ level. The remaining six safety culture dimensions saw insignificant decreases from study start to follow-up, ranging from 0.5 to 2.6 percentage points. The largest decreases in facility per cent positive were in ‘Training and Skills’ (2.6 percentage point decline on average) and ‘Compliance with Procedures’ (2.3 percentage point decline on average).

For all dimensions there was large variation across individual nursing homes, showing both large declines and improvements in facility-level ratings over the course of the collaborative.

For example, although ‘Management and Support for Resident Safety’ saw a mean 3.7 percentage point improvement, change scores for specific nursing homes ranged from a decline of 37 percentage points to improvement of 38 percentage points.

Patient outcome measures

Reductions in CAUTI from this intervention have been published elsewhere.¹² Overall, nursing homes across all cohorts saw a 54% decline in CAUTI rates, with unadjusted rates decreasing from 6.78 to 2.63 per 1000 catheter days. Catheter utilisation rates were largely unchanged.¹² Nursing homes included in this analysis saw a 52% reduction in unadjusted CAUTI rate. On average, nursing home in cohorts 1–3 provided 11 monthly CAUTI reports (of 12 possible), while cohort 4 nursing homes provided 9.5 (of 10 possible).

Association between NHSOPS measures and patient outcomes

Multivariable models tested the hypotheses that nursing homes with higher safety culture scores would have lower initial rates of CAUTI, and also would have greater success in implementing the technical and socioadaptive interventions delivered by the collaborative, and thus would see larger decreases in CAUTI rates over the course of the collaborative. Full model results for initial and overtime models examining the association between NHSOPS dimensions and overall grade and CAUTI outcomes, controlling for bed size and ownership, are presented in online supplementary appendices 3–5. Model results for the NHSOPS items of interest were depicted using coefficient plots, which plot the coefficient point estimate for each safety culture domain and overall grade per cent positive and the corresponding 99% CI. Figure 2 shows the coefficient plots for both the initial models and the over-time models. None of the coefficients for either initial or time-varying effects of culture on CAUTI rates were significant at the predefined conservative testing criteria level of $p < 0.01$, indicating no statistically significant associations between NHSOPS dimensions and CAUTI rates.

Sensitivity analyses examined the same models for the set of facilities with complete CAUTI outcome data and initial and follow-up NHSOPS response rates of 50% or higher ($n=104$). These analyses also found no statistically significant associations between initial or over-time NHSOPS dimensions and CAUTI rates.

Discussion

Key results

Recent research has highlighted the potential impact of issues related to safety culture in nursing homes. These concerns have led to efforts to improve nursing home safety culture, including work within this AHRQ-funded nursing home collaborative; however, the impact of safety culture change on clinical outcomes, and particularly HAI, is unknown. This study, which uses data from the AHRQ Safety Program for Long-term Care: HAIs/CAUTI project, allows us to test the hypothesis that higher levels of safety culture are associated with reduced infection rates, and that improvements in safety culture can reduce infection rates.

Although 7 of the 13 safety culture measures saw positive movement over the course of the study, none of these increases were statistically significant. Further, we found no significant

association between facility-level safety culture as assessed by the NHSOPS and CAUTI rates, either initially or in time-varying models examining change over the course of the collaborative. While CAUTI rates fell substantially in the 196 nursing homes included in our analyses, we did not observe large or even unidirectional change in the safety culture measures, and no significant associations between any of the safety culture domains or overall grade and CAUTI rates were observed. Although this project included socioadaptive intervention components designed to improve certain safety culture domains, facility-level per cent positive responses for the 12 safety culture domains and overall safety grade saw little movement on average over the intervention period.

Our results build on findings from two similarly AHRQ-funded hospital collaboratives targeting CAUTI and central-line associated bloodstream infections that found no relationship between safety culture measures measured by the HSOPS and infection rates either initially or over time,²² suggesting that reductions in HAI rates can occur without improvements in safety culture as measured by the NHSOPS or the HSOPS instruments. It follows that in nursing homes, just as in acute care, reduction in CAUTI rates may occur in the absence of large changes in survey-measured safety culture. Both technical and socioadaptive intervention components may facilitate improved adoption of the more technical aspects of infection prevention, such as standardising catheter use and maintenance care, urine culture ordering, and antimicrobial stewardship. These findings also add further heft to prior recommendations that short-term collaboratives aimed at reducing catheter-associated infections can reduce infection rates through interventions (whether socioadaptive or more technical in nature) aimed at standardising catheter care and urinary tract infection diagnosis without necessarily improving safety culture as measured by current instruments, in both acute care and nursing home settings. As this intervention combined socioadaptive and technical intervention components, future work may also aim to better explicate how and whether each type of intervention component affected the process measures of interest. Given findings here, as well as in acute care settings, however, efforts focused on improving technical aspects of infection control (through either technical or socioadaptive interventions) may also be more cost-effective for short-term collaboratives than those focused on safety culture improvement measurable through instruments like the NHSOPS.

