



## Impact of educational intervention among nurses on implementation of surgical safety checklist at a tertiary care teaching institute

<sup>1</sup>Shomin Dhiman, <sup>2</sup>Shweta Talati, <sup>3</sup>Lileswar Kaman and <sup>4</sup>Anil Kumar Gupta

<sup>1</sup>Department of Hospital Administration, PGIMER, Chandigarh, India

<sup>2</sup>Department of Hospital Administration, PGIMER, Chandigarh, India

<sup>3</sup>Department of General Surgery, PGIMER, Chandigarh, India

<sup>4</sup>Ex-Head, Department of Hospital Administration, PGIMER, Chandigarh, India

**Corresponding Author:** Shweta Talati

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### Abstract

**Background:** With increasing volumes of surgery, ensuring patient safety as well as quality of surgical care is of utmost importance. Surgical Safety Checklist (SSC) has been conceptualized for preventing major surgical catastrophe. Nursing staff are involved at all stages of surgical care.

**Objectives:** To assess the impact of educational intervention among nurses on implementation of Surgical Safety Checklist in Main Operation Theatre Complex of our Institute.

**Methods:** A Prospective, Interventional study was conducted at the Main Operation Theatre complex (MOT) of our Institute. Entire population of nurses posted in the Main OT Complex of the hospital were invited to participate in this study. Baseline data was collected after which intervention in the form of educational lecture supported with power point presentation and audio-visual information was given to the nursing staff. During post intervention, Observational audit (phase-1) and note review (phase-2) was done.

**Results:** Total 71 surgical safety checklists were observed during pre-intervention and post-intervention phase 1 & phase 2. The percentage of completed items in the 32-item checklist increased from 32.09% to 79.66% in Post 1 and 58.19% in Post 2 phases. Out of the total possible score of 32 in checklist, mean scores of 10.27, 25.49 & 18.62 were observed in Pre-intervention, Post 1 and Post 2 phases respectively. There was a statistically significant increase in the mean score of Post 1 as compared to Pre-intervention phase by 15.225 ( $p < 0.001$ ) and Post 2 phase as compared to Pre-intervention phase by 8.352 ( $p < 0.001$ ).

**Conclusion:** This study re-establishes the important role of continued education and training in successful implementation of SSC in OTs.

**Keywords:** Surgical safety checklist, nurses education and training, patient safety, operation theatres

### Introduction

Surgery is associated with preoperative and post-operative complications which sometimes might prove fatal. Almost 7 million people suffer notable surgical complications each year globally and a million among these, lose their lives during or immediately after the surgery [1-3]. Major surgery is associated with 5-10% mortality in developing world. The rate of the mortality during general anaesthesia is reported to be as high as 1 in 150 in parts of Sub Saharan Africa. Nearly half of these adverse events are determined to be preventable [4-6]. With increasing volume of surgical procedures in healthcare environment, patient safety as well as quality in surgical care is of utmost importance [7-8]. Nearly one in ten, in-hospital patients experience iatrogenic events and more than half of them occur in perioperative care [9]. Surgical Safety, therefore, has emerged as a significant global public health concern. As a consequence, Surgical Safety Checklist (SSC) has been conceptualized for preventing major surgical catastrophe.

World Health Organization (WHO) introduced Surgical Safety Checklist under its flagship programme; "Safe Surgery Saves Lives", in 2009 [10]. Surgical Safety checklist is a set of 19-points Do's, which are to be filled up on the checklist from at three stages which are also the critical junctures in any surgical procedure i.e. before the induction of anaesthesia ("Sign-In"-), before making the first incision ("time-Out"-) and before the leading surgeon leaves the operation theatre ("Sign-Out"-) [11]. Introduction and sustaining the use of SSC is not easy [12].

Effective education and formation of a core team/task force/local team at facility level to facilitate implementation is one of the strategies. Nursing staff is involved during all stages of surgical care. They form the important pillar of the surgical team worldwide. Theatre sisters are key managers about the various issues pertaining to OT management and patient's safety. If motivated to start a new tool during surgery, they can act a driving force to motivate and encourage rest of the team members for complete

compliance of surgical safety check list in a sustainable way.

### Objectives

The present study was done to assess the impact of educational intervention among staff nurses on implementation of surgical safety checklist in Main Operation Theatre (MOT) Complex of the Institute.

