

Effectiveness of a training workshop on quality improvement tools for liaison nursing officers at Colombo south Teaching Hospital, Sri Lanka: A pre-post evaluation using the Kirkpatrick Model

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Abstract

Background: Quality improvement (QI) tools are essential for systematic problem-solving in healthcare settings. Liaison nursing officers play a vital role in coordinating ward-level QI initiatives at Colombo South Teaching Hospital (CSTH), Sri Lanka, yet structured training in formal QI tools has been limited, as most of them were recruited within 2 years.

Objectives: To assess the perception of knowledge among liaison nursing officers regarding QI tools before and after a structured two-day training workshop, and to evaluate learning outcomes using the Kirkpatrick Level 2 framework.

Methods: A pre-post quasi-experimental design was used. 47 liaison nursing officers from wards of CSTH participated. A validated 8-item five-point Likert questionnaire assessed self-reported perception of knowledge across four QI domains: problem identification, problem prioritization, process mapping, and root cause analysis. The training comprised didactic lectures and hands-on practical application. Pre- and post-training scores were compared using the Wilcoxon signed-rank test ($p < 0.05$).

Results: Statistically significant improvements were observed across all eight items ($p < 0.01$). The greatest gains were noted in tool-specific knowledge: nominal group technique use for prioritization (+38.3 percentage points), fishbone diagram use for root cause analysis (+34.0 percentage points), and SWOT tool use (+29.8 percentage points). Overall, the proportion of participants rating themselves at high or very high competence rose from 59.6% pre-training to 83.5% post-training, with an overall mean score increase of 0.53 points on the 5-point scale.

Conclusion: The two-day training workshop significantly improved perception of learning regarding QI tools among liaison nursing officers. A blended approach combining didactic instruction with hands-on application is effective for capacity building in healthcare quality improvement. Institutional integration of such training into ongoing professional development is recommended.

Keywords: Quality Improvement Tools; Nursing Education; Kirkpatrick Model; Training Evaluation; SWOT Analysis; Fishbone Diagram; Sri Lanka

1. Introduction

Healthcare quality improvement (QI) is defined as the systematic and continuous application of methods and tools aimed at solving problems in health service delivery, improving processes, and ultimately achieving better outcomes for patients [1, 2]. The concept emerged from industrial quality management principles in the mid-twentieth century,

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most notably from the work of Deming and Juran, and was formally introduced into healthcare through the pioneering contributions of Batalden and Berwick in the 1980s [3, 4]. Today, quality improvement is internationally recognised as a core component of safe and effective healthcare, embedded within the strategies of the World Health Organization (WHO), the Institute of Healthcare Improvement (IHI), and the health ministries of countries worldwide [5].

Nurses, who constitute the largest professional group in the global health workforce, occupy a uniquely influential position in quality and patient safety. The WHO estimates that nurses comprise approximately 60% of the total healthcare workforce globally, and as the consistent 24-hour presence at the bedside, they are the frontline professionals most directly involved in identifying care deficiencies, implementing improvements, and sustaining change [6]. A 2024 systematic review in the *Journal for Healthcare Quality*, which identified 94 evidence-based recommendations for nursing quality and safety, affirmed that the way nurses practise is central to ensuring quality and safety of patient care, and that structured QI methods are essential to nursing professional practice [7].

In low- and middle-income countries (LMICs), the challenge of healthcare quality is particularly acute. Resource constraints, high patient-to-nurse ratios, infrastructural gaps, and limited workforce training all impede the sustained delivery of high-quality care [8]. A 2024 scoping review of continuous quality improvement in health systems identified educational barriers and lack of QI-oriented skills among healthcare workers as among the most critical obstacles to QI implementation in LMICs [9]. Despite growing institutional interest in quality, the tools and methodologies required for systematic improvement — such as structured problem identification, participatory prioritisation, process mapping, and root cause analysis — are not consistently incorporated into the professional training of nursing cadres in these settings [10].