An alternative explanation for our findings is that the reduction in CAUTI rates was driven by improvements in safety culture, but that these improvements were not captured by the current NHSOPS instrument, or detection was impeded by study design. Even in better-studied acute care settings, safety culture is difficult to measure, as staff may have limited understanding, exposure to or influence over the aspects of culture that directly influence patient care. This may be particularly salient in nursing home settings, which have been understudied compared with hospitals. Evaluating change in safety culture measures poses an even larger challenge, as evaluations in safety culture may also reflect changes in resources, staffing and/or competing facility priorities.⁵⁸⁵⁹ While the NHSOPS is a validated measure of safety culture,⁴³ and has been used in prior studies to describe patterns in safety culture across nursing homes,²⁹³⁰ or between nursing homes and other settings,⁴⁵ its validity for accurately capturing short-term change due to collaborative or intervention efforts (particularly for HAI reduction) is unclear and may warrant further study.

Given prior scholarship suggesting safety culture may require 3–5 years for observable, measurable change,⁶⁰⁶¹ safety culture improvement may also take longer than our 12-month time frame to reflect in facility-wide reports. The study time frame for this collaborative was determined by considerations related to the expected time necessary for intervention effectiveness, as well as practical considerations related to cost and facility effort. Interventions designed specifically to improve safety culture as measured by current instruments may require longer follow-up periods and/ or better understanding of the temporal dynamics of safety culture change to accurately convey change.

Strengths and limitations

This study has a number of strengths and limitations. The major strength is the scope and novelty of the data, which came from a large national collaborative prospective cohort study of nursing homes implementing evidence-based intervention strategies for improving safety culture and reducing CAUTI rates. Recruited facilities represented 48 states, the District of Columbia and Puerto Rico, and were largely representative of nursing homes nationwide, including substantial variation in size, ownership, quality and provision of care. As such, this study represents one of the first and largest evaluations of safety culture and patient safety outcomes in nursing homes.

Our study also has important limitations. For one, our findings are subject to possible non-response bias. Nearly half of the nursing homes participating in the collaborative did not collect NHSOPS instruments from at least 10 employees at both study start and follow-up and thus were excluded from analyses. Although the nursing homes in the analytical sample were not significantly different from excluded nursing homes with respect to size, ownership, CMS star rating or care provision, it is possible that excluded facilities exhibited different associations between safety culture as measured by the NHSOPS and CAUTI rates.

Further, even within the analytical subset, one-fifth of nursing homes at study start and nearly one-half at follow-up failed to meet the collaborative goal of a 60% response rate. Response rates at nursing homes excluded from the analytical sample were even lower. Although the response rates in this collaborative are not markedly lower than those seen in acute care collaboratives,²² they remain lower than those seen in prior studies using instruments such as the Safety Attitudes Questionnaire.⁴⁸⁶² Continued low response rates in national collaboratives, particularly given significant investment of resources for evaluating safety culture with the NHSOPS instrument and tying this evaluation to major project goals, raise questions about the feasibility and utility of the NHSOPS and related tools in evaluating success of large-scale, patient safety-focused collaboratives. While NHSOPS provides guidance for improving response rates in survey administration,⁶³ and these instructions were followed by collaborative organisational leads, real-world data collection efforts in this nationwide collaborative involving a diverse set of hundreds of nursing homes may not reflect ideal standards. Significant variability was seen in response rates across cohorts, with the percentage of cohort facilities achieving the benchmark 60% response rate at study start varying across cohorts from 28% to 79%. Future collaboratives interested in ensuring valid and reliable measurement of change in safety culture may consider exploring organisational predictors of culture survey response rates and/or collecting process measures

to reflect variation in application of NHSOPS 'best practices' across facilities to inform improvement of this type of data collection. Future collaborative efforts to evaluate safety culture should include qualitative data collection efforts to understand staff perceptions of the relevant safety culture instruments in the context of interventions designed to improve safety culture reports.

