IMPROVING MEDICATION SAFETY IN PUBLIC HOSPITAL SETTINGS: DEVELOPMENT AND USABILITY TESTING OF A MOBILE APP-BASED VISUAL DRUG IDENTIFICATION TOOL FOR BEDSIDE NURSES

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Abstract

Medication errors represent a major patient safety issue in Public hospital settings, with up to a third resulting in harm. Visual identification of drugs by bedside nurses is a frequently cited contributing factor. This study aimed to develop and test a mobile application-based visual drug identification tool to improve nurses' accuracy and efficiency in Public medication identification. An Android prototype app providing high-resolution images of common Public drug tablets and capsules was iteratively refined based on user-centered design principles and feedback from end-user testing with 15 Public nurses. Quantitative analysis of drug identification tasks demonstrated significantly improved accuracy rates (18-31% gains) and efficiency (35-55% time reductions) using the app compared to traditional references. In qualitative assessments, nurses reported excellent usability and high perceived utility of the app. Results provide support for implementing this innovative mobile app in Public hospital units to reduce medication selection errors and improve medication safety.

Introduction

Medication errors are one of the most prevalent safety issues affecting Public patients in hospital settings globally (Ameer et al., 2014; Rinke et al., 2014). Studies indicate up to a third of all Public medication errors result in harm, with the most common involving incorrect drug

selection and preparation (McPhillips et al., 2005). Public patients face higher risks due to complex weight-based dosing, limited communication abilities, and other factors (Ameer et al., 2014). Nurses play essential roles in medication administration but frequently lack robust tools to aid visual identification at the bedside. This study aimed to develop and test a mobile application providing images of Public drug products to assist nurses in accurate visual identification as a strategy to improve medication safety.

Background

Public Medication Errors

The Institute of Medicine has identified medication errors as one of the most common preventable Public adverse events (Miller et al., 2006). Error rates in hospitals range from 3-37% of orders involving children (Miller et al., 2006). Errors occur across the medication process from ordering through administration. High-risk steps include drug preparation/selection and administration, where nurses play central roles (Keers et al., 2013). Resulting harm includes organ damage, disabilities, and even fatalities (McPhillips et al., 2005).

Contributing Factors

Numerous factors contribute to