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Developing an objective framework for scrub nurse training: A Japanese pilot study

Abstract

Background: Scrub nurses play a critical role in maintaining safety and efficiency in the operating room, requiring both advanced technical precision and non-technical competencies such as communication and situational awareness. In Japan, however, scrub nurse education is often apprenticeship-based and lacks standardised, objective assessments or structured feedback. To address this, we developed the Scrub Nurse Competency and Performance Evaluation (SCOPE), a concise tool designed to evaluate both technical and non-technical skills, that is integrated within the 'briefing, intra-operative teaching, debriefing' (BID) educational model.

Methods: A preliminary needs assessment, involving interviews, direct observations and a survey of nine scrub nurses with one to three years' experience, identified deficits in structured feedback and non-technical skills – particularly situational awareness and prediction. Based on these findings, SCOPE was designed with five domains (instrument handling, safety management, situational awareness, situational prediction and communication) and anchored behavioural criteria. Two novice scrub nurses participated in a pilot study involving 26 surgical procedures, during which real-time intra-operative instruction and post-procedure feedback were delivered using SCOPE. Assessments were performed by trained instructors, attending surgeons and the participants themselves.

Results: Gradual improvement in novice scores was observed over time. Inter-rater reliability between instructors and the primary researcher was high (ICC = 0.9078). Instructor scores correlated with case experience, particularly for Novice B (r = 0.88). Novices tended to rate themselves lower than instructors, though this difference was not statistically significant (p = 0.056). Survey data emphasised the need for more regular, structured feedback and highlighted variability in skill acquisition.

Conclusion: Integrating SCOPE with the BID model enhances both technical and cognitive competencies in novice scrub nurses. The framework is feasible and well-received in clinical settings. Further multicentre studies are warranted to assess long-term skill retention and validate broader applicability for standardised perioperative nursing education.

Keywords: operating room, nursing assessment, non-technical skills, training, education, evaluation, feedback, scrub nurse, instrument nurse

Introduction

Scrub nurses in an operating room (OR) environment must acquire advanced technical skills, including the precise and timely transfer of surgical instruments, strict adherence to aseptic procedures and rigorous maintenance of patient safety standards. Complementing these technical skills, essential non-technical skills such as effective interdisciplinary collaboration, clear communication and heightened situational awareness play a crucial role in optimising surgical workflow and improving patient outcomes[1]. However, in Japan, scrub nurse training predominantly relies on apprenticeship-based methods, shaped largely by institutional customs and individual instructor preferences. This traditional approach often lacks systematic objectivity in skill assessment and standardised feedback mechanisms[2].

In contrast, healthcare systems in Western contexts commonly use structured educational frameworks and standardised assessment instruments, as exemplified by guidelines from the Association of periOperative Registered Nurses (AORN) and the Objective Structured Assessment of Technical Skills (OSATS) tools[3,4].

Standardised assessment instruments, such as the OSATS, provide objective, consistent and reproducible methods for evaluating the surgical competencies of nurses and physicians. Despite their recognised effectiveness in fostering structured learning and comprehensive feedback, the extensive nature of these evaluation instruments frequently poses implementation challenges in fast-paced surgical environments[5]. Additionally, hierarchical structures within OR teams and demanding clinical schedules often impede regular post-procedure debriefings and the routine use of checklist-based evaluations[2].

Furthermore, while these international tools provide structured evaluation models, they primarily target surgeons or general perioperative staff and lack behavioural assessments specific to scrub nurses[3,4]. At present, no widely adopted global tool provides real-time, role-specific evaluation tailored to the technical and non-technical competencies required of scrub nurses. This gap in competency-based assessment has been noted in prior literature, particularly regarding the absence of behavioural anchoring and feedback specificity for scrub nurse training[1,6]. The absence of such a framework highlights the need for concise, targeted instruments that can support consistent evaluation and structured feedback for scrub nurses in high-demand clinical settings.

To address these challenges, this study explores the integration of the 'briefing, intra-operative teaching, debriefing' (BID) educational model[5], designed to deliver targeted feedback at critical junctures: pre-operative briefing, intra-operative instructional interventions and post-operative debriefing. By systematically embedding timely feedback within the clinical workflow, the BID model aims to improve educational outcomes while mitigating the barriers associated with clinical time constraints and hierarchical workplace dynamics.