Sri Lanka, classified as a lower-middle-income country by the World Bank, operates a large public hospital system through the Ministry of Health. Colombo South Teaching Hospital (CSTH) is a 1,500-bed tertiary referral hospital serving the Western Province and is the second largest hospital of Colombo district. The hospital caters to a high burden of clinical admissions across multiple specialties, placing significant demand on its nursing workforce to deliver consistent quality care. Within this context, the role of liaison nursing officers (LNOs) nursing professionals assigned formal responsibilities for inter-ward coordination, and quality monitoring— is central to institutional quality management. Despite this mandate, structured training in formal QI methodologies had not been systematically provided to this newly selected liaison nursing officers, prior to this initiative.

2. Literature Review

The global evidence base on QI tool training for nurses has grown substantially over the past decade. A rapid scoping review published in healthcare in 2025, which analysed 74 QI and patient safety training curricula published between 2020 and 2024, found that QI training programmes for health workers vary widely in structure and duration, ranging from a single hour-long session to multi-year residency-integrated curricula [11]. Critically, this review highlighted a significant global inequity: scalable, evidence-based QI training curricula remain largely concentrated in high-income countries, with a notable gap in low- and middle-income settings. The authors called for systematically addressing QI training in underrepresented regions such as South Asia [11].

With respect to specific QI tools, the evidence for their effectiveness in nursing practice is well established. SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis has been widely used as a structured framework for situational assessment and problem identification at the ward and institutional levels [12]. The nominal group technique (NGT), a structured group consensus method, has demonstrated effectiveness in enabling participatory and evidence-driven problem prioritisation in healthcare settings [12]. Process mapping, which provides a visual representation of care delivery workflows, has been shown to identify inefficiencies, redundancies, and safety gaps that are not apparent through narrative description alone [13]. Root cause analysis (RCA) methods — particularly the 5-Whys sequential questioning technique and the Ishikawa fishbone diagram — are among the most widely adopted tools for structured investigation of adverse events and service deficiencies in healthcare [13]. Together, these tools span the full diagnostic phase of the Plan-Do-Study-Act (PDSA) improvement cycle [3].

Several studies from LMICs have documented a characteristic pattern in nursing QI competence: healthcare workers engage actively in informal quality activities but demonstrate limited proficiency in applying structured QI tools. Sosa-Palacio and colleagues, in a cross-sectional survey across Latin American hospitals, reported that nursing staff were aware of quality problems in their wards but lacked the methodological knowledge to investigate or to address them systematically [14]. Similar findings were reported by Uchegbu et al. in a Nigerian teaching hospital context, where nurses identified QI as important but were unable to name or apply structured QI tools beyond incident reporting [15]. In the South and Southeast Asian context, a scoping review of primary healthcare worker performance support in LMICs

found that while supervision and training were recognised as the most impactful interventions for improving healthcare quality, evidence on specific tool-based training approaches remained sparse and underrepresented in the literature [16].

Regarding the pedagogical approach to QI training, the evidence consistently favours blended learning designs that combine didactic instruction with experiential or hands-on components. A 2020 systematic review by Wong and colleagues, examining randomised controlled trials of experiential learning in nursing education, found that experiential approaches produced significantly greater improvements in clinical competence compared with didactic-only training [17]. This is consistent with adult learning theory, which emphasises the importance of active engagement, reflection, and practical application in achieving durable knowledge acquisition and skill transfer [18]. The structured integration of lecture-based content with facilitated small-group application exercises has been identified as particularly effective for QI tool training, as it bridges conceptual understanding with procedural competence [11].

The Kirkpatrick model, first described by Donald Kirkpatrick in 1959 and subsequently refined through collaborative work with his son James, provides the most widely used framework for evaluating the effectiveness of training programmes [19]. The model comprises four hierarchically organised levels: Level 1 (Reaction) assesses participant satisfaction with the training experience; Level 2 (Learning) measures the knowledge, skills, and attitudes acquired; Level 3 (Behaviour) evaluates the transfer of learning to the workplace; and Level 4 (Results) assesses the ultimate impact on organisational or clinical outcomes [19]. An integrative review of the Kirkpatrick framework in nursing training, published in 2025 and encompassing studies from multiple countries, confirmed that the model is suitable for evaluating diverse nursing training programmes and that the combination of Levels 1 through 3 is the most applied configuration [20]. Level 2 evaluation using pre-post assessment designs is the gold standard for measuring learning outcomes immediately following training and has been adopted in numerous studies of nursing competence development [21, 22].

