

Bar Code Medication Administration (BCMA): Finding the Return on Investment

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Outline

- BCMA Overview
 - Cost
 - Benefits
- Complexity of measuring "prevented" errors from "near miss" logs.
 - "Near misses" estimates
 - Noise in the logs
- Strategy for measuring value of averted errors
 - Determining internal cost for adverse event
 - Sources/variables available to measure costs.
 - Strategies for collecting cases
 - Matching cases
 - Scales for assessing severity
- Summary and recommendations



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Growth in BCMA

Survey Year	Number	Percent
2008	527	25.1
2007	531	19.6
2006	460	13.2
2005	510	9.4
2004	493	4.4
2003	550	3.2
2002	505	1.5



Pedersen, C. A. and K. F. Gungor (2008). "ASHP national survey on informatics: assessment of the adoption and use of pharmacy informatics in U.S. hospitals—2007." *Am J Health Syst Pharm* 65(23): 2344-64.

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Ballpark of Cost for Average Hospital (191 beds)

- Initial costs
\$377,000
- Annual costs
\$320,000



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Food and Drug Administration, H. (2003). Bar Code Label Requirement For Human Drug Products and Blood: Proposed Rule, Federal Register. 68: 12500-12534.

Benefits to Bar Coding Drug Products

- Average likely liability award per preventable ADE \$532
- Societal \$181,600
- Drug charges 63 percent to 97



Food and Drug Administration, H. (2003). Bar Code Label Requirement For Human Drug Products and Blood: Proposed Rule, Federal Register. 68: 12500-12534.

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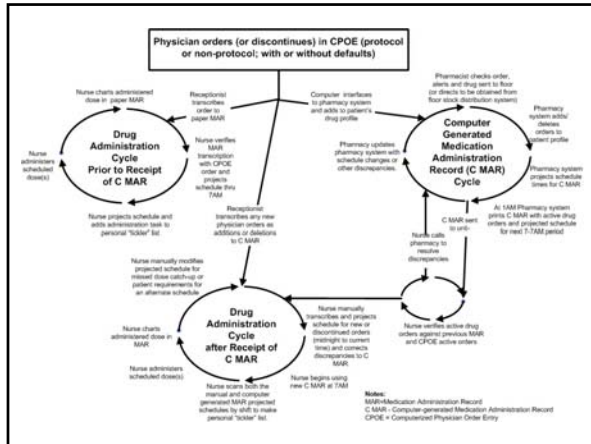
Impacts Processes

- Franklin et al 2007 -- Time Spent
 - Pharmacy service 68 min to 98 min weekdays (p = 0.001; t test)
 - Drug administration round 50 min to 40 min (p = 0.006; t test)
 - Nursing medication tasks other than drug rounds 21.1% to 28.7% (p = 0.006; xtest)
- Poon et al., 2006 – Time Spent
 - Statistically unchanged for time on medication administration
 - Before 26.5% -- after 24.5%



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Franklin, B. D., K. O'Grady et al. (2007). "The impact of a closed-loop electronic prescribing and administration system on prescribing errors, administration errors and staff time: a before-and-after study." *Quality & Safety in Health Care* 16(4): 279-284.
Dean, B. S., N. D. Barber, et al. (1999). "A validated, reliable method of scoring the severity of medication errors." *American Journal of Health-System Pharmacy* 56(1): 87-92.



Near Misses—How Do You Know?

Scanning Process

Medication Label

TRAZODONE TAB 50MG
 MFG BARR LABS 00555-0489-04
 LOT 9872 EXP 01/31/07
 CTRL TRAZODONE EXP 07/01/08

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Estimated Error Rate by Administrative Error Type per 1000 Opportunities

Error type	Baseline	Lower bound	Upper bound
Wrong drug	43	8.6	60
Wrong dose	129	43	456
Missed dose	43	9.5	49
Wrong frequency	34	18.9	34.4

9 (Karnon et al., 2007)

Probability of "No Harm" – Two Prediction Models from Karnon, 2002

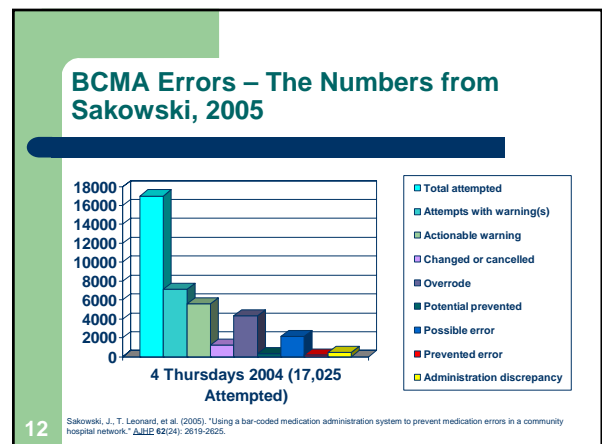
Parameter	Original values	Revised values
Prescription wrong drug & route	80–99%	50–70%
Prescription wrong dose & frequency	80–99%	70–90%
Dispensing	80–99%	96–99%
Administration wrong drug & dose	80–99%	98–99.9%
Administration missed dose & rate	80–99%	99.5–99.9%