In particular, the model's emphasis on immediate intra-operative instructions and rapid post-operative debriefing sessions is expected to enhance trainees' comprehension by directly connecting their actions with clinical outcomes. Consequently, this study first seeks to perform a comprehensive needs assessment, followed by the development of a streamlined yet rigorous evaluation framework that incorporates core principles from both the OSATS and BID methodologies. Finally, this study aims to gather preliminary evidence on the validity and feasibility of this integrated educational approach through a pilot investigation.

Methods

Needs assessment survey

Based on the educational framework for curriculum development, a needs assessment was conducted to clarify the necessity of establishing a structured feedback system and an objective evaluation tool for scrub nurses. This included preliminary interviews with senior staff and informal observations in the OR to identify specific gaps in the existing education. A needs assessment survey was conducted based on these observations. The survey included the following key items:

- satisfaction with educational programs and materials (5-point Likert scale)
- frequency and methods of feedback (e.g. after every surgery, once a week, rarely)
- usage frequency of checklists
- perceived importance of various scrub nurse skills
- skills currently mastered and skills perceived as insufficient (5-point Likert scale).

Survey participants

An anonymous online survey targeting scrub nurses with one to three years of experience was conducted using Google Forms. Prior to participation, all respondents received a written explanation of the study's purpose, and written informed consent was obtained. Participation was voluntary, and no identifying information was collected.

Development of assessment tool

Based on the needs assessment, an evaluation framework was jointly developed by the primary researcher, instructor nurse and expert scrub nurse. For domain creation, the Surgical Medical Practice Guidelines were consulted to clarify the fundamental competencies for scrub nurse performance[6,7]. As a result, an assessment tool called the Scrub Nurse Competency and Performance Evaluation (SCOPE) was developed (see Figure 1).

SCOPE is an assessment tool designed to evaluate both technical and non-technical skills of scrub nurses (instrument nurses) during surgery. It consists of nine items in five domains – two technical skills domains (instrument handling, safety management) and three non-technical skills domains (situational awareness, situational projection, communication). Each item is rated on a four-point Likert scale (4 = always performed well, 3 = performed well, 2 = not performed well, 1 = not performed at all) with the addition of 'N/A' (not applicable). The maximum possible score is 36.

For technical skills, behaviour-dependent rating scales were developed based on previous studies to minimise subjective variability[7]. For non-technical skills, we referred to the non-technical skills for surgeons (NOTSS) to classify and evaluate situational awareness, anticipatory skills and team communication of scrub nurses[8].

The behavioural criteria used for scoring all the technical skill items are included in supplement 1. To illustrate, for the item 'accurate instrument identification and handling' the behavioural criteria were as follows.

- 4 points: understands the names, purposes and handling of all instruments used in surgery
- 3 points: understands the names, purposes and handling of general surgical instruments
- 2 points: understands the names, purposes and handling of general surgical instruments but requires occasional guidance
- 1 point: does not understand the names, purposes or handling of general surgical instruments and requires constant guidance

Intra-operative education

Intra-operative education for novice scrub nurses was systematically implemented using a BID educational model[5]. This instructional approach comprised three distinct phases.

1. **Pre-operative briefing:**

   Prior to surgery, the supervising nurse provided a detailed overview of the anticipated surgical procedure with a novice scrub nurse. This session encompassed the identification and discussion of essential procedural steps, establishment of individualised learning objectives, clarification of role-specific expectations and resolution of pertinent questions or concerns.

2. **Intra-operative instruction:**

   During surgery, real-time instructional interventions were delivered by a supervising nurse or operating surgeon. These interventions included explicit guidance on instrument-handling techniques, adherence to standardised procedural protocols and continuous reinforcement of patient safety and risk management practices.

3. **Post-operative debriefing:**

   At conclusion of each surgical case, a structured evaluation was conducted using the SCOPE assessment tool. The instructor nurse led a formal debriefing session based on SCOPE assessment results. This session facilitated targeted feedback, identification of specific areas necessitating further development and collaborative goal-setting aimed at incremental competency enhancement in subsequent surgical encounters.

Performance assessments were independently conducted by the primary researcher, who was actively involved in the design and validation of the SCOPE tool, and by the instructor. Additionally, assessments by the operating or attending surgeon were systematically incorporated, particularly in cases where surgical trainees served as primary operators. Rater training was not provided to the attending surgeons. Novice scrub nurses completed reflective self-assessments using the SCOPE tool to encourage introspection, foster autonomous learning and enhance professional growth.