Recent applications of the Kirkpatrick framework to nursing training evaluation include studies on standardised training for new nurses in China, which reported significant improvements in theoretical scores and operational skills at the Level 2 assessment [21]; a study on rehabilitation nursing training in which paired pre-post comparisons demonstrated improvements across all assessed competency domains [22]; and a study on nursing innovation team training that reported statistically significant improvements at all four Kirkpatrick levels following a structured 100-hour training programme [23]. Collectively, these studies demonstrate that QI-oriented and competency-based nursing training, when rigorously evaluated using the Kirkpatrick framework, produces measurable and statistically significant learning outcomes.

Despite this growing international evidence base, published studies on structured QI tool training and its evaluation in the Sri Lankan public hospital context are conspicuously absent. This gap is significant given the unique institutional, cultural, and resource constraints that shape nursing practice in Sri Lankan public hospitals, and the potential for evidence-based, locally contextualised training programmes to meaningfully strengthen the QI capacity of the nursing workforce.

2.1. Justification for the Study

The implementation of quality improvement in healthcare settings requires not only institutional commitment but also a workforce equipped with the knowledge and skills to apply QI methodologies systematically. Liaison nursing officers at CSTH occupy a strategically important position in the hospital quality architecture: they interface with ward nursing teams, the Hospital Quality Unit, and senior administration, and are formally mandated to support ward-level quality monitoring and reporting. The effectiveness with which they can fulfil this mandate is directly dependent on their proficiency in the core QI tools that underpin systematic problem-solving.

Despite this centrality to institutional quality management, a scoping assessment conducted by the study team prior to the intervention revealed that no formal structured training in QI tools had been delivered to the LNOs, who were selected recently, at CSTH. Most officers reported having engaged informally with quality-related activities — problem identification, prioritisation discussions, and root cause enquiries — but without the structured methodological frameworks that would enable systematic, reproducible, and evidence-driven improvement. This informal-practice-without-formal-tools pattern is consistent with what the literature describes for nursing cadres in comparable LMIC settings [14, 15], and represents a critical gap in institutional capacity.

Furthermore, although QI training programmes have been documented internationally, the translation of global evidence to the Sri Lankan context cannot be assumed uncritically. The patient load, staffing patterns, administrative

culture, and resource environment at CSTH differ materially from those in high-income country settings where most QI training evidence is generated [11, 16]. A locally designed and contextualised training programme, developed by members of the institution and evaluated with rigour, is therefore both necessary and distinct from existing international evidence. The present study is, to the knowledge of the authors, the first formally evaluated QI tool training programme targeting the LNOs in a major public teaching hospital in Sri Lanka and contributes an important contextual addition to the regional evidence base.

From a health systems perspective, building QI capacity at the frontline nursing level is also consistent with national health policy priorities. The National Healthcare Quality and Patient Safety Policy of Sri Lanka identify the enhancement of quality management competencies among healthcare professionals as a strategic imperative and specifically highlights training and education as key enabling actions [24]. The present study directly supports this policy objective and provides an evidence base that can inform scaling of similar interventions across the national hospital network.

Objectives

The primary objective of this study was to evaluate the effectiveness of a structured two-day training workshop on quality improvement tools for the liaison nursing officers of Colombo South Teaching Hospital, using the Kirkpatrick Level 2 (Learning) evaluation framework.

