Research article

Nurses' training evaluation: An assessment of effective transfer of simulation training

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Abstract

Objective: The question that laid the foundation for this study was whether simulation-based training for new nurses, hired in a multispecialty hospital in Delhi, NCR Region, is effective in terms of implementation of learnings as effective clinical practice in in-patient wards. The study relied on Kirkpatrick's model of effectiveness to assess the impact of the technical training imparted to the nurses.
The objective of the study was to assist HR departments, in hospitals, to make evidence-based decisions, on such future initiatives, for improved clinical performance by nurses.
Method: A sample size of 178 newly recruited nurses was studied over a period of five months. These nurses underwent a mandatory 40 hours simulation training program conducted by credentialed trainers.
The descriptive study evaluated the impact of training, at the prescribed Level 1, 2 and 3 of Kirkpatrick's model of effectiveness, by investigating the degree of change in clinical skills, measured by a self-rated tool before and after training, designed by the trainers.
Results: An analysis of the pre and post-training test demonstrated a significant improvement in the learning levels of the new nurses and an association between learning and transforming of learning into practice has been identified.
Conclusion: The study shows a positive learning outcome and transfer of skills in the real work area hence confirming a positive association between the first three levels of Kirkpatrick's model. We, therefore, recommend that HR departments of hospitals should encourage simulation training initiatives to be able to improve their nurses' performance and keep them updated on latest clinical techniques.

Keywords: Operational definitions, training effectiveness, training-transfer, training outcomes, training intervention, Kirkpatrick model

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1. Introduction

Training and training effectiveness
Training plays an important role in preparing employees for their jobs [1].

According to Goldstein, 1993, as cited by Quinones [2], organizations invest in providing training on job-related skill sets, knowledge and behaviors to enable employees to perform well and gain a competitive advantage [3].
For training to be successful, they must be evaluated for effectiveness [4]. A successful training is one which is not just restricted to classroom effectiveness but evidently enhances an employee's work performance on the floor [5]. Hence, the need to assess training outcomes and training transfer to analyze real training effectiveness.

While training outcomes assess the level of effectiveness immediately before, during and after completion of a training program, transfer of training is assessed on basis of the level at which the knowledge and skills learned are applied on the job [6] over a period of time [7].

While assessing training effectiveness is not an easy task [8], there is no doubt that evaluating the effectiveness of these interventions is crucial for human resource development [9] to highlight the impact of training on improved productivity in an organization. It further ensures that programs are accountable and meet specific needs of employees in a cost-effective manner [1].

Kirkpatrick's model of training effectiveness

Kirkpatrick's model of training evaluation is a popular method to assess training effectiveness through four levels of training outcomes and transfer: reaction, learning, behavior, and results [10].These can be described as:

Level 1: Reaction assesses the initial attitude of the participants and their perception towards the program.

Level 2: Learning assesses the level of skills learned by way of a post-test in comparison to the pre-test conducted prior to the training.

Level 3: Behaviour is evaluated to analyze the level of implementation of skills learned in the real work area, post three or more months of training.

Level 4: The fourth level focuses on the results i.e. cost versus benefits of training [11].

The process of evaluation begins at the reaction stage and gets difficult as one goes into higher levels of assessment but effectiveness should be assessed at all 4 levels so that an association between the various levels can be derived [12].

Despite its simplicity and popularity, Kirkpatrick model has been criticised for focusing much on the reaction stage of evaluation [11]. Further, there is not much evidence of the implied causal relationship between each level [13]. While Alliger, Tannenbaum, Bennett, Traver, & Scotland [14], found modest associations among various criteria within the same level of the model but they did not find strong associations between different levels. They further concluded that while trainee reactions are important they cannot be used to determine learning or performing levels

Simulation training

Simulation training is an effective training tool that exposes participants to experiential learning and helps improve their performance [15] through a series of trial and error and repetition[16].While low-fidelity mannequins provide anatomical representations only, high-fidelity simulation involves training participants on mannequins that complement anatomical representations with human-like physiological and vocal responsiveness [17]which facilitates enhanced retention of knowledge, critical thinking skills and self-confidence of the learners [18].

