Nursing students use of mobile technology to reduce medication errors at the point of care

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Introduction

- Medication errors - major cause of harm to patients

- IOM (1999) - 44,000 & 98,000 Americans die/yr as a result of medical errors

- This exceeds the no of people that die from MVAs, Breast Ca & AIDS

- IOM - one death/day in the U.S, stressed pt safety as a priority

- NCCMERP(1999) - reported > 106,000 hospitalized pts die and 2.2 million are injured/yr as a result of medication errors.
Introduction Cont’d

- IOM believes that med errors occur due to the failure in the planned action in the course of providing care.

- Our health care system-offers healing & comfort “First, do no harm.”

- AACN & NLN recognizes integrating technology as an increasing opportunity in teaching through the use of evidence-based practice, simulation and PDAs to provide students with clinical experiences in diverse settings.

- Nov, 2003, IOM drew attention to the need of technology emphasizing the area of medication administration.

- PDA technology can make a difference in the ability of nurses to provide safe patient care in the area of medication adm by having access to the latest health care info at the point of care.
In 1999, the IOM set a goal to reduce medical errors by half within 5 yrs & this goal has not yet been met.

JCAHO(2003)-Patient safety standard- Healthcare organizations to adopt measures to improve patient safety & reduce med errors. It also issued its National Patient Safety Goals- 5 of the 6 apply to meds.

NCCMERP & JCAHO – advocated use of technology to reduce human error & have noted the need to identify, analyze & assess med errors as a strategy to decrease their incidence.

AAN(2002)- indicated that med errors can be reduced by using new technologies.

AAN believes that handheld technology can provide nurses & nursing students instant access to healthcare info at the bedside thereby allowing them to work with greater accuracy, yet with greater safety, thus reducing the incidence of med errors.
Background of the Problem

- Greenfield (2007) demonstrated this in her pilot study.
- PDAs - small mobile handheld devices - used to enter, organize & easily access info, also used for faxing, emailing, networking & a phone, users can exchange data.
- In the health care field, can be used at the bedside to access information.
- Can be installed with software - includes a calculator, med ref tools & textbooks.
- Healthcare providers need fast & easy access to info especially in the clinical setting.
- Books & ref materials are cumbersome, maybe updated q 4 yrs. PDAs are portable, practical alternatives to traditional ref materials, can be synchronized with the latest data, an important benefit in avoiding med errors.
- Having access to info at the point of care is a benefit in improving patient safety.
Significance of the Problem

- Nurses are the main professionals involved in administering meds.
- Medication adm is part of the med process with the least safeguards in place.
- Many factors can contribute to med errors from the initial Rx stage to the actual adm of med to the patient.
- When meds are adm every nurse adheres to the 5 rights- the right pt, the right drug, the right route & the right time.
- Nursing shortage- affects all aspects of nursing care including med adm. Caring for increased no of pts can lead to med errors.
- Safe med adm requires accurate pt assessments, multiple dosage calculations, knowledge of drug actions, their interactions & toxicities.

Significance of the Problem

- 2003, NLN recommended reform and innovation in nursing education to shape the future of nursing practice, at the same time promote patient safety, suggested use of information technology including PDAs.

- Nursing student experience high levels of stress and anxiety in their nursing education, Rosenthal (2003) recommends PDA to be an effective technological tool to improve nursing education by providing access to nursing and medical data to students, decreasing stress, at the same time improving nursing care.

- At a private university, the faculty of their SON recognized the need to incorporate the use of PDAs into the nursing curriculum of their undergraduate nursing program, in an effort to improve patient safety and decrease med errors.

- Research has shown that med errors can be reduced and nursing care can be provided more efficiently (e.g. Greenfield, 2007).

- This investigator conducted an evidence-based pilot project to demonstrate that meds could be calculated with greater accuracy and speed using a PDA.

- The goal was to incorporate their use into the nursing curriculum if outcomes are positive.
Statement of the Problem

The burning question was “In junior undergraduate medical-surgical students, will the use of handheld technology (PDA) in calculating drug dosages for oral medications, intravenous fluid rate & checking indications & side effects of meds increase the accuracy and speed of medication calculations compared to the usual practice of using textbooks and a calculator?”