### Methodology

This prospective, interventional study was conducted from July 2016 to June 2017 in the Main Operation theatre complex of our Institute with an aim to assess the compliance of SSC among nurses in MOT complex of hospital before and after educational intervention. Approval for study was given by the institute ethics committee.

### Pre-Intervention phase

The Pre-intervention period was utilized for baseline data collection of all the 16 Operating rooms in MOT complex. As the entire population of nurses posted in the Main OT Complex of the hospital were invited to participate in this study, no sampling was required. Out of total 98 nurses posted in the study area 95 consented to participated in the study. A Circulating Nurse in the OT was supposed to fill the Surgical Safety Checklist. As it was a single observer study a random selected sample by lottery system of the OT Table was taken. Each OT Table was observed for two days, not on consecutive days. The researcher visited the randomly selected OTs and observed the existing practice of filling /compliance of the SSC. The parameters of Surgical Safety Checklist of all the surgeries in MOT Complex of the hospital, of all the sixteen operating tables were analyzed.

### Exclusion criteria

#### The following nurses were excluded:

- Who did not give consent to participate
- Who proceeded on leave during the study duration and were not present at any one of the pre-intervention, intervention or post-intervention phases.

### Intervention Phase

An Interventional tool in the form of educational lecture of one hour duration was devised which included power point presentation and audio-visual information. Existing literature and material were used for the purpose. The power point presentation and lecture content (concepts, principals, role of circulating nurse in filling the checklist, video clip of Do's and Don'ts of SSC) were vetted by the experts in the field i.e. Surgeons, Hospital Administrators etc. 20 training sessions over a period of 20 days were conducted for the nurses posted in MOT complex.

### Post-Intervention Phase

During post-intervention, the implementation of checklist was monitored in two groups of 8 OT tables each. Data of one set of 8 OT tables was collected in the physical presence of observer (Hawthorne Effect) for the period of three days

(not on consecutive days) which was considered as Post-intervention Phase 1 (Post 1). Data of another set of 8 OT tables was collected in the physical absence of observer (Note review) for the period of three days (not on consecutive days) was considered as Post-Intervention Phase 2 (Post2).

The percent compliance of surgical safety check was calculated as follows:

$(\text{No of times all three phases of the surgical safety checklist was performed} / \text{Total surgeries}) \times 100 = \% \text{ compliance}$

The surgical safety checklist was considered "performed" when the designated checklist coordinator (circulating nurse) confirms that surgical team members had implemented and/or addressed all of the necessary tasks and items in each of the three phases: Sign In; Time Out; and Sign Out<sup>[13]</sup>.

### Data Analysis

Descriptive Statistics was used to display the compliance and completeness of the Surgical Safety Checklist. The statistical analysis was carried out using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 20 for windows).

Normality of data was checked using Kolmogorov Smirnov test. One way ANOVA followed by post-hoc test/Turkey HSD were used as the test of significance. Chi-square test was used to analyze qualitative data. The p-value of < 0.05 had been taken to be statistically significant.

### Results

The present study evaluated the impact of an educational intervention amongst nurses on implementation of Surgical Safety Checklist. The data was collected for 16 operation tables in MOT complex of the hospital. The response scores to all the 32 items to the checklist and to various parts of the Checklist viz. Sign In (13), Time Out (14) and Sign Out (5) were analyzed in all the three phases of study i.e. Pre-intervention phase (Pre), Post-intervention phase 1 in the physical presence of observer (Post1) and Post-intervention phase 2 in the physical absence of observer (Post 2). These have been tabulated in Table 1.

Total 213 surgical safety checklists were observed during the study period. Out of which 71 surgical safety checklists were observed each during Pre, Post1 and Post2 intervention period.