In this study, simulation was an instructional technique adopted to assist newly hired nurses to assimilate smoothly into the real work scenario in inpatient wards. Through simulation, the newly hired nurses were exposed to factual or hypothetical scenarios with the aid of low to high-fidelity simulators.

The effectiveness of the simulation training was evaluated on the first 3 levels of Kirkpatrick's model. First, the focus was on assessing the new nurses' reaction to the program followed by analysis of the effect on their learning levels. The third level involved examining the level of implementation of skills learned in the inpatient wards.

Effectiveness was studied for training provided on four modules: Aseptic Method of Suctioning, Suitable Site for Vein Puncture, the Correct angle of Intradermal Injection and Drug Calculation.

Hypothesis

The study will demonstrate training effectiveness through positive associations between the first three levels of Kirkpatrick's training effectiveness model hence validating the implied relationship between each level.

Hypothesis 1: There is a significant difference in the pre and post test of training at the level of $p<=0.05$.

Hypothesis 2: There is a significant association between the new nurses' immediate feedback on the training program (Reaction Stage) and their Post Test scores (Learning Stage)

Hypothesis 3: There is a significant association between Learning Stage (Level 2) and Behaviours Stage (Level 3) whereby skills learned are transformed into effective patient care

2. Methodology

The research was conducted using a quantitative approach with a pre-test intervention followed by post-test and observation design. The independent variable in this study is the simulation-based training and the

dependent variables were the reaction learning and behavior of the newly hired nurses.

The study was conducted in a tertiary hospital located in the Delhi, NCR, and included a convenience sample of 178 new hired nurse attending the hospital's orientation program. The training program is a simulation-based training conducted by Vidyanta Skills Institute, a private training provider to supplement the orientation program offered by the host hospital. The institute providing this simulation-based training, although housed in the hospital where the nurses were hired, is a separate entity. The institute has as its aim to assist nurses in acquiring skills necessary to become competent practitioners and to prepare them for domestic as well as global practice.

The participants were recruited by the hospital from various nursing colleges and hospitals across India. They were selected on the basis of success in a screening written examination on general nursing knowledge and a personal interview. Once they joined the hospital, they attended a 6-days orientation program conducted by the hospital's nursing education team. Upon conclusion of this program, the new nurses were then sent to the Vidyanta Skills and Simulation laboratory where they attended the skill sessions for 5 days (40 hours) under the guidance of Vidyanta Skills Center faculty.

The simulation-based program was designed by Vidyanta Skills Institute in collaboration with the nursing team of the host hospital. The program consisted of 10 modules, however, for the convenience of the study, the new nurses were evaluated only on four modules to assess the impact of training output and transfer. As the study continued over a period of five months, the sample size reduced greatly per module.

The real test of training in terms of training transfer was assessed based on the performance of the nurses in the inpatient wards. Observation-based audits were conducted in the inpatient wards, post 3 months of training, by the nurses' supervisors whose observations were considered the final deciding factor to assess the impact of training in the inpatient wards by the new nurses.

Training effectiveness for each module was assessed at first3 levels of Kirkpatrick's model:

Level 1: Reaction assessment

Immediately upon completion of training, a questionnaire was administered to all newly hired nurses to provide their perception on the quality of the program, trainer, tools used for training and possibility of skills learned being implemented in the actual work area. The feedback received was anonymous and used to assess the initial reaction of the new nurses to the program.

New nurses were asked to rate their responses to the questions on a scale of 1 to 5 where 1 was Strongly Disagree, 2 Disagree, 3 Somewhat Agree, 4 Agree and 5 was Strongly Agree

Level 2: Assessment of learning level

Before the training commenced, a pre-test was conducted to assess knowledge levels of the new nurses. Each new nurse was asked to demonstrate their existing knowledge of Aseptic Method of Suctioning, Suitable Site for Vein Puncture, and Correct angle of Intra Dermal Injection on the mannequin. Knowledge of Drug Calculation module was assessed through a test on paper. During the pre-test, a participant would get 1 point for correctly demonstrating knowledge of the skill at the first attempt. If unable to demonstrate skill, no points were given.