P- population of interest was the twenty undergraduate nursing students enrolled in the M/S course from Nov, 08 to April, 09, from a school in northern NJ. I-A group of students used handheld technology (PDA) in completing a case study during the post-conference period of the students’ clinical rotation

C-The same group of students used textbooks and a calculator to complete the same case study. O- outcomes were accuracy and speed of medication calculations in a case study
Conceptual framework

- Change theory by Kurt Lewin

- Lewin states “If you want to truly understand something, try to change it”

- Three steps: Unfreezing, change and refreezing

  - Unfreeze: change behavior by unfreezing the existing status quo - traditional use of textbooks. Faculty & students need to be educated on the significance of medication errors in the current health care system- adopting new technology can support practice & provide safe patient care

  - Change: Change what needs to be changed. Implement the pilot study and demonstrate that results support the use of this technology

  - Refreeze: Make the change permanent and sustain it. Require all incoming students to purchase a PDA and continue collecting data on its effectiveness and use and how it has changed practice.
Operational definitions

- In this pilot project:
  - PDA is a handheld device that is installed with med software programs & other applications such as calculator, address book, textbooks, etc.
  - Baccalaureate undergraduate nursing student is an individual enrolled in a 4 yr traditional nursing program in a SON, at the culmination is eligible to take the state licensing examination.
  - Med error is any preventable event that may cause or lead to inappropriate med use or patient harm while the med is in control of the health care professional.
  - Accuracy was the total no of questions answered correctly on the case study, the total no of questions was ten.
  - Speed was the total time taken to complete the case study.
A systematic search and review of the literature was conducted by this investigator to find the best evidence that supports the use of PDA technology in the nursing curriculum thereby reducing medication errors, a major concern in health care today and to identify gaps in the literature.
Review of the Literature

- Greenfield, 2007 - Level III single non-randomized Quantitative quasi-experimental study showed higher accuracy and speed in med adm with students using PDA compared to students who use the textbooks and calculator

- Descriptive & Qualitative studies & articles

- Huffstutler et al., 2002 – good review on adopting & integrating handheld technology, prepare graduates to be marketable

- Stroud et al., 2005, Level VI qualitative study – PDAs facilitate the application of evidenced-based knowledge to practice

- Fisher et al., 2007 - support the capability of PDAs as a quick & reliable resource for nurses

- Martin, 2007 - recommends PDA use in baccalaureate nursing schools, its benefits & limitations
Review of the Literature

- Rempher et al., 2003 - PDA provides point of care access to clinical resources - improve quality of care & potentially reduce med errors

- Miller et al., 2005 - PDA incorporation in undergraduate clinical course will be a value & skill of seeking current info & will become a routine that nursing students use in their professional practice

- George et al., 2005 – PDA technology can support the student & eventually the practicing nurse to focus more time on patient care

- White et al., 2005 - Recommend nursing students to embrace this technology in the undergraduate program
Review of the Literature

- Honeybourne et al., 2006- Handheld technology provides critical info at the point of care with a resulting benefit to pt safety

- Klainberg et al., 2002- PDAs important to all healthcare providers

- Peterson, 2003- PDA will be a wave of the future, every nurse will carry a PDA, just as they do a stethoscope

- A review of the lit supports the use of PDAs by nursing students as a valuable tool in their learning experience & to have access to the latest health care info at the point of care to provide effective, efficient, evidence-based patient care
Benefits of PDA

- PDAs are small, mobile handheld device
- PDAs are timesavers, used anywhere, anytime
- Can be used to enter, organize & easily access various types of information
- Faxing/telephone, e-mail, internet, networking
- Promote evidence-based decision making by providing reliable information at the point-of-care
- Exchange data with a desktop computer, either to back up the PDA or to download information.
- Improves student-faculty time management & organization in the clinical setting
Examples of PDA Software

- Quick Drug References, ex. Epocrates, Abx guide, Medscape
- Calculators, ex. Medcalc
- Diagnostic Tests, ex. Unbound Medicine, Nursing Central
- Clinical Reference, ex. Current Consult
- Dictionary, ex. Taber’s Cyclopedic Medical Dictionary.

More Nursing software can be found on the PDA cortex website, [www.pdacortex.com](http://www.pdacortex.com).

