Supplemental Digital Content # 1

Clinical Significance of Bar Code Administration Workarounds from the Literature

Authors (Year)	***Purpose***	***Research Design***	***Setting***	***Results***
Patterson, Cook Render (2002)	What negative unintended side effects, if any resulted from the introduction of BCMA that might create new paths to ADEs?	Cross sectional observation	Acute care and nursing home ward of 3 Veterans Administration hospitals	In observational study, 5 unintended consequences occurred that could result in error. These included; nurses unsure of how to use equipment; lessened coordination between providers; workflow interruptions; and nurses priorities changing.
Low, Belcher (2002)	Is there a difference in medication error rate after 12 month implementation of BCMA compared with the medication error rate 12 months before implementation of BCAM?	Retrospective, comparatives, descriptive	Two medical surgical units at Mid-west government hospital	No statistical significance was noted in the 2 groups. Note-increase in rate may be explained by difference in reporting system (before implementation reported by nurse, after implementation reported by BCMA).
Patterson, Rogers, Chapman, Render (2002)	To identify types and extent of work-around strategies with the use of BCMA in acute and long term care settings	Prospective, ethnographic	15 nurses in Acute Care and 13 long term care nurses	Noncomplieance observed in all settings and facilities; A larger proportion of acute care nurses than long term care nurses scanned bar coded wristbands to ID patients (53% versus 8%); A larger proportion of acute care nurses than long term care nurses administered bar-coded medications immediately after scanning significant (*p*-.0006).
Carayon, Wetterneck, Hundt, Oakaynak, DeSilvey, Gudwig, Ram, Rough (2007)	To explore nurses' use of BCMA technology from human factors viewpoint	Structured observations of BCMA process	19 interviews	18 different sequences were identified and represented very large variability in order of steps of the med. Administration process; some of the steps were potentially unsafe. Various working conditions hindered the med administration process. Some patient factors (e.g. isolation) were identified as making BCMA challenging.

Franklin, O'Grady, Donyal, Jacklin, Barber (2007)	To access the impact a closed loop electronic prescribing automated dispensing barcode patient identification and electronic medication record system on prescribing and administration errors, confirmation of patient identify before administration, and staff time.	Observational	28-bed general ward of a London teaching hospital in ICU or intermediate care units	Prescribing errors and medication administration errors dropped after implementation. Patient ID checks went from 82% of not checking to 18.9% post- implementation. Medical staff time for prescribing increased from 15 seconds to 39 seconds post-implementation. Nurses time for administration of medications decreased from 50 min. to 40 min. These findings were not statistically significant.
Hurley, Bane, Fotakis, Duffy, Sevigny, Poon, Gandi (2007)	What is nurses' satisfaction with medication administration.	Descriptive	Pre/post partum	Nurses were very satisfied with barcode/MAR. Increased scores in efficacy, safety, and access occurred and nurses acknowledged that extra time was wisely spent to assure verification findings were significant at ($p<.001$).
Ulanimo, Kelley, Connolly (2007)	What are nurses' perceptions of frequent causes of med errors? What is the estimated percentage of med. Errors reported? What are nurses' perceptions of barriers and empowerments to reporting> What are nurses' perceptions of the effects of Physician Order Entry (POE) and BCMA on med errors?	Descriptive	VA center in Northern CA	The causes of med errors were; 1) failure to check patients' identification band; 2) exhausted nurse. 28.9% of med errors were reported to manager. 60% of nurses because of fear of reaction from manager, and 40% feared reaction from peers. All nurses agreed that med. errors decreased since implementation of POE and BCMA.
Maviglia, Yoo, Franz, Featherstone, Churchill, Bates, Ganhi, Poon (2007)	To assess the cost and benefits and determine the return on investment at institutional level for implementing a pharmacy bar code system	Descriptive	735 bed tertiary hospital	Net savings after 5 years was $3.49M and the breakeven point occurred in 1 year after full implementation.
Poon, Keohan, Bane, Featherstone, Hays, Dervan,	To evaluate the impact of BCMA on nursing workflow	Comparative, time motion study	Voluntary participation by 232	Proportion of time spent on med administration. Activities remained

Woolf, Hayes, Newmar, Ganhi (2008)			hours. Medical, surgical and ICU at 735-bed tertiary hospital	unchanged, the proportion of time spent on inefficient activities fell from 10.8/5 to 7.3% (p <.03)
Koppel, Wetternec, Telles, Karch (2008)	Devlop technology	Observation	2 hospitals in midwest	10.3% of medications were over-Ridden; 31 types of workarounds were identified.
Morris, Abramowitz, Nelson, Milvetz, Miichael, Pendergast, Cook (2009)	To determine if BCMA technology would reduce preventable, ADEs in neonatal ICU	Prospective, observational cohort	NICU at midwest teaching hospital	The BCMA system reduced the risk of targeted, preventable ADEs by 47%.
Fowler, Schler, Zarillo (2009)	What is nurse satisfaction with current system and what is the nurse satisfaction rate with the electronic med. System 3 and 6 months after implementation	Descriptive comparative	Staff nurses	Most satisfaction was with safety of BCMA and least satisfaction with stat turnaround times.
Poon, Keohane, Yoon, Ditmaor, Bane (2010)	Evaluate the effects of bar-code technology on safety	Descriptive comparative	Observed 14,041 med. administrations	More errors on units that did not use bar code, Timing errors were decreased, no transcription errors were noted with BCMA

Key: ADE= Adverse Drug Event
POE= Physician Order Entry
Med= Medication
ICU= Intensive Care Unit
BCMA= Bar Code Medication Administration