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ADEs with Potential for Harm

	Baseline	Lower Limit	Upper Limit
No harm	95%	80%	99%
Significant harm	2%	1%	8%
Serious harm	2%	1%	8%
Severe/life threatening/fatal harm	1%	0%	4%

11 (Karnon et al., 2007)



Predicting the effect of “Cry Wolf”

- Alarm reliability known in advance or learned over time
- Demanding task primary task
- 10% all or none
 - Choose an optimal strategy
- Most responded in parallel to alarm reliability
- Consistent response requires reliable alarms



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Bliss, J. D., MC (2000). "Behavioral implications of alarm mistrust as a function of task workload." *Ergonomics* 43(9): 1293-1300.
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Findings on Near Misses

- Morriss et al., 2008
 - Pre BCMA 15.1/1,000
 - Post BCMA 4.4/1,000
- Franklin et al., 2007
 - Wrong dose 5/1,178
 - Omission 11/1,178
- Mahoney et al., 2007
 - Wrong patient 12.2/100,000
 - Wrong time 25/100,000
 - Wrong dose/drug/route 2.6/100,000



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Franklin, B. D., K. O'Grady, et al. (2007). "The impact of a closed-loop electronic prescribing and administration system on prescribing errors, administration errors and staff time: a before-and-after study." *Quality & Safety in Health Care* 16(4): 279-284.
Mahoney, C. D., C. M. Berard-Collins, et al. (2007). "Effects of an integrated clinical information system on medication safety in a multi-hospital setting." *American Journal of Health-System Pharmacy* 64(18): 1969-1977.
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BCMA Near Miss Rate (cont.)

Error	Not Given	Given	Doses	Proportion
No order	50	98	17025	0.0087
No order patient specific	7	0	17025	0.0004
Order discontinued	24	23	17025	0.0028
Wrong dose	0	123	17025	0.0072
Wrong route	4	5	17025	0.0005
Too early	88	167	17025	0.0150

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Sakowski, J., J. M. Newman, et al. (2008). Severity of medication administration errors detected by a bar-code medication administration system. 65: 1661-1666.

Direct Savings to Hospitals for Bar Code Medication Administration (BCMA)

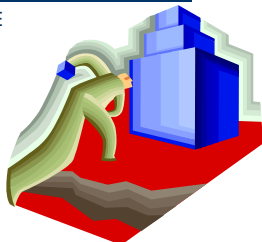
- Many positives to BCMA
- Hard dollars for inpatients from reduction in ADEs measured with “near misses”:



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Strategy for Identifying ROI BCMA

- Determine costs per ADE
 - Identify ADEs with harm
 - Identify matching case controls
 - Statistical analysis
- Count near misses with potential for harm
- Apply percentage would have caught anyway
- Near misses x costs = \$



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Costs of ADEs with Harm from the Literature—Matched Case Controls

- (Kaushal et al., 2007) – adverse events & drug events
 - \$3,961 medical intensive care
 - \$3,857 cardiac intensive care
- (Bates et al., 1997)
 - \$4685 for preventable ADEs
- (Senst et al., 2001)
 - \$2162
- (Gardner, 2003)
 - \$800
- (Food and Drug Administration 2003)
 - \$2,257
- (Backster et al., 2007)
 - Pre-op antibiotic timing \$2500



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Criteria for Selecting Matching Case Controls

- Age
- Gender
- Race
- Payer
- Time Period
- Nursing Unit
- Length of Stay
- Pre-event Costs
- Diagnosis
- Diagnosis Case Weight
- Severity
- Discharge Destination (especially alive or dead)



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Criteria so far...

- Nursing unit on day of stay of event case
- Admission date within 14 days of event case
- Length of stay >= event day
- Optimal score matching (Greevy, 2004)
- Four matches maximum



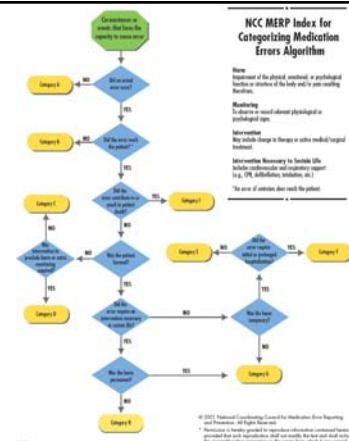
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NCC MERP Index for Categorizing Medication Errors Algorithm

- **Harm**
 - Impairment of the physical, emotional, or psychological function or structure of the body and/or pain resulting there from.
 - **Monitoring**
 - To observe or record relevant physiological or psychological signs.
 - **Intervention**
 - May include change in therapy or active medical/surgical treatment.
 - **Intervention Necessary to Sustain Life**
 - Includes cardiovascular and respiratory support (e.g., CPR, defibrillation, intubations, etc.)
- *An error of omission *does* reach the patient.