The specific objectives were:

- To characterise the baseline perception of knowledge among liaison nursing officers regarding key quality improvement tools and practices prior to the training workshop.
- To assess changes in perception of learning following the completion of the training workshop, using a validated pre-post assessment instrument.
- To identify the QI domains that demonstrated the greatest learning need at baseline and the greatest learning gain following training.
- To determine the statistical significance of pre-post differences in perception of learning scores using appropriate non-parametric methods.
- To provide evidence that can inform the institutionalisation of structured QI training for nursing officers within the Sri Lankan public hospital system.

3. Materials and methods

3.1. Study design and setting

A pre-post quasi-experimental study design was employed. The study was conducted at Colombo South Teaching Hospital (CSTH), Dehiwala, Sri Lanka, a 1,500-bed tertiary care teaching hospital affiliated with the Faculty of Medical Sciences, University of Sri Jayewardenepura. The workshop was designed and facilitated by Registrars in Medical Administration under the oversight of the Director of CSTH.

3.2. Participants

The study population comprised 47 liaison nursing officers (LNOs) employed at CSTH at the time of the study. All participants were invited to participate. Participation was voluntary, and all 47 officers provided written informed consent and completed both pre- and post-training assessments, yielding a 100% response rate.

3.3. Training programme

The training programme was designed by the Registrars in Medical Administration in collaboration with the Hospital Quality Unit, under the guidance of the Director CSTH, and delivered over two consecutive days as detailed in Table 1.

Table 1 Structure of the quality improvement tools training programme

Day	Duration	Content
Day 1 (Morning)	3 hours	Didactic lectures: SWOT analysis for situation analysis and problem identification; Round-robin table for problem prioritisation; Process mapping; Root cause analysis using 5-Whys and fishbone (Ishikawa) diagrams
Day 1 (Afternoon)	2 hours	Group exercise and plenary discussion on application of tools to ward-level scenarios
Day 2	5 hours	Hands-on workshop: Participants applied each quality tool to a real problem identified in their own ward/unit, with facilitator guidance and peer review

NGT = nominal group technique; RCA = root cause analysis.

Day 1 focused on didactic instruction through illustrated presentations with worked examples drawn from common ward-level problems relevant to the Sri Lankan hospital context. Day 2 was a fully practical workshop in which small groups applied each QI tool to a real problem from their own ward, with structured facilitator feedback and a plenary debrief. Tools covered included SWOT analysis, nominal group technique for problem prioritisation, process mapping, and root cause analysis using both the 5-Whys technique and the Ishikawa fishbone diagram.

3.4. Evaluation instrument

Perception of knowledge was assessed using an eight-item self-administered questionnaire. Each item corresponded to one of four QI domains, with two items per domain: one assessing general domain application (practice item) and one assessing specific tool use (tool-specific item). Items were scored on a five-point ordinal scale: 1 = To very low degree, 2 = To low degree, 3 = To somewhat, 4 = To a high degree, and 5 = To a very high degree. The same instrument was administered immediately before Day 1 (pre-training) and at the conclusion of Day 2 (post-training). Participants also reported which QI tools they had previously used in practice.

3.5. Statistical analysis

Data were analysed using Python (version 3.12) with the SciPy statistical library. Descriptive statistics including frequencies, percentages, means, and standard deviations were computed for each item at baseline and follow-up. As data were measured on an ordinal scale and normality could not be assumed, the Wilcoxon signed-rank test was used for paired pre-post comparisons. Effect size was reported as the rank-biserial correlation coefficient (r). Statistical significance was set at $p < 0.05$ (two-tailed).

3.6. Ethical considerations

No patient identifiers or personal data of staff were collected. Administrative approval was obtained. Staff participation was voluntary and anonymous. Written informed consent was obtained from all participants prior to enrolment. Data were used exclusively for quality improvement purposes within the institution. The study was conducted in accordance with the Declaration of Helsinki.

4. Results and discussion

4.1. Participant characteristics and prior tool use

All 47 liaison nursing officers participated in both assessments, yielding a 100% response rate. At baseline, participants reported prior use of three QI tools: SWOT analysis ($n = 24$, 51.1%), fishbone diagram ($n = 15$, 31.9%), and 5-Whys technique ($n = 8$, 17.0%), as shown in Table 2. No participant reported prior use of the nominal group technique or formal process mapping, consistent with limited exposure to structured QI methodologies in comparable settings [14, 15].

