# Simulation-Based Usability Testing Methods Support Nurses' Safe Transition between Bar-Code Medication Administration Systems

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## Background

- There has been a recent shift from homegrown (typically single site) electronic health records (EHR) systems to large commercial EHR systems.
- Implementation of a new EHR changes the nature of the work done by its users, especially nurses and physicians.[1]
- Safe medication administration is a high volume, time-consuming aspect of nursing care that is considered high risk.[2]
- Changes to medication administration as a result of a new EHR in inpatient settings may affect patient safety in unexpected ways.

## Objective

- To facilitate a safe and effective transition from a home-grown EHR to a new large commercial EHR.
- Examine how nurses performed realistic tasks using both the prior and new EHRs' bar-code medication administration (BCMA) modules.

## Methods

- The evaluation included three phases of data collection: 1) baseline metrics in the prior BCMA system, 2) preliminary end user performance metrics in a training version of the new BCMA system prior to go live, and 3) follow up evaluation 4-5 months post-implementation in the new BCMA system.
- Participants *(Table 1)* included inpatient registered nurses who perform direct patient care at Vanderbilt University Medical Center; 15 total with 7 nurses completing all three phases of evaluation (Phase 1=12, Phase 2=14, Phase 3=9).
- Participants completed the same six tasks *(Table 2)* distributed across three simulated patients in each round. Task presentation order was counterbalanced.
- All sessions were audio and video recorded.
- Analysis included safety-related errors, successful task completion, use difficulties, time on task, and ease-of-use. *(Figures 1–4)*

## Results

***Table 1.*** **Participant Demographics**

| Demographic | % of total (n) |
|---|---|
| **Gender** | |
| Female | 86.7% (13) |
| Male | 13.3% (2) |
| **Age** | |
| 20-29 years | 40% (6) |
| 30-39 years | 33.3% (5) |
| 40-49 years | 26.7% (4) |
| **Education** | |
| Associate degree | 6.7% (1) |
| Bachelor's degree | 73.3% (11) |
| Master's degree | 20% (3) |
| **Nursing Experience** | |
| < 1 year | 20% (3) |
| Between 1-2 years | 13.3% (2) |
| Between 2-5 years | 13.3% (2) |
| Between 5-10 years | 13.3% (2) |
| > 10 years | 40% (6) |
| **Patient Population** | |
| Adult | 60% (9) |
| Pediatric | 33.3% (5) |
| Both | 6.7% (1) |
| **Practice Area** | |
| Critical Care | 33.3% (5) |
| Stepdown Unit | 20% (3) |
| Acute Care/Med-Surg | 46.7% (7) |
| **Comfort with Technology** | |
| First adopter | 46.7% (7) |
| See how works before adopt | 40% (6) |
| Adopt only well-established tech | 13.3% (2) |
| Reluctantly adopt new tech | 0% (0) |

***Table 2.*** **Tasks**

| Task | Description |
|---|---|
| **Hold & Administer** | Five medication orders due: hold two (subcutaneous insulin set dose + sliding scale dose); administer three/address BCMA alerts (adjust dose amount for a partial package dose, and administer multi-package dose) |
| **IV Fluids** | Switch existing IV fluids to new IVF order at a higher rate |
| **PRN Pain** | Administer PRN pain medication and document pain assessment/score |
| **Insulin** | Administer subcutaneous insulin doses (set dose + sliding scale) based on blood glucose value |
| **Downtime & PRN** | Document meds that were previously administered and documented on paper MAR during downtime and administer a PRN medication now |
| **Message** | Send a message to pharmacy to adjust insulin schedule |

***Figure 1.*** **Percentage of Participants Who Successfully Completed Each Task**

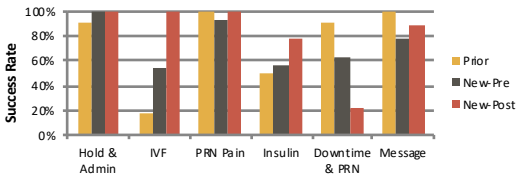



***Figure 2.*** **Average Number and Range of Safety-Related Errors by Task**

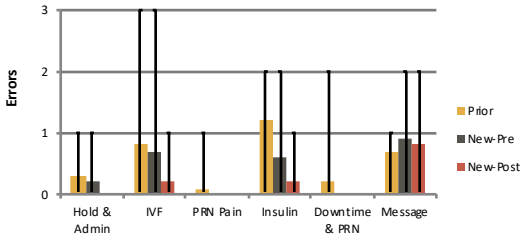



***Figure 3.*** **Average Task Times: Actual Performance Compared to Expected Pathway**

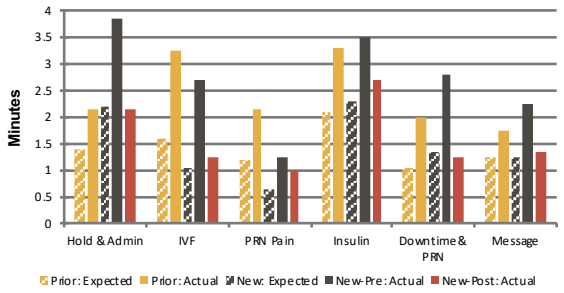
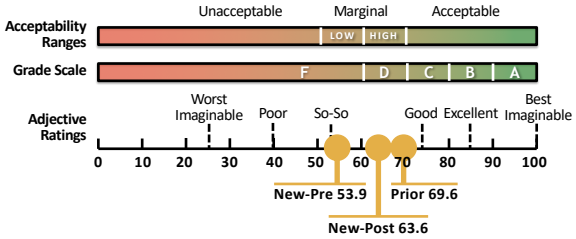



***Figure 4.*** **System Usability Scale (SUS) Scores**

*SUS scores range from 0-100 where higher scores are better*




## Conclusions

- Post-implementation performance in the new system was substantially improved over pre-implementation performance in all but one task, and in most cases, exceeded baseline performance in the prior system.
- Satisfaction ratings indicate a positive shift in perceptions of the new system that are approaching the ratings given to the prior system at baseline.
- These findings suggest that in less than six months post-implementation, the nurses had adapted to the new BCMA system and experienced enhancements in efficiency and effectiveness for the specific tasks evaluated.
- Study identified multiple opportunities for nurse informaticists to support and improve the BCMA system transition, including the development of highly targeted training to address known task pitfalls, opportunities to enhance the system's configuration prior to implementation, and evidence-based prioritization of future system optimization efforts.

## References

1. Ludwick, D. A., & Doucette, J. (2009). Adopting electronic medical records in primary care: lessons learned from health information systems implementation experience in seven countries. International journal of medical informatics, 78(1), 22-31.

2. Patterson, E. S., Cook, R. I., & Render, M. L. (2002). Improving patient safety by identifying side effects from introducing bar coding in medication administration. Journal of the American Medical Informatics Association, 9(5), 540-553.