### Overall Compliance score of implementation of SSC

Out of the total possible score of 32 in checklist, mean scores of 10.27, 25.49 & 18.62 were observed in Pre-intervention, Post-intervention phase 1 and Post-intervention phase 2 respectively. There was a statistically significant increase in the mean score of Post-intervention phase 1 by 15.225 (P=0.000) and Post-intervention phase 2 phase by 8.352 (P=0.000) as compared to Pre-intervention phase. The effect of intervention on nurses' overall compliance to the SSC was found to be statistically significant [P=0.000]. Table-1

**Table 1:** Compliance score to various parts of the checklist, pre-intervention & post-intervention (post 1-physical presence of observer; post 2-no physical presence of observer)

Part of Checklist (No of Items)	Phase	Max. Possible Score	Mean (M)	Standard Deviation (SD)	Compliance Percentage (%)	ANOVA		Difference of Means In Post1-Pre	T	P-Value	Difference of Means in Post 2-Pre	T	P-Value	Difference of Means In Post 2-Post1	T	P-Value
						F	P-Value									
Sign In (13)	Pre	13	5.82	3.654	44.76	27.347	0.000	4.437	-7.481	0.000	2.099	-3.419	0.002	-2.338	3.939	0.000
	Post-1		10.25	3.409	78.84											
	Post-2		7.92	3.660	60.92											
Time Out (14)	Pre	14	3.80	4.810	27.14	53.800	0.000	7.972	-11.807	0.000	4.310	-4.951	0.000	-3.662	4.884	0.000
	Post-1		11.77	3.039	84.07											
	Post-2		8.11	5.538	57.93											
Sign Out (5)	Pre	5	0.65	1.135	13.00	59.048	0.000	2.817	-11.585	0.000	1.944	-7.644	0.000	-0.873	2.952	0.003
	Post-1		3.46	1.706	69.29											
	Post-2		2.59	1.817	51.80											
Total (32)	Pre	32	10.27	8.337	32.09	57.002	0.000	15.225	-11.598	0.000	8.352	-5.489	0.000	-6.873	4.765	0.003
	Post-1		25.49	7.270	79.65											
	Post-2		18.62	9.740	58.18											

**Compliance score in “Sign In” component**

Out of the maximum possible score of 13 in the "Sign In" part of checklist, mean scores of 5.82, 10.25 & 7.92 were observed during Pre-intervention, Post-intervention phase 1 and Post-intervention phase 2 respectively. There was a statistically significant increase in the mean score of Post-intervention phase 1 by 4.437 (T=-7.481, P=0.000) and Post-intervention phase 2 by 2.099 (T=-3.41, P=0.002) as compared to Pre-intervention phase. However, a statistically significant drop in the post intervention mean score by a value of 2.338 was evident from Post-intervention phase 1 to Post-intervention phase 2 (T=3.939, P=0.000). There was a significant effect of intervention on nurses’ compliance to

“Sign In” component of the SSC [F (2, 210) = 27.347, P=0.000].

Post hoc comparisons using the Tukey HSD test further confirmed that for the Sign In part of the Checklist, the mean score for Pre-Intervention (M=5.82, SD = 3.654) was significantly different than Post-intervention phase 1 (M=10.25, SD=3.409) [P=0.000] & Post-intervention phase 2. (M=7.92, SD = 3.660) [P=0.002]. Similarly, mean score for Post-intervention phase 1 was also significantly different than that of Post-intervention phase 2 [P=0.000].

The response score to individual items of “Sign In” part in the Pre, Post 1 and Post 2 intervention is shown in Table 2.

**Table 2:** Comparison of response score to individual items of “Sign In” part in Pre, Post 1 & Post 2 Intervention phases

Sr. No	Items	Max. Possible Score	Pre-Intervention %	Post 1 %	Post 2 %	Pre-Intervention & Post 1		Pre-intervention & Post 2		Post 2 & Post 1				
						χ <sup>2</sup>	P-Value	χ <sup>2</sup>	P-Value	χ <sup>2</sup>	P-Value			
						1.	Patient Identity	71	71	100	71	100	70	98.6
2.	Site & Side	71	21	29.6	68	95.8	40	56.3	66.50	0.000	10.38	0.001	30.32	0.000
3.	Procedure	71	18	25.4	56	78.9	70	98.6	40.75	0.000	80.80	0.000	13.81	0.000
4.	Written Consent	71	59	83.1	69	97.2	67	94.4	7.92	0.005	4.51	0.034	0.69	0.404
5.	Weather resuscitation Fluid available?	71	12	16.9	43	60.6	27	38.0	28.52	0.000	7.95	0.005	7.21	0.007
6.	Anaesthesia machine & drugs	71	36	50.7	52	73.2	45	63.4	7.65	0.006	2.33	0.127	1.59	0.207
7.	Pre medication& other medications	71	19	26.8	63	88.7	45	63.4	55.88	0.000	19.23	0.000	12.53	0.000
8.	Pre-operative monitors functioning and attached	71	13	18.3	53	74.6	40	56.3	45.30	0.000	21.95	0.000	5.27	0.022
9.	Does the patient have a known allergy?	71	37	52.1	58	81.7	39	54.9	14.03	0.000	0.11	0.736	11.74	0.001
10.	Airway or Aspiration risk	71	23	32.4	48	67.6	25	35.2	17.61	0.000	0.13	0.723	14.91	0.000
11.	Is the site marked?	71	37	52.1	49	69.0	35	49.3	4.25	0.039	0.11	0.737	5.71	0.017
12.	Risk or loss of 10% or more blood volume?	71	37	52.1	49	69.0	32	45.1	4.25	0.039	0.71	0.401	8.31	0.004
13.	I/V access, central line, fluids planned	71	30	42.3	49	69.0	27	38.0	10.30	0.001	0.26	0.608	13.70	0.000