Scrub Nurse Competency and Performance Evaluation (SCOPE)

No:		Date: / /				
		4	3	2	1	N/A
Instrument handling						
1	Accurate instrument identification and handling?	◯	◯	◯	◯	◯
2	Smooth instrument passing to the surgeon?	◯	◯	◯	◯	◯
Safety management						
3	Safe scalpel/needle passing?	◯	◯	◯	◯	◯
4	Operative field and table free of clutter?	◯	◯	◯	◯	◯
Situational awareness						
5	Attentive to the field and surgical process?	◯	◯	◯	◯	◯
Situational prediction						
6	Anticipated and prepared the next instrument?	◯	◯	◯	◯	◯
7	Prepared additional instruments/materials as needed?	◯	◯	◯	◯	◯
Communication						
8	Effective communication with the surgeon?	◯	◯	◯	◯	◯
9	Effective communication with the circulating nurse?	◯	◯	◯	◯	◯

4 = always performed well, 3 = performed well,
2 = did not perform well, 1 = did not perform at all, N/A = not applicable

Figure 1: Scrub Nurse Competency and Performance Evaluation (SCOPE) tool

Statistical analysis

All statistical analyses were performed using JMP Pro 17.2.0. Inter-rater reliability was assessed using the intraclass correlation coefficient (ICC) with a two-way random-effects model to evaluate consistency among the evaluators. Pearson's correlation coefficients (r) were calculated to assess the relationship between instructor nurses' SCOPE scores and the number of cases. Descriptive statistics were calculated for mean scores and standard deviations (M ± SD) for each skill domain.

Ethical considerations

This study was approved by the institutional ethics committee of the Japanese Red Cross Asahikawa Hospital (Approval No: 202376-3). Written informed consent was obtained from all participants prior to data collection. All data were anonymised and used solely for statistical analysis in accordance with ethical guidelines.

Reporting guidelines

This study was reported in accordance with the Standards for QUality Improvement Reporting Excellence in Education (SQUIRE-EDU) guidelines for reporting educational interventions[9]. A completed SQUIRE-EDU checklist is provided as supplement 2.

Results

Survey results

A survey was conducted in March 2024 with nine scrub nurses (five female, four male) from our institution. Table 1 presents the respondents' background information and key survey results. Satisfaction with the educational program was moderate (M = 3.2±0.6). Regarding feedback frequency, daily

feedback was reported by only one respondent (11.1%) while four respondents (44.4%) reported 'one or two times a week' and another four respondents (44.4%) reported 'once a month or rarely'. Anticipatory skills (situational prediction) were reported as lacking by eight respondents (88.9%), and adaptability (situational awareness) by six respondents (66.7%).

Pilot study: Implementation of new education system

The pilot study included two first-year scrub nurses (novices A and B) who had been assigned to the OR for less than six months and had no prior scrub nurse experience. Novices A and B participated in 12 and 14 cases, respectively, with SCOPE evaluations conducted after each procedure. The inter-rater reliability between the instructor nurse and primary researcher involved in developing this assessment tool was high (ICC = 0.9078). However, when attending surgeons were included, the agreement was moderate, with ICC values ranging from 0.6855 to 0.5665 (see Table 2).

A comparison of the total SCOPE scores from instructor nurses and novice self-assessments revealed no significant difference by a paired t-test ($p = 0.056$), although novices tended to give themselves lower ratings that the instructor nurse (17.8 ± 4.0 and 19.8 ± 4.5, respectively), as shown in Figure 2.

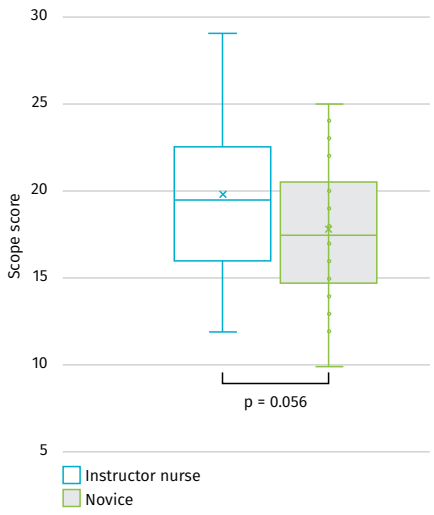

Figure 2: Comparison of total SCOPE scores between instructor nurse evaluations and novice self-assessments

Both novices exhibited gradual increases in their scores over time (see Figure 3). Instructor nurse evaluations correlated with the number of cases for novice A ($r = 0.54$) and showed a stronger correlation for novice B ($r = 0.88$).

