Impact Study of a Central Lines Simulation Training Program Using Kirkpatrick's Four-Level Evaluation Model

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Background:

- The breakneck speed of medical science and technology far outpaces the current capabilities of our healthcare delivery system and theprofessionals who work in them to prevent medical errors.
- Central line-associated infections are preventable events that harm patients and generate significant costs.
- Key contributing factors to these adverse events include insufficient training, lack of provider collaboration and uneven application of evidence-based patient safety protocols.
- There is a paucity of evidence regarding the long-term impact of simulation training on patient outcomes.

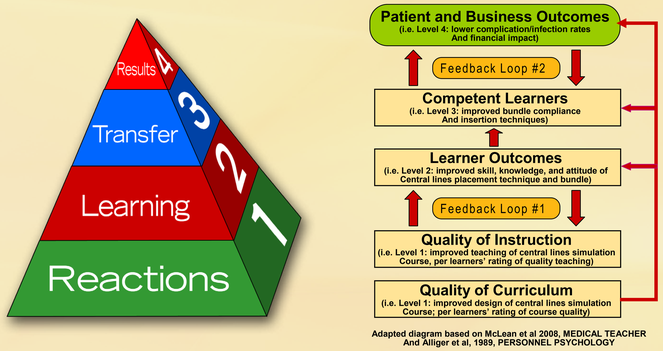
Objectives:

The study evaluates the impact of central lines simulation training program from 2006-2009 on learner and patient outcomes within the framework of Kirkpatrick's four-level evaluation model.

Methods:

- Assessing training effectiveness often entails using the four-level model developed by Donald Kirkpatrick. As shown in Figure 1, Kirkpatrick's model is based upon the premise that training programs can be evalauted across four levels:
  - Level 1 (reaction)
  - Level 2 (knowledge)
  - Level 3 (application)
  - Level 4 (impact)
- According to this model, information from each prior level serves as a base for the next level's evaluation. Thus, each successive level represents a more precise measure of the effectiveness of the training program, but at the same time requires a more rigorous and time-consuming analysis.
- The study utilizes a mixed methods, quantitatiave/qualitative approach to:
  - (a) determine reliability of evaluation instruments
  - (b) understand perceptions of resident course participants and nurses
  - (c) determine the relationships between course outcomes, operator practices, and patient outcomes
  - (d) validate the accuracy of data collected on the procedural checklist
  - (e) determine how changes in training, policies and protocols impact a hospital's central line-associated infections trend rate.

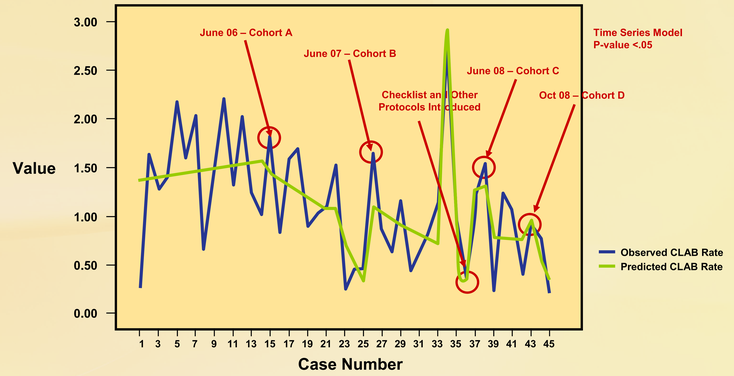
Figure 1: **Kirkpatrick's Four Level Evaluation Model**
Impact Study of a Central Lines Simulation Training



Results:

- Level 1 course evaluations indicated that simulation, small group teaching, and feedback were useful, relevant and motivating to participants.
- Level 2 t-tests and ANCOVA analyses of knowledge scores showed significant knowledge gains and retention within and between cohorts.
- Level 3 chi-square and linear regression analyses suggested that operators' Institute for Healthcare Improvement (IHI) central lines bundle compliance rate predicted their complications rate.
- Focus group data suggested that having a nurse in the room had an unanticipated effect of reducing the number of attempts by course taking residents and therefore, lowering complications rate.
- Cronbach's Alpha on the Level 3 procedural checklist instruments showed "good" reliability.
- As shown in Figure 2, Level 4 time-series analysis suggested that central lines training and changes in policies and practices had significantly reduced the hospital's central line-associated infection trend rate since April 2005.

Figure 2: **LVHN Central Lines Acquired Bloodstream Infection Rate**
April 2005 - December 2008



Significance:

- This study produced evidence suggesting that interprofessional simulation training contributes to better resident adherence with IHI Central Lines Bundle and lower complication/infection rates than if the course did not exist.
- Performance support mechanisms introduced in the course and present in the clinical setting, such as a central lines checklist and peer support, reinforce course learnings and enable skill transfer.
- Kirkpatrick's Four-Level Evaluation Model is a promising framework for evaluating the impact of clinical training programs on resident performance.