Designing an Optimal eMAR for Nurses: Preliminary Findings of a Usability Study

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- David Butz Programmer, PS&E

Background

- Mismatch of nurses' workflow and computerized applications in acute care
 - User-centered design, usability principles still not widely adopted in health care
- Recent and continued focus on patient safety
 - Human factors, usability especially pertinent
- Medication tasks have clear correlation with both of the above
 - Studied computerized medication orders management studied little – used by many!
 - Yet, eMAR's being developed in many EHRs
 - eMAR at the center of integration of orders, meds, pt and all their devices

Purpose

- Determine critical nursing activities supported by safe and effective computerized medication orders management
- Evaluate a newly designed eMAR (electronic medication administration record) to determine user accuracy and satisfaction
 - Initially approved for a comparison study
- Outline design principles for eMARs

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Phase One – Activities Model

- IRB approvals x 4
- Interviews and observations of medication management tasks in 3 settings
 - Army, Navy, Air Force
 - Medical center in the southwest United States
 - Active clinic in the western US
 - Interviews of military nurses in graduate school at the University of Utah
- Information flow diagrams created and validated

Phase Two – Application Development

- Web application developed by David Butz using ASP.net
- Used the critical activities and the information flow identified during Phase One of the study
- Tested by the research staff and during a pilot study
 - Program and methods tweaked
 - Data accuracy improved for current meds

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		14b	Baker	John	22978457	М	36	Dr. H. Noonan	Charlson, Mark	
		14a	Blaney	Rick	12324578	М	55	Dr. T. Hubner	Ditzel, Wendy	
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		4a	Charlson	Mark	67439987	М	65	Dr. L. Kilpatrick		
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		2b	Ditze	Karen	67633249	F	63	Dr. R. McMurphy	view patient details	
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		4	Reisner	Gary	68904291	М	62	Dr. M. Moore		
		3	Richardson	Julia	23786108	F	56	Dr. J. Manning		
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		5	White	Patricia	90547283	F	55	Dr. M. Moore		
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Select	Allopurinol	600 g	Daily							Ditzel, Wendy Dockett, Roman	
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Phase Three – Application Evaluation

- Nurses recruited from a large medical center
 - Nielson indicates as few as 6-8 participants will discover 80% of design flaws
- 20 clinical staff nurses participated
 - 16 females, 4 males, modal education = BSN
 - Experience in nursing, mean = 7.8 years, range of 28 years
 - System use: CHCS (6), Pyxis (8) CliniComp (14)
 - Medical, surgical, L&D, critical care represented
 - Computer experience assessed by SNCEQ
 - Common uses centered in charting patient data, word processing, email
 - Most currently charted medications mail using CliniComp

Phase Three – Application Evaluation

- Study held in the site's computer training room, away from patient care areas on identical PCs
- Procedure for participants after a consent was signed
 - Completed the SNCEQ (computer experience)
 - Learned the application using a standardized, computerized training application developed by Christine Brown using Captivate
 - Assessed the application using scenarios
 - Add, delete, modify, find interactions, find meds due, etc.
 - Study completion time was 45 minutes to about 1 hr 30 min
 - Completed Questionnaire for User Interface Satisfaction or QUIS and other questions of interest

Phase Three - Application Evaluation

- QUIS (Questionnaire for User Interaction Satisfaction) scores
 - Overall score, M = 7.34 (range 1-9)
 - Highest score for difficult or easy (8.2)
 - Lowest for dull or stimulating, inadequate/adequate power (7)
 - Terminology, M = 7.3
 - Highest score for inconsistent, consistent messages (8)
 - Lowest for terminology relates well to the work you are doing (3.3)
 - On-line tutorial, M = 7.8
 - Highest score for time given to perform tasks (8.3)
 - Lowest for speed of presentation (5.8). Tutorial went at a set speed)

Phase Three - Application Evaluation

- QUIS scores, cont.
 - Learning, M = 7.5
 - Highest for ease of remembering names and uses of commands
 - Lowest for feedback on completion of steps
 - Multimedia, M = 8.4
 - Highest for sound and focus quality (8.9)
 - Lowest for colors used (7.5)
- User satisfaction positive overall
 - 90% agreed or strongly agreed that the application provided good situational awareness of all patients
- Also queried about specific task performance
 - Use of roster, new, modify, d/c meds

Comments – Pro's

- "Good colors and symbols for easy ID of route of medication and if given."
- Liked the daily roster.
- Include the med type (antibiotic, anti-hypertensive)
- Like having notes, instructions on the same page
- "I love the ease of entering information and how the program keeps track of your meds and times for each patient."

Comments – Pro's and Con's

- "More accurate than current system."
- Icons for medication routes "Loved it!" "I liked the graphics"
- It is a user-friendly system. "It is consistent with the 5 rights and I am focused on reducing risk of medication errors."
- Overall meets my medication mgmt needs
 - "But not on L&D" L&D uses a few set meds; too many hoops required in this application"
- Make format consistent with Microsoft when possible

Comments – Con's

- The tutorial was too slow
- Would like more hours visible to the right
- When patients are in and out frequently, this application would not save time
- Users did not find all the meds, routes when asked (they did not scroll to find meds offscreen)

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Integration and real-estate

- Auto-connect to orders, automed-interactions
- Organize by bed number on the left of pt name everywhere
- Allow as much real-estate for meds display as possible
 - X/Y layout works (pt and meds on left, time above)
 - Progressively disclose specific order info for modify, new only
- Have user preference for viewable times (some want 12hour display
- For pts with a lot of meds, very clear indication of continuing pages, whole line with "MORE"
- Auto-message to pharmacy, physician for new, modified orders

• Graphics

- Icons for medication route very well accepted
 - However, prn's should not be displayed like routine meds
- Have current pt in "attention-grabbing color"
- Gray out meds given
- Red or another alert color for meds due now/over-due
 - Do not use flashing icons, have a connection to reason for meds not going to be given
- Different appearance, color for d/c'ed meds screen

• Display

- Name, bed bolded, separate and clear from other text on every screen
- Flexible roster able to be sorted by time, individual patient
- Special instructions viewable on same page as med without click if possible
 - Need a clear indicator of instructors on summary view
- Feedback to user when step completed
- User preference for scroll range from 1 hr to whole shift
- Allow charting for range of doses (1-2)
- No case sensitive requirements (meds in all CAPS)
- Include an immediately available drug calculator with the eMAR

• Efficiency requirements

- Allow batch charting, e.g., all 9AM meds given
- Use principles similar to common apps like
 Microsoft file, edit view, e.g., placement of roster
- Rethink display for L&D and other fast-paced environments (default to roster list perhaps?)
- Progressive disclosure for parsed information
- Nurses count clicks so designers must count the number of clicks for each function, especially the common ones

Conclusions

- Graphical representation of routes immediately recognizable to nurses
 - Differentiates from all the text
 - No universal symbols yet, e.g., sublingual
- Getting the "big picture" of meds delivery with an eMAR is helpful, maximize real-estate
- Still more work to do to match the workflow of each specialty to an eMAR in the future

Next Steps

- Refinement of eMAR still required (complex activity)
- Wide-spread integration of bar-coding devices, meds dispensing machines such as Pyxis, orders, ADT (registration) and eMAR
- Increased attention to the impact of workflow on design of high intensity applications like eMAR

Acknowledgements

- CDR Axman, Nurse Researcher for her help with this study
- Patricia Kelley, TSNRP, Washington DC
- We would especially like to thank the volunteer participants in this study
 - With many staff members deployed, these nurses still found time to help with our study