**Compliance score in “Time Out” component**

In the Time Out component of the checklist, there were 14 points and hence a maximum score of 14 was possible. Mean scores of 3.80, 11.77 & 8.11 were observed in Pre-intervention, Post-intervention phase 1 and Post-intervention phase 2 respectively.

A statistically significant increase by 7.972 in the mean score of Post-intervention phase 1 (P=0.000) and by 4.310 in the Post-intervention phase 2 (P=0.000) as compared to Pre-intervention phase was observed. A statistical significant difference in the Post-intervention mean score by a value of -3.662 was evident from Post-intervention phase 2 to Post-intervention phase 1 phase (P=0.000). The effect

of intervention on nurses’ compliance to “Time Out” component of the SSC was found to be statistically significant (P=0.000).

Post hoc comparisons using the Turkey HSD test further confirmed that for the Time Out part of the Checklist, the mean scores for the Pre-Intervention was significantly different than Post-intervention phase 1 (P=0.000) & Post-intervention phase 2 (P=0.000). Similarly, mean score for Post-intervention phase 1 was also significantly different than that of Post-intervention phase 2 (P=0.000) [Table 3].

The response score to individual items of “Time Out” part in the Pre, Post 1 and Post 2 intervention is shown in Table 3.

**Table 3:** Comparison of response score to individual items of “Time Out” part in Pre, Post 1 & Post 2 Intervention phases

Sr. No	Items	Max. Possible Score	Pre-Intervention	%	Post 1	%	Post 2	%	Pre-Intervention & Post 1		Pre-intervention & Post 2		Post 2 & Post 1	
									$\chi^2$	P-Value	$\chi^2$	P-Value	$\chi^2$	P-Value
1.	All the team members have introduce themselves	71	26	36.6	70	98.6	48	67.6	62.25	0.000	13.66	0.000	24.27	0.000
2.	The team confirmed the patient name	71	25	35.2	70	98.6	48	67.6	64.40	0.000	14.91	0.000	24.27	0.000
3.	Procedure	71	27	38.0	70	98.6	46	64.8	60.15	0.000	10.18	0.001	27.12	0.000
4.	Incision Site	71	23	32.4	70	98.6	41	57.7	68.83	0.000	9.22	0.002	34.71	0.000
5.	Has sterility been confirmed	71	30	42.3	68	95.8	49	69.0	47.55	0.000	10.30	0.001	17.53	0.000
6.	Are there any equipment issue or any concern	71	26	36.6	67	94.4	49	69.0	52.38	0.000	14.95	0.000	15.26	0.000
7.	Sensitivity to prophylactic antibiotic checked previous night	71	21	29.6	58	81.7	41	57.7	39.06	0.000	11.45	0.001	9.64	0.002
8.	Has the antibiotic prophylactic been given within last 30 min.	71	21	29.6	58	81.7	41	57.7	39.06	0.000	11.45	0.001	9.64	0.002
9.	Are there any patient specific concern? ....	71	9	12.7	56	78.9	31	43.7	62.67	0.000	16.85	0.000	18.55	0.000
10.	What are the critical or nor routine steps?	71	17	23.9	57	80.3	44	62.0	45.15	0.000	20.95	0.000	5.80	0.016
11.	How long will the case take?	71	24	33.8	57	80.3	45	63.4	31.30	0.000	12.43	0.000	5.01	0.025
12.	What is the anticipated blood loss?	71	20	28.2	47	66.2	39	54.9	20.60	0.000	10.47	0.001	1.89	0.170
13.	Is X-ray/ CT Scan/ MRI displayed?	71	1	1.4	47	66.2	33	46.5	66.59	0.000	39.60	0.000	5.61	0.018
14.	Is all the intra operative equipment required available?	71	0	0	41	57.7	21	29.6	57.64	0.000	24.65	0.000	11.45	0.001