A further limitation is that the only unit for aggregation was the nursing home facility level. While use of facility-level aggregation is in line with AHRQ design intentions for the NHSOPS⁶⁴ and prior literature examining the NHSOPS,²⁹³⁶⁴⁵ it is possible that safety culture in nursing homes operates meaningfully at a smaller level that was not captured by our analyses.

Conclusions

Results from analyses of a national collaborative aimed at improving CAUTI and other HAI rates in nursing homes found small improvements in several NHSOPS safety culture domains as a result of participating in the collaborative, but no relationship between facility-level safety culture ratings and CAUTI rates, or improvements in CAUTI over the course of the collaborative. These findings suggest that reductions in nursing home patient infection rates can be achieved without measurable improvements in safety culture reports. These findings further strengthen calls to prioritise interventions that focus on improvement of the technical aspects of infection control, such as standardising protocols for catheter insertion, removal and maintenance, through a combination of technical and socioadaptive interventions. Collaboratives or quality improvement initiatives interested in improving safety culture may need to investigate other methods for evaluating change in safety culture beyond existing instruments and may need to explore whether additional processes or resources are necessary to attain acceptable levels of response to ensure valid and reliable comparisons.

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Figure 1.
Study flow diagram. NHSOPS, Nursing Home Survey on Patient Safety Culture; OSCAR, Online Survey, Certification and Reporting.

Figure 2.

Do facility-level NHSOPS predict catheter-associated urinary tract infection rates?

Coefficient plots for both initial and time-varying models in analytic sample. Incidence rate ratios and their 99% CIs are given in the coefficient plots for all NHSOPS domains and overall grade. CIs that cross the vertical line at the value of 1 indicate non-significant findings. In addition to the culture domains of interest shown below, models also adjusted for hospital ownership and bed size. For detailed model results, see online supplementary appendices 3–5. NHSOPS, Nursing Home Survey on Patient Safety Culture

Table 1

How much change do we see between initial and follow-up NHSOPS scores across facilities? NHSOPS dimension score summary for analytic sample (n=196), mean (SD) (range)

NHSOPS dimension	Study start	Follow-up	Change score
Teamwork	68 (15) (29, 100)	69 (16) (23, 100)	1.0 (13) (-31, 37)
Staffing	52 (14) (17, 96)	52 (17) (13, 99)	-0.5 (16) (-45, 49)
Compliance with procedures	65 (11) (34, 91)	62 (19) (3, 100)	-2.3 (18) (-60, 37)
Training and skills	72 (12) (36, 97)	69 (20) (2, 100)	-2.6 (20) (-95, 32)
Nonpunitive response to mistakes	54 (14) (25, 96)	53 (20) (2, 100)	-1.0 (20) (-94, 39)
Handoffs	61 (14) (25, 94)	62 (16) (24, 99)	0.5 (14) (-27, 49)
Feedback and communication about incidents	83 (9) (38, 100)	83 (12) (40, 100)	0.2 (10) (-41, 37)
Communication openness	55 (16) (23, 99)	58 (18) (21, 100)	2.5 (14) (-50, 42)
Supervisor expectations and actions promoting resident safety	79 (11) (25, 100)	81 (12) (40, 100)	1.3 (11) (-49, 46)
Overall perceptions of resident safety	87 (10) (46, 100)	86 (12) (43, 100)	-0.9 (10) (-46, 22)
Management support for resident safety	69 (15) (11, 100)	72 (17) (32, 100)	3.7 (13) (-37, 38)
Organisational learning	70 (13) (25, 98)	68 (16) (15, 100)	-1.8 (14) (-65, 29)
Overall grade	64 (18) (15, 100)	67 (19) (15, 100)	2.1 (16) (-39, 46)

Study start and follow-up scores represent the per cent of positive responses for all items in the domain at study start and follow-up time points. NHSOPS change scores are computed as the change in per cent positive responses for all items within each dimension from study start to the follow-up survey period (approximately 11 months later). Values greater than 0 represent an increase in per cent positive responses, while values less than 0 represent a decrease in per cent positive responses.

Note: No changes were significant at $p < 0.01$ level.

NHSOPS, Nursing Home Survey on Patient Safety Culture. SD, standard deviation