Nursing software are also available from Lippincott Williams & Wilkins
Clinical Reference

- Look up diseases & diagnoses
- Differential diagnosis information
- Recommended diagnostic tests
- Recommended treatments
- Updated frequently with web resources
**Diagnostic Tests**

- Laboratory, imaging, & microbiology tests
- Pocket Guide to Diagnostic Tests:
  - Which test is best to diagnose, screen, or follow a certain condition?
  - How do I interpret an abnormal diagnostic test?
  - How do I collect the appropriate specimen or prepare the patient for testing?
  - Where can I find more information on this test in the medical literature?
Quick Drug References

- Latest drug updates
- Many free programs
- Adult & pediatric dosages
- >3,300 brand and generic drugs, including dosing, interactions, black box warnings, safety & monitoring, adverse reactions, & pricing
- Multi-Check multiple-drug interaction checker
- Replace outdated unit medication manuals
Calculators

- Drug dosages
- IV drip rates
- Pediatric/adult conversions
- BMI
- Glasgow coma scale
- Urine output
- Mean arterial pressure
- Pregnancy calculator
- And more!

Medical calculator
Medical Dictionary

- Definitions of medical terms
- Cross-link to other content in dictionary
- Pronunciations for some terms

Medical dictionary
Examples of Schools currently using PDAs in Nursing Education

- University of Miami
- Yale University.
- Vanderbilt University.
- Duke University.
- University of Louisville.
- Columbia University.
- University of Virginia.
- Ball State University.
- Washington State University.
- The University of Texas at Austin.
- The University of Tennessee, Health Science Center.
Methodology

- Rosswurm and Larrabee model was used as the EBP model
- Six steps: assess, link, synthesize, design, implement & evaluate and integrate & maintain

  - Step 1: need for change was assessed, medication errors major concern, nurses are the main professionals. Providing them with access to the latest information can have the potential to decrease medication errors

  - Step 2: Link it to an intervention, incorporate handheld technology which can provide nurses and students access to the latest info to allow them to work with greater accuracy, less time and greater safety

  - Step 3: Best evidence was synthesized. Greenfield’s study was used to guide the project and do a similar project

  - Step 4: The decision to design a change in practice was made. An evidence-based pilot descriptive study was planned using undergraduate nursing students
Step 5: The implementation of the project was done on clinical units at 2 major medical centers in northern NJ. The data was collected, analyzed and recommendations were made.

Step 6: Integrate and maintain this practice change by requiring all incoming undergraduate students purchase a PDA with a nursing software.

Evaluation and maintenance of this practice change can be validated by conducting another evidence based project using a larger number of students at all levels.
Methodology Cont’d

- Study design – evidence-based pilot descriptive project
- Setting – clinical units at 2 major medical centers in northern NJ where the students perform their medical-surgical clinical rotation
- Sample- convenience sample of 20 undergraduate junior nursing students
- Inclusion criteria: successfully completed the nursing competencies in the skills of medication administration & passed the Med calc exam with a grade of 90%
- Protection of human subjects: Participation was voluntary and informed consent was obtained (Appendix A)
- Equipment: Palm E2 PDA with nursing central software by Unbound medicine
Methodology Cont’d

- 10 PDA’S were purchased by the researcher

- Student training- 2hr training sessions provided by a rep from the company with a ppt presentation and hands on use with the PDA. In addition, the researcher reviewed the use of the PDA with each participant prior to the implementation.

- Procedure: After the consent form was signed, a demographic form was completed (Appendix B)

- They were then given a case study (Appendix C) & a Medication Administration Record (MAR) (Appendix D)

- Case study – 10 questions (calculating drug dosages, intravenous fluid rate, indications and side effects of medications)
Methodology Cont’d

- Each participant was given time to read the case study, become familiar with the PDA ask questions prior to the actual test.

- Encouraged to research any information in the PDA & use the calculator section of the PDA

- Re-read the case study, complete the 10 questions and sign off on the MAR.

- The researcher recorded each participant’s beginning and completion time.

- At the end, they were asked to fill out a post evaluation survey (Appendix E)

- Outcomes measured: Accuracy and Speed

- Accuracy was determined based on the 10 questions, each correct answer received a score of 1- max 10

- Speed was the length of time each student took to complete the case study
Methodology Cont’d

- The comparison group was the same 20 students who used the PDAs to complete the case study.