**Compliance score in “Sign Out” component**

Out of the maximum possible score of 5 in the Sign Out part of checklist, mean scores of 0.65, 3.46 & 2.59 were observed in Pre-intervention, Post-intervention phase 1 and Post-intervention phase 2 phases respectively.

The increase in the mean score by 2.817 in Post-intervention phase 1 (P=0.000) and by 1.944 in Post-intervention phase 2 (P=0.000) as compared to Pre-intervention phase was found to be statistically significant.

A statistical significant difference in the post intervention mean score by a value of -0.873 was observed from Post-intervention phase 2 to Post-intervention phase 1 (P=0.003).

A statistically significant effect of intervention on nurses compliance to “Sign Out” component of the SSC has been observed (P=0.000).

Post hoc comparisons using the Tukey HSD test further confirmed that for the Sign Out part of the Checklist, the mean scores for the pre-intervention was significantly different than Post-intervention phase 1 (P=0.000) & Post-intervention phase 2 (P=0.000). Similarly, mean score for Post-intervention phase 1 was also significantly different than that of Post-intervention phase 2 (P=0.000) [Table 4].

The response score to individual items of “Time Out” part in the Pre, Post 1 and Post 2 intervention is shown in table 4

**Table 4:** Comparison of response score to individual items of “Time Out” part in Pre, Post 1 & Post 2 Intervention phases

Sr. No	Items	Max. Possible Score	Pre-Intervention	%	Post 1	%	Post 2	%	Pre-Intervention & Post 1		Pre-intervention & Post 2		Post 2 & Post 1	
									$\chi^2$	P-Value	$\chi^2$	P-Value	$\chi^2$	P-Value
1.	Name of Procedure	71	19	26.8	61	85.9	53	74.6	50.50	0.000	32.57	0.000	2.85	0.082
2.	Count of instruments, sponges, cotton pieces and needles	71	19	26.8	61	85.9	53	74.6	50.50	0.000	32.57	0.000	2.85	0.082
3.	Specimen Labelling	71	6	8.5	51	71.8	34	47.9	59.35	0.000	27.29	0.000	8.47	0.004
4.	Equipment problems to be addressed	71	0	0	50	70.4	22	31.0	77.17	0.000	26.03	0.000	22.29	0.000
5.	Specific post-operative recovery instruction for the team	71	2	2.8	23	32.4	21	31.0	21.40	0.000	20.06	0.000	0.03	0.857

**Discussion**

The present study analyzed the impact of an educational intervention amongst staff nurses on implementation of Surgical Safety Checklist. Significant improvement was observed in the nurse’s compliance to the checklist post-intervention. The percentage of completed items in the 32-item checklist increased from 32.09% ( $\bar{x}$  = 10.27) to 79.66% ( $\bar{x}$  = 25.49) in Post 1 and 58.19% ( $\bar{x}$  = 18.62) in Post 2 phases. This is commensurate to the findings of Haynes *et al.* [12], Melekic TB, Getahun GM [13] Haugen AS *et al.* [14] and Hancorn K, Blair S [15]. Who have indicated the need for follow up and sustained education sessions for good compliance to SSC.

It was also observed that the impact of educational intervention was significant in all the three parts of checklist viz. Sign In, Time Out and Sign Out, in both the post-intervention phases.

A low compliance was observed to the ‘Time Out’ component of checklist pre-intervention (27.14%) which later improved to 84.07% and 57.93% in the Post 1 and Post 2 phases respectively. These findings are in contrast to the observation in a systematic review done by Annegret *et al.* [16] who stated a mean compliance of 91% to this part of checklist. She also calculated a mean overall compliance rate of 75% to the checklist in contrast to 56.64% in this study. Although unlike the quoted review, the Time Out phase did not have highest score in all the three phases of this study.