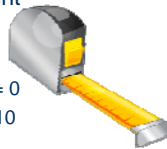


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Another Severity Scale

- Does not require patient abstraction/knowledge of patient outcome
- Eleven score scale
 - Incident with no potential effect = 0
 - Incident would result in death = 10



Sakowski, J., J. M. Neuman, et al. (2008). Severity of medication administration errors detected by a bar-code medication administration system. *ASA*, 16(1)-1656.
Dean, B. S., N. D. Barber, et al. (1999). "A validated, reliable method of scoring the severity of medication errors." *American Journal of Health-System Pharmacy* 56(1): 57-62.

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Discrepancies with Potential for Harm

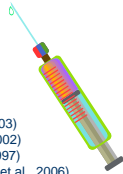
- Amount
 - 24 Hour dose and critical dose levels used in decision support
 - Single dose tenfold (Kozler et al.)
- Route
 - IV more serious (J. P. Santell & Cousins, 2005)
 - Wrong route/wrong technique disproportionate error rate (J. P. C. Santell, D. D.; Hicks, R., 2005)
- Setting - ICU vs. Obstetrics (Bates et al., 1997; Classen, et al., 1997)
- Timing - Pre-op antibiotics (Backster et al., 2007; Bratzler et al., 2005)



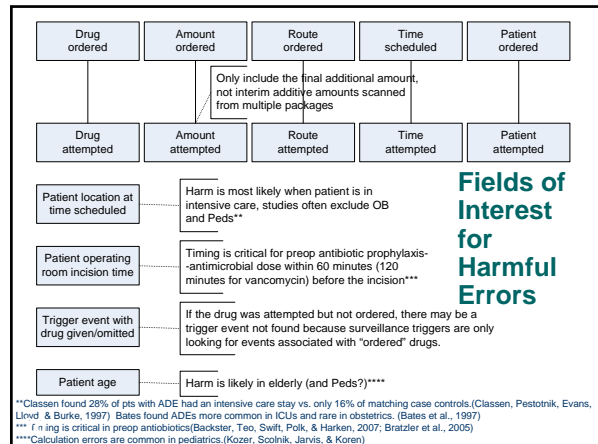
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Discrepancies with Potential for Harm - Wrong Drug

- Drug in drug classes included for costs by Poon (Poon et al., 2006)
- BCMA study sample -- 23 involved drugs with high potential for serious ADE. (Sakowski et al., 2005)
 - Opioids (morphine); n=11
 - Insulin; n=8
 - Anticoagulants (heparin or warfarin); n=2
 - Potassium; n=1
 - Sodium chloride; n=1
- High Alert Drugs (Cohen, 2007)
- Drug products reported in MEDMARX (J. P. Santell, et al., 2003)
- Drug categories reported by Winterstein (Winterstein et al., 2002)
- Drugs causal in errors reported by Classen (Classen et al., 1997)
- Drugs causal in 5 or more ADEs reported by Kane (Kane-Gill et al., 2006)
- Pediatric causal drug categories reported by Kaushal (Kaushal et al., 2001)
- MEDMARX top 10 cited in error reporting 2002-2003 (Santell et al., 2003)
- MEDMARX Neuro-Muscular Blocking Agents (Santell, 2006)
- Most harmful outcomes MEDMARX 2002 (Santell et al., 2003)



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Wrong Dose Criteria

Ignore "now and" orders with "now" half way or more to next scheduled dose*

Max/Min daily dosage (Enoki) Percent of Max/Min daily dosage

Total of this drug ordered for patient for 24hr (across orders and formulations) Total of this drug charged for patient for 24hr (across orders and formulations)

Max/Min daily dosage (Enoki) Percent of Max/Min daily dosage

What is the size of the over or underdose based on the clinician's intent and usual daily dose?

Drug Number: 99362 IASIX DILUEN

Should Dosage Range Checking be performed? Based on Frequency & Type of Units I99

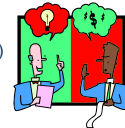
Category	Based On A	Minimum	Maximum	Per	Per
1	1.00	0.000	4.000	K	H
2	144.00	0.000	8.000	K	H
3	999.00	20.000	480.000		H
4	0.00	0.000	0.000		
5	0.00	0.000	0.000		

**We know Vanderbilt had omissions related to combined orders. (FitzHenry et al., 2007)

Dosage Range Percent Variation: 10.00%

Summary

- Evaluation so far...
- Strategy for quantifying hard dollars from BCMA
 - Identify cost of ADEs (or literature estimate)
 - Identify near misses with potential for harm
- Cost/benefit balances savings against system costs
- Improve and re-evaluate



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Recommendations

- BCMA application
 - Talk to other users/conferences
 - Read the literature
 - Dig into the detail for sample
 - Full day/week/unit for short period
 - Limited drug(s) for long period
- Pick a unit/drug with higher probability
 - High alert drug
 - Intensive care



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Final Thoughts

- Great potential for improving patient safety
- Pick your focus (e.g. de-emphasize timeliness?)
- Watch for new types of challenges
- Informed integration of the process changes
- Decision support
 - Integrate laboratory alerts
 - Allergy checks
 - Reasonable dose checks

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Questions?

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