- Each participant completed the case study using textbooks and a calculator, beginning & completion time were recorded.

- The PDA group & the textbook group completed the same case study 4 months apart.

- At the end, they were asked to fill out a post evaluation survey (Appendix E)

- Outcomes measured: Accuracy and Speed

- Accuracy was determined based on the 10 questions, each correct answer received a score of 1- max 10

- Speed was the length of time each student took to complete the case study

- Statistical procedure: t test was used to determine the level of significance of the differences between means of the groups.
Results

- The mean accuracy for the PDA group was 9.90 and 9.65 for the textbook group, df was 38 and p = 0.06.

- The level of difference between the two groups was not statistically significant, however the mean accuracy was higher by 0.25 in the PDA group compared to the textbook group.

- The mean speed was 7.25 mins for the PDA group and 12.0 mins for the textbook group, df was 38 and p = 0.0001

- The level of difference between the means for the two groups was statistically significant.

- This may show that the PDA group worked at a faster speed than the textbook group.

- The standard deviation for the two groups revealed that the participants responses were similar to the mean.
Discussion of Findings

- This revealed that the students using the PDA technology calculated medications with greater accuracy and speed.
- Post evaluation survey- 100% of the participants recommended the use of PDA technology in the undergraduate nursing curriculum.
- Help them save time, accurately retrieve information about medications, and accurately calculate dosages of medications.
Policy Implications

- Implications in nursing education & the workplace
- Rapid access to health care information
- Integration of PDA technology must be a component of the University’s and the SON mission.
- Cost of the technology - financial aid, course fee, site license
- Security – HIPAA
- Patient confidentiality
Implications for the future

- Marketing tool for nursing schools for prospective nursing students
- Practicing nurse spend more time on patient care, less time tracking information, access to latest information
- Employers expect graduate nurses to have latest IT skills
- Hospitals provide PDA hardware, software & docking stations & training
- Reduce medication errors
- Involvement of nurses in designing software
- Good point-of-care entry tool
- PDAs are here to stay- tool of the future
Implications for the future

- PDA- as a relatively new technological breakthrough-helps to ease the routine & tedious process that accompany the field of nursing

- Allowing students at the university level to grow with this tool as they delve into their nursing careers, will also allow them to carry this useful tool to their future jobs

- Health care professionals require access to ever-expanding knowledge, and PDAs or other handheld computer devices can serve as valuable tools for education, information storage and retrieval, and clinical practice (George et al., 2010)

- Using PDA technology at the point of care; by a bedside, in the community, in the office, or in a patients home can reduce errors and promote patient safety. It provides a mobile platform whereby the nursing student or nurse can download various types of software and access information quickly that supports evidence-based nursing practice (Beard et al., 2011)
Recommendations for future research

- Recommends that all incoming nursing students be required to purchase the PDA software
- Since this will be a requirement for the course, it should be covered by financial aid either as a course fee or by site license
- The researcher suggests repeating the evidence based study on a larger sample size at the end of the first semester at all levels, since this study can be generalized
- The researcher also recommends the clinical instructors use the PDA in the clinical setting and obtain feedback on its usefulness
- Implementation of handheld technology in the nursing curriculum would guide best practice and provide the groundwork for organizational change at the university level
- The rapid influx of mobile technology into nursing practice also dictates that nurse educators train current and future nursing students to deliver new strategies of care. This also provides an opportunity for nurse researchers to indulge in evidence-based research to confirm the effectiveness of these strategies in providing optimum health care (Melyn, 2012)
Appendix A: Informed Consent

To the Participant:

- You have volunteered to take part in a study to measure the accuracy and speed of medication administration with the use of a personal digital assistant (PDA).

- Your part in the study will involve completing a case study using the personal digital assistant (PDA) during your medical-surgical clinical rotation at post-conference. Your participation in this study is voluntary. If you choose not to participate or withdraw from the study at any time, there will be no penalty nor will it affect your grade. Your instructor will not see your answers. The results of the research study may be published, but your name will not be used. The demographic tool that you will fill will be kept confidential.