A comparison of instructor nurse evaluation scores across domains (see Figure 4) revealed relatively high scores for the two technical skills domains – instrument handling (4.5 ± 0.9) and safety management (4.7 ± 1.0) – and the non-technical skills domain of communication (4.7 ± 1.2). The scores for the non-technical skills domains of situational awareness and situational prediction tended to be lower (2.4 ± 0.6 and 3.5 ± 1.4, respectively). This difference suggests the need to strengthen situational awareness and situational prediction skills.

Table 1: Background information and key results of survey respondents (N=9)

Item		Results
Gender	female	5 (55.6%)
	male	4 (44.4%)
Years of experience in the OR	1 year	4 (44.4%)
	2 years	3 (33.3%)
	3 years	2 (22.2%)
Satisfaction with the educational program (5-point scale) (M ± SD)		3.2 ± 0.6
Frequency of feedback	daily	1 (11.1%)
	one or two times per week	4 (44.4%)
	once a month or rarely	4 (44.4%)
Skills acquired*	instrument handling/ safety management/ communication	5 (55.6%)
	situational awareness	3 (33.3%)
	situational prediction	0 (0.0%)
Skills lacking*	situation prediction	8 (88.9%)
	situation awareness	6 (66.7%)
	instrument handling	5 (55.6%)
	communication	3 (33.3%)
	safety management	2 (22.2%)

M = mean, SD = standard deviation. *Multiple responses were allowed.

Table 2: Intraclass correlation coefficients (ICC) for the instructor nurse, surgeons and primary researcher

Comparison	ICC	95% confidence interval (CI) (lower CI, upper CI)
Instructor nurse – Primary researcher	0.9078	(0.85, 0.94)
Instructor nurse – Surgeon	0.6855	(0.62, 0.74)
Primary researcher – Surgeon	0.5665	(0.50, 0.64)

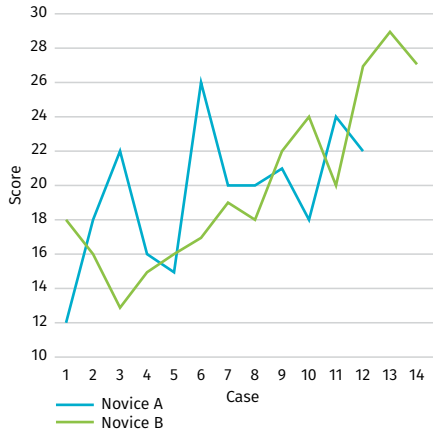

Figure 3: SCOPE scores of novice A and novice B across cases

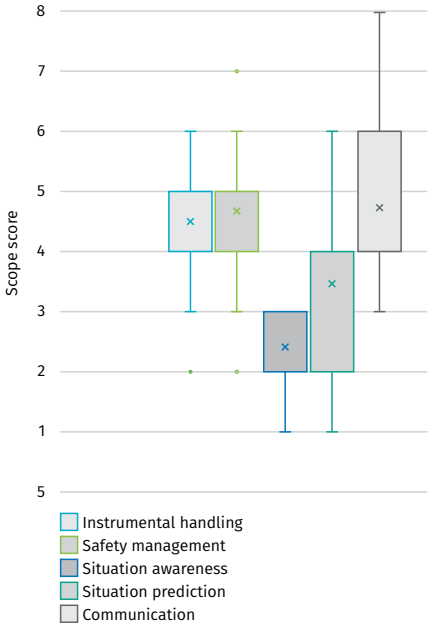

Figure 4: Comparison of instructor nurse evaluation scores across domains

Feedback from participants

Learners commented that timely feedback allowed them to reflect more efficiently than in the existing education system. Goal-setting and post-surgical reviews have made it easier to focus on specific learning objectives. The instructor nurse noted that the existing system lacked regular review opportunities and a clear framework for assessing novice performance. The new evaluation system enabled targeted feedback and improved the efficiency of the learning process.