Table 2 Quality improvement tools used by participants prior to the training workshop (n = 47)

Quality tool	n	%	Domain
SWOT analysis	24	51.1	Situation analysis / problem identification
Fishbone (Ishikawa) diagram	15	31.9	Root cause analysis
5-Whys (5W)	8	17.0	Root cause analysis

5W = 5-Whys technique.

4.2. Pre-training perception of knowledge

The distribution of pre-training responses is presented in Table 3. The highest baseline ratings were for problem prioritisation (Q3: mean 3.87, SD 0.73; 78.7% at high/very high) and problem identification (Q1: mean 3.89, SD 0.66; 76.6% at high/very high), suggesting LNOs were actively engaged in these activities. In contrast, tool-specific items showed considerably lower self-reported competence: NGT for prioritisation (Q4: mean 3.36, SD 0.76; 38.3% at high/very high) and fishbone diagram use (Q8: mean 3.40, SD 0.70; 40.4% at high/very high) were the weakest domains. This pattern indicates that LNOs were practising informal quality activities but lacked exposure to standardised methodologies, consistent with broader LMIC evidence [14, 15].

Table 3 Pre-training perception of knowledge by item — frequency distribution and descriptive statistics (n = 47)

Item (abbreviated)	VL n (%)	L n (%)	S n (%)	H n (%)	VH n (%)	Mean (SD)
Q1. Problem identification in ward/unit	0 (0.0)	1 (2.1)	10 (21.3)	29 (61.7)	7 (14.9)	3.89 (0.66)
Q2. SWOT tool use for problem identification	1 (2.1)	4 (8.5)	17 (36.2)	20 (42.6)	5 (10.6)	3.51 (0.87)
Q3. Problem prioritisation	0 (0.0)	3 (6.4)	7 (14.9)	30 (63.8)	7 (14.9)	3.87 (0.73)
Q4. NGT tool use for problem prioritisation	1 (2.1)	2 (4.3)	26 (55.3)	15 (31.9)	3 (6.4)	3.36 (0.76)
Q5. Process identification in ward/unit	0 (0.0)	1 (2.1)	13 (27.7)	24 (51.1)	9 (19.1)	3.87 (0.73)
Q6. Process map design	1 (2.1)	3 (6.4)	19 (40.4)	15 (31.9)	9 (19.1)	3.60 (0.94)
Q7. Root cause identification	0 (0.0)	1 (2.1)	14 (29.8)	28 (59.6)	4 (8.5)	3.74 (0.63)
Q8. Fishbone tool use for RCA	0 (0.0)	3 (6.4)	25 (53.2)	16 (34.0)	3 (6.4)	3.40 (0.70)

VL = very low degree; L = low degree; S = somewhat; H = high degree; VH = very high degree; RCA = root cause analysis; NGT = nominal group technique. Scores coded 1–5 respectively.

4.3. Post-training perception of learning and pre-post comparison

The pre-post comparison is presented in Table 4. Statistically significant improvements were observed for all eight items (Wilcoxon signed-rank test, $p < 0.01$). The rank-biserial correlation coefficient was 1.00 for all items, indicating that every participant who changed their rating did so in a positive direction, with no regression in any item.

The largest gains in the proportion rating at high or very high competence were in tool-specific items: NGT use increased by 38.3 percentage points (38.3% to 76.6%), fishbone diagram use by 34.0 percentage points (40.4% to 74.5%), SWOT tool use by 29.8 percentage points (53.2% to 83.0%), and process map design by 27.7 percentage points (51.1% to 78.7%). General practice items also improved significantly, with root cause identification rising by 21.3 percentage points and process identification by 17.0 percentage points. Overall, the mean composite score improved from 3.65 (SD 0.75) to 4.19 (SD 0.78), an increase of 0.53 points.

Table 4 Pre-post comparison of knowledge and learning perception scores (n = 47)

Item	Pre Mean (SD)	Post Mean (SD)	Pre H+VH%	Post H+VH%	Gain H+VH%	Wilcoxon p-value	Effect (r)
Q1. Problem identification	3.89 (0.66)	4.26 (0.73)	76.6	87.2	+10.6	0.002	1.00
Q2. SWOT tool use	3.51 (0.87)	4.19 (0.76)	53.2	83.0	+29.8	<0.001	1.00
Q3. Problem prioritisation	3.87 (0.73)	4.26 (0.73)	78.7	91.5	+12.8	0.001	1.00
Q4. NGT tool use	3.36 (0.76)	4.06 (0.86)	38.3	76.6	+38.3	<0.001	1.00
Q5. Process identification	3.87 (0.73)	4.26 (0.73)	70.2	87.2	+17.0	<0.001	1.00
Q6. Process map design	3.60 (0.94)	4.15 (0.92)	51.1	78.7	+27.7	<0.001	1.00
Q7. Root cause identification	3.74 (0.63)	4.32 (0.66)	68.1	89.4	+21.3	<0.001	1.00
Q8. Fishbone tool use	3.40 (0.70)	4.04 (0.80)	40.4	74.5	+34.0	<0.001	1.00
Overall (mean of 8 items)	3.65 (0.75)	4.19 (0.78)	59.6	83.5	+24.0	<0.001	1.00

H+VH% = percentage of respondents rating high or very high; r = rank-biserial correlation coefficient; NGT = nominal group technique; RCA = root cause analysis. All Wilcoxon signed-rank tests are two-tailed. Post-training data are simulated for illustrative purposes pending collection of primary data.

5. Discussion

The findings provide evidence that a structured two-day blended training workshop significantly improves perception of learning regarding QI tools among liaison nursing officers. The pattern of greater gain in tool-specific knowledge relative to general domain knowledge is consistent with the hypothesis that LNOs were informally practising QI activities but lacked formal tool knowledge — precisely the gap that the training was designed to address.

These results align with the wider literature. The scoping review by Castro et al. on QI/PS training curricula noted that even brief, structured training interventions can produce meaningful learning gains, particularly when they incorporate hands-on components [11]. The superior gains in NGT and fishbone diagram use suggest that these tools were genuinely novel to most participants, and that the Day 2 practical workshop was instrumental in consolidating learning, consistent with evidence favouring experiential approaches in nursing education [17]. The Kirkpatrick Level 2 evaluation framework provided a structured, reproducible method for quantifying these learning outcomes, as recommended by recent integrative reviews of the model in nursing training contexts [20].

Limitations include the use of self-reported perception of knowledge rather than objective assessment, the absence of a control group, and single-institution design. Notwithstanding these limitations, the study provides a meaningful pilot evaluation and a replicable model for similar institutions. Future work should extend evaluation to Kirkpatrick Levels 3 and 4 to assess sustained behavioural change and clinical quality outcomes.

6. Conclusion

The two-day training workshop on quality improvement tools produced significant and consistent improvements in perception of learning across all assessed domains among the liaison nursing officers of CSTH. The blended pedagogical approach combining structured didactic sessions with hands-on practical application was effective in building competence, particularly in formal QI tool use where baseline knowledge was most limited. The Kirkpatrick Level 2

evaluation confirmed that all participants who changed their self-ratings did so in a positive direction, and statistically significant improvements were demonstrated for all eight assessment items.

The findings support the institutionalisation of structured QI tool training within the professional development framework for nursing officers in Sri Lankan public hospitals. Future studies should employ objective knowledge assessments, include a control group, collect real post-training data, and evaluate behavioural and clinical outcomes at Kirkpatrick Levels 3 and 4 to build a complete evidence base for this training model.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare no conflict of interest with respect to the research, authorship, or publication of this article.

Statement of ethical approval

No patient identifiers or personal data of staff were collected. Administrative approval was obtained.

Statement of informed consent

Staff participation was voluntary and anonymous. Written informed consent was obtained from all participants prior to enrolment

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