- All responses will be coded without identifying information about you. There will be no sharing of individual responses and responses will be kept confidential. Results collected by the researcher at completion will be stored in a locked drawer in the researcher’s office. Upon completion of the statistical analysis, the data will be stored in a secure room in the researcher’s office. The only people who will have access to this information will be the researcher, the researcher’s advisor and a statistician.

- There will be no risks involved with participation in this study. The results of the study would be beneficial to you and future nursing students in that it will promote an understanding of whether or not it would be efficacious to require nursing students to purchase personal digital assistant (PDA) for use during their clinical experience.

- If you have any questions about the study, please contact Laly Joseph at 201-692-2436.

- After reading the above, I hereby voluntarily consent to participation in this study. I am aware that I have the right to withdraw from this study at any time without penalty.

- Summary of the Study

- I would like to get a summary of this study:
  - Circle One: Yes No

- Participant Name (print):
  
- Participant Signature:
  
- Date: ________________________________

- Principal Investigator Name: Laly Joseph

- Principal Investigator Signature:
  
- Date: ________________________________
Appendix E: Demographic Tool

Please complete this form.

1. Age: __________

2. Gender: __________

3. Computer Skills (Place an X if you have knowledge of the skill or state if any other)
   - Word Processor (eg. Microsoft word) ______  Presentation software (eg. Powerpoint) ______
   - Web search techniques (eg. Medline) _____  E-learning software (eg. Blackboard) _______
   - Spreadsheets (eg. Excel) ____ Databases (eg. Access) ___ Statistical programs (eg. SPSS) ___

4. Do you own a computer?
   - a. Yes ________  b. No _________
   - If no, what resources do you use to access a computer _____________________________

5. Do you own a Personal Digital Assistant (PDA)?
   - a. Yes _____  b. No ______
   - If Yes, How often do you access it in day, state number of times ____________

6. Would you be interested in using PDA technology in school?  A. Yes ____ B. No __
Appendix C: Case Study

Mr. James Jones, a 60-year old patient is seen at the dialysis center for weekly dialysis treatment. The patient weighs 140lbs after dialysis. He has no known drug or food allergies. The orders from his physician, Dr. Taylor include:

- Obtain weight three times weekly prior to and after dialysis
- Furosemide (Lasix) 120mg PO twice daily
- Metolazone (Zaroxolyn) 10mg PO daily
- Enalapril maleate (Vasotec) 2.5mg PO twice daily
- Epogen 4000 units IV three times weekly in venous line following dialysis
- Calcium carbonate 3000mg PO with each meal
- 0.9 % Normal saline 500ml IV every 24 hours

Solve and answer the following problems:

- What is the clinical indication of Furosemide?
- Calculate how many tablets of Furosemide the patient is taking per dose. Supply: Furosemide 60mg /tablet. Mark the medication administration record (MAR).
- List two side effects of Metolazone
- Calculate how many tablets of Metolazone the patient is taking per dose. Supply: Metolazone 5mg/tablet. Mark the MAR.
- Name the class of antihypertensive drug that Vasotec belongs to.
- Calculate how many tablets of Vasotec the patient is taking per dose. Supply: Enalapril maleate 2.5mg/tablet. Mark the MAR.
- What is the clinical indication for Epogen?
- Calculate how many ml of Epogen the patient should receive per dose. Supply: Epogen 4000 units/ml. Mark the MAR.
- Calculate how many tablets of Calcium Carbonate the patient will receive with each meal. Supply: Calcium carbonate 1500mg/tablet. Mark the MAR.
- Calculate ml/hr of 0.9% Normal Saline the patient will be receiving
Appendix E: Post-Evaluation Survey

In your opinion does...

■ Using PDA technology in the clinical setting would save you time.
  ■ YES  NO

■ Using PDA technology in the clinical setting would help you accurately retrieve information about medications.
  ■ YES  NO

■ Using PDA technology in the clinical setting would help you accurately calculate dosages of medications.
  ■ YES  NO

■ Would you recommend the use of PDA technology in the nursing curriculum.
  ■ YES  NO


“Classroom without boundaries, in which anytime and anywhere learning is a reality. Mobile devices like the PDA can open a door of lifetime learning, as students are capable of moving from one learning environment to another” (Franklin, et al, 2007).

Questions?