Immediately after completion of training, a post-test was administered to assess the learning levels gained by new nurses. The post-test was conducted on the same lines as the pre-test. Points were given based on skill levels demonstrated by the new nurses whereby 1 indicated that skill was demonstrated correctly at first attempt while 0 implied a participant's inability to demonstrate the skill learned.

Level 3: Evaluation of behaviour transfer

Transfer of skills in the inpatient wards was assessed through observation by nursing supervisors over a period of three to five months after training was delivered. Nursing supervisors asked the new nurses to perform techniques learned, on patients who required the necessary nursing intervention. Based on their observations in the inpatient wards, nursing supervisors rated the new nurses on all 4 modules.

A questionnaire was designed by training faculty and shared with nursing supervisors to rate the level of skills exhibited by new nurses on a scale of 1 to 5 where 1indicated "Below Requirements (BR)", 2 "Meets Some Requirements (MSR)", 3 "Meets All Requirements (MAR)",4 "Exceeds Requirements (ER)", and 5"Significantly Exceeds Requirements (SER)"

The complete study design can be viewed in Figure1
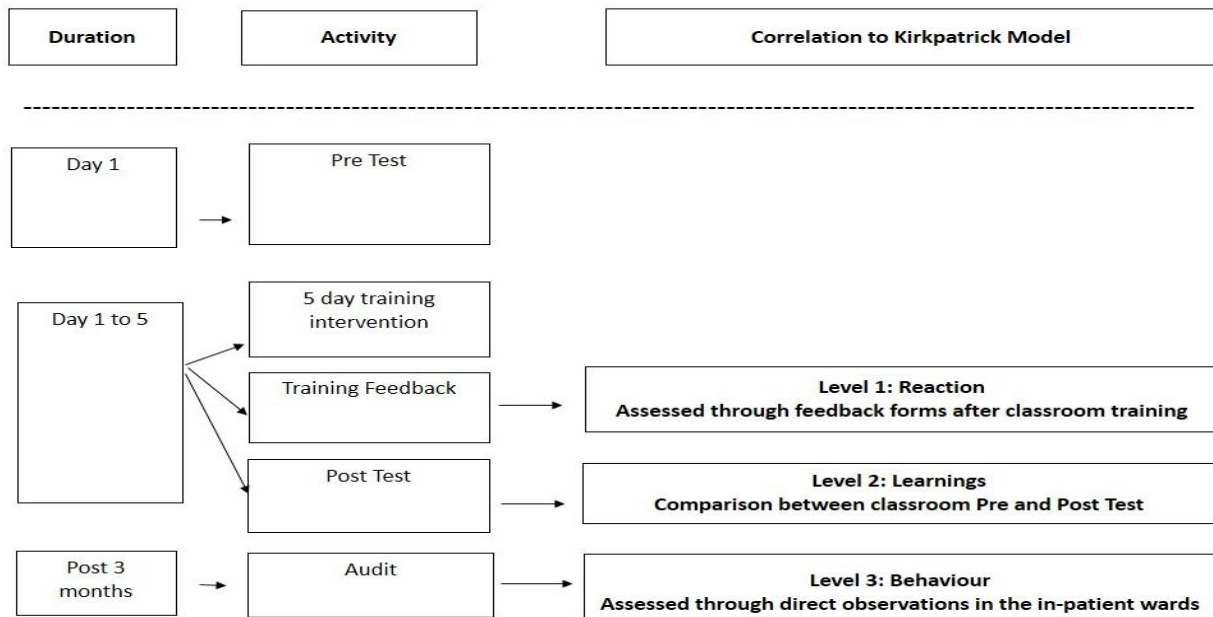
3. Results

The data in Tables 2 to 5 shows that with p-value < 0.0001 being statistically significant, there is a significant association between the pre-test and post-test scores undertaken before and after the simulation program. The post-test scores of the new nurses had improved after completing their training, in comparison to their pre-test performance, hence, we accept the first hypothesis and confirm that there is a significant difference in the pre and post-test of training at the level of p<=0.05.