The Sign In part showed higher scores and the mean compliance in this study was found to be 61.51%, ranging from lowest 44.76% in pre intervention phase to highest 78.84% in the Post 1 phase. The WHO considers components of Sign In part as important in preventing the most common errors with a potential to cause serious harm to patient besides being easily executable [17]. The items like

'Patient Identity' and 'Written Consent' are legal obligation in our country, and hence had a very high compliance rate. Other critical items like marking of the surgical site, anaesthetist's preparation for machine and drug, documentation of any known allergy, risk assessment of blood loss and I/V or Central Line access showed moderate to high compliance. All these added to a good compliance rate in this part of the checklist. Similar findings about the Sign In part have been experienced by Kasatpibal, *et al.* [18] in their study in Thailand.

This study observed an overall significant Hawthorne Effect on the implementation of Surgical Safety Checklist in OT. A drop by 21.47% in the compliance rate from Post 1 to Post 2 phase implied that the compliance was significantly higher in presence of the observer than in his absentia. Such an effect was present for all the three parts of checklist in all three phases. Sendlhofer *et al.* [19] observed a similar effect of presence of quality managers on compliance to SSC in a tertiary university hospital in Austria. McCambridge *et al.* [20] have further observed in their systematic review that the research participation has been found to be consequential in most of the Hawthorne Effect studies.

The compliance of few items in Sign In part, viz 'Does the patient has known Allergy' and 'Airway or Aspiration Risk' improved significantly in Post 1 phase but reversed back to nearly the pre-intervention levels in Post 2 phase suggesting Hawthorne effect. Although the overall compliance rates were similar to those observed by Melekic *et al.* [13], the individual item rates in the Sign In part did contrast from this study. Another vital observation of our study was the fact that initially an extremely low compliance rate was observed for the items 'Is X-Ray/CT Scan/MRI displayed?' And 'availability of intra-operative equipments' There was a highly significant improvement after the reinforcement intervention in these items, which also persisted in the Post 2 phase, although to a lesser extent. Hawthorne effect was also significant. Rydenfält *et al.* [21] and Melekic *et al.* [13] also observed minuscule response rates to these items in their studies.

All the Time Out items observed a significant improvement owing to the intervention, as also the significant Hawthorne effect. The items representing the extent of communication between various members as a team had the highest compliance as compared to other items of this part of checklist. A highly significant Hawthorne effect was observed which reinforces the WHO's concept that such checklists are helpful tools in encouraging teamwork and communication [17]. Pugel *et al.* [22] also concluded SSC to be an effective tool in improving the communication and thus the safety culture in operating rooms.

The total compliance score was found to be lowest (31%) in the 'Sign Out' part in all the three phases, a finding similar to that of Melekic *et al.* [13] and consistent with the experience of Conley *et al.* [23] and Lingard *et al.* [24]. This may be due to the tightly preoccupied team members in the last phase, hurriedness to shift the patient in view of next scheduled surgery, casual attitude, or fatigue on completion of the surgery, communication barriers or reservations, lack of motivation, logistic issues etc. This significant observation needs a further investigation to find out the major causes specific to non-compliance especially in this part of checklist and for corrective measures. The item like

'Specific post-operative recovery instructions for the team' had involvement of all the team members, and it neither did improve beyond a compliance rate of more than 1/3rd, nor did experience a Hawthorne effect. Melekic *et al.* [13] had similar compliance rate of 1% only in their study. They concluded that the Sign Out section was perceived to be difficult and less important than other parts.

The study could initiate the process of comprehensive implementation of the surgical safety checklist. There was significant improvement in the compliance of the nursing staff in the implementation of SSC. However, there was gap in complete implementation. Even a minor lapse in the implementation of the checklist may lead to surgical implications. Identifying the shortcoming and positive reinforcement of the other members of the team may bridge the gap. Training of the other members of the team including the technical staff and strict vigil by the operating surgeons may further strengthen the implementation of SSC at the institute.

### Conclusion and Recommendation

This study re-establishes the important role of continued education in improving the safety practices and successful implementation of SSC in an OT. A regularly scheduled, well structured, educational programme based on universally accepted principals of SSC must be in place to keep the OT staff well informed and updated.

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