Discussion

This study aimed to address identified gaps in scrub nurse education by conducting a comprehensive needs assessment, developing an evaluation tool (SCOPE) and implementing the tool within a structured BID educational framework. The results of the needs assessment survey reflected moderate satisfaction with existing educational resources and infrequent structured feedback, and highlighted particular deficits in anticipatory skills among novices. Pilot testing demonstrated that SCOPE-based structured feedback contributed to measurable improvements in scrub nurse competence, supported by strong inter-rater reliability between trained evaluators.

A central contribution of this research is the creation of the SCOPE tool and its five domains which were designed to capture the breadth of perioperative nursing responsibilities. Although previous assessment frameworks, such as the OSATS, focus heavily on surgical or procedural skills, adaptation for scrub nurses has been limited[3,4]. By incorporating behaviour-dependent rating scales and real-time evaluation, SCOPE provides a nuanced understanding of performance, which aligns with studies showing that detailed and immediate feedback improves clinical competence[5,10,11]. Similarly, our data demonstrate how novices' continuous reflections on their performance can facilitate targeted skill development.

Notably, although the domains of 'safety management' and 'communication' scored relatively highly, 'situational awareness' scored lower. This corroborates research suggesting that under time pressure and hierarchical constraints, novice nurses find it challenging to maintain a broader perspective of the surgical field[8]. Situational awareness deficits may lead to delayed responses and increased cognitive load, ultimately affecting overall performance. Strengthening this domain may require more emphasis on simulation scenarios, real-time prompts to encourage scanning of the environment, and deliberate practice exercises aimed at anticipating surgeons' needs[12,13].

Our findings also highlighted that novices tended to rate themselves lower in core competencies than instructor nurses rated them. This phenomenon is also documented in other healthcare professions, wherein trainees commonly underestimate their skills[14]. Such self-critical tendencies may reflect both humility and heightened anxiety, which are typical in high-pressure environments such as ORs. Encouraging accurate self-appraisal is crucial, as the literature suggests that bridging the gap between perceived competence and external evaluations can accelerate skill acquisition and improve patient outcomes[15–17]. Structured debriefing sessions, as recommended by simulation-based learning frameworks, may further enhance self-confidence without compromising patient safety[10–13].

This study had several limitations. First, this was a pilot study with a very small sample size, involving only two novice scrub nurses. While the preliminary results are encouraging, the findings should be interpreted with caution. The limited cohort restricts statistical power and precludes generalisation. Future studies with larger, more diverse samples are necessary to evaluate the framework's reliability, validity and educational impact more rigorously. Second, the study was conducted at a single institution, and institutional culture and training styles may have influenced the results. Multicentre validation is needed to confirm the external validity. Third, the observation period was relatively short (four months), limiting the assessment of long-term skill retention and its impact on attrition. Finally, although evaluator agreement was high among instructor nurses, it was moderate when surgeons were included, reflecting differences in assessment focus between disciplines.

In future studies, we plan to implement SCOPE in multiple institutions with varying levels of scrub nurse experience ranging from novices to senior staff members. We aim to conduct in-depth analyses of the tool's validity and reliability using a larger sample size. Additionally, by examining educational outcomes such as skill acquisition and retention, and determining impact on patient safety, we hope to build a stronger evidence base for the integration of objective assessment and structured feedback in perioperative education. Such investigations will clarify the broader applicability of our findings and guide further refinement of the evaluation framework, ultimately strengthening the association between robust nursing competence and high-quality surgical care.

The generalisability of the SCOPE framework should also be further explored in diverse clinical environments. Cultural and institutional factors, such as the hierarchical nature of surgical teams, feedback norms and role demarcations, may significantly influence its adoption in other countries. In settings where scrub nurses operate with greater autonomy or where competency-based feedback is already standard practice, adaptation strategies may be required to ensure contextual relevance. Cross-cultural validation and stakeholder engagement will be essential steps before broader international dissemination.

Furthermore, although SCOPE was developed specifically for scrub nurses in Japan, its core structure may be applicable to other perioperative roles, including circulating nurses, anaesthetic nurses and surgical trainees. With appropriate role-specific calibration of the evaluation domains, SCOPE could serve as a foundation for interdisciplinary, competency-based education across the OR team. Such expansion would not only improve the quality of nursing education but also foster a more cohesive perioperative care environment worldwide[18,19].

Conclusion

In conclusion, this pilot study offers preliminary support for the integration of structured evaluation and feedback into scrub nurse education. While limited in scope, the findings underscore the potential benefits of competency-based, role-specific training frameworks. Further research is warranted to assess their broader applicability and long-term educational impact.

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