The participating nurses' positive feedback for the overall training program indicated that they were satisfied with the training program and believed that skills learned could be applied well in their new job. The new nurses' positive response directly correlated to their post-training evaluation undertaken by trainers, which positively signified effective learning of skills during the training intervention. Hence, we can confirm [19] view that an employee satisfied by training program would learn well during the training. The data in Table 6 shows that there is a significant association between the feedback score (reaction) and post-test (learning) at level p ≤0.05 at df 2. Hence, the second hypothesis is accepted as there is a significant association between the new nurses' immediate feedback on the training program (Reaction Stage) and their Post Test scores (Learning Stage).

The audit undertaken by the nurses' supervisors, in the real work area, indicated that participants were successful in transferring the skills learned in the classroom to the inpatient wards hence, confirming a correlation between levels 2 and 3 of Kirkpatrick Model of Evaluation [19].The data in tables 7 to 10 shows that there is a significant association between the post-test score (learning) and supervisor feedback (behavior and results) at level p ≤0.0001. Hence, the study supports hypothesis 3 as there is a significant association between Learning Stage (Level 2) and Behaviours Stage (Level 3) whereby skills learned are transformed into effective patient care.

Table no 1: Participation numbers and percentage scored for pre and post test for each module

Tests	Results	Aseptic		Vein Puncture		Injection		Drug	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
Pre Test	0	50	67.6	42	71.2	72	93.5	62	80.5
	1	24	32.4	17	28.8	5	6.5	15	19.5
Post Test	0	16	21.6	4	6.8	8	10.4	2	2.6
	1	58	78.4	55	93.2	69	89.6	75	97.4

(Number= number of new nurses participated in pre and post test for specific modules, Percent= Percentage of participants)

Association of grade between pre and post test of 4 clinical skills.

2 Analysis of aseptic method of suctioning

Table no 2: Association of grade between pre and post test

Pre Test	Post Test		
	0	1	Total
0	9	41	50 (67.6)
1	7	17	24 (32.4)
Total	16 (21.6)	58 (78.4)	74 (100.0)

Chi Square value= 22.688; p– value< 0.0001*, statistically significant

3 Analysis of suitable site for vein puncture

Table no 3: Association of grade between pre and post test

Pre Test	Post Test		
	0	1	Total
0	4	38	42 (71.2)
1	0	17	17 (28.8)
Total	4 (6.8)	55 (93.2)	59 (100.0)

Chi Square value= 36.026; p– value < 0.0001*,statistically significant

4. Analysis of the correct angle of intradermal injection

Table no 4: Association of grade between pre and post test

Pre Test	Post Test		
	0	1	Total
0	6	66	72 (93.5)
1	2	3	5 (6.5)
Total	8 (10.4)	69 (89.6)	77 (100.0)

Chi Square value= 58.368; p– value< 0.0001*, statistically significant

5 Analysis of drug calculation module

Table no 5: Association of grade between pre and post test

Pre Test	Post Test		
	0	1	Total
0	2	60	62 (80.5)
1	0	15	15 (19.5)
Total	2 (2.6)	75 (97.4)	45 (100.0)

Chi-Square value= 58.017; p-value< 0.0001*, statistically significant

The data in Tables 2 to 5shows that there is a significant association between the pre-test and post-test of training modules. Hence, hypothesis 1 is accepted.

Table no 6: Comparison of the mean value of total feedback score between Post-test category results

Post Test	Aseptic		Vein Puncture		Injection		Drug	
	n	Total Score (Mean±SD)	N	Total Score (Mean±SD)	n	Total Score (Mean±SD)	n	Total Score (Mean±SD)
0	16	48.56±1.96	4	47.75±2.63	8	48.63±0.92	2	48.00±1.41
1	58	48.67±1.13	55	48.67±1.15	69	48.65±1.36	75	48.63±1.32
p-value	0.774		0.168		0.956		0.695	

*p-value < 0.05, statistically significant

Association of grade between post test (learning) and audit by nursing supervisor (behaviour & results)

7 Analysis of aseptic method of suctioning

Table no 7: Association of Grade between Post Test and Audit by Nursing Supervisor

Post Test	Audit by Nursing Supervisor		
	0	1	Total
0	16	0	16 (21.6)
1	45	13	58 (78.4)
Total	61 (82.4)	13 (17.6)	74 (100.0)

Chi Square value = 43.022; p – value < 0.0001*, statistically significant

8 Analysis of suitable site for vein puncture

Table no 8: Association of Grade between Post Test and Audit by Nursing Supervisor

Post Test	Audit by Nursing Supervisor		
	0	1	Total
0	3	1	4 (6.8)
1	42	13	55 (93.2)
Total	45 (76.3)	14 (23.7)	59 (100.0)

Chi Square value = 37.209; p – value < 0.0001*, statistically significant

9 Analysis of correct angle of intradermal injection

Table no 9: Association of grade between post test and audit by nursing supervisor

Post Test	Audit by Nursing Supervisor		
	0	1	Total
0	7	1	8 (10.4)
1	52	17	69 (89.6)
Total	59 (76.6)	18 (23.4)	77 (100.0)

Chi Square value= 47.170; p– value < 0.0001*, statistically significant

10 Analysis of drug calculation module

Table no 10: Association of grade between post test and audit by nursing supervisor

Post Test	Audit by Nursing Supervisor		
	0	1	Total
0	2	0	2 (2.6)
1	66	9	75 (97.4)
Total	68 (88.3)	9 (11.7)	77 (100.0)

Chi Square value= 64.015; p– value < 0.0001*, statistically significant

4. Discussion

The pre and post-test of nurses indicate that the simulation training for nurses did improve their technical skills in workplace hence confirming a positive association between the first three levels of Kirkpatrick's model of evaluation.

Results of our study confirm research conducted by Gordon and Buckley [20] who stated that 94% of medical-surgical nurses benefitted from increased confidence and perceived technical and non-technical skills during clinical emergencies following simulation-based learning.

The study also supports findings of another study conducted by Rajeev et al. [11] at the Indian Institute of Spices Research, which confirmed a positive association of scores in the three phases of evaluation of Kirkpatrick Model while training postgraduate students in life sciences who were being trained to use scientific tools to perform their job effectively impacting organisational logistics.

To improve patient care, hospital administration should organize simulation training programs for nursing staff. However, training should be monitored for effectiveness at all three stages of Kirkpatrick model through a positive association between reactions, learning and behavior changes of participants.

Limitations and recommendations

While planning this study, the focus was to train all the new nurses and assess the effectiveness of the training across all participants. Variables such as age, experience, education of both new nurses and nursing supervisors were not considered. It is recommended that in future studies efforts are made to study effectiveness levels in relation to demographic variables of both participants as well as assessors. Analysis based on demographics may help provide specific insights to strengthen the training program and its effectiveness.

Lastly, while the initial target audience for the study was 178 new nurses, the participant numbers per module reduced considerably over a period of time resulting from absenteeism, shift duties, busy work schedule, etc. It is recommended that future studies should consider shift duty hours and busy work schedules whereby rosters for training participants can be prepared in alignment with the availability of supervisors to facilitate observations of all participants.

Acknowledgement

Conclusion

HR departments of hospitals, based on this study, can make evidence-based decisions to initiate simulation programs to enhance the performance of their nurses. The programs must be monitored strictly for effectiveness to ensure that HR department can justify the financial costs and logistical efforts undertaken by the hospitals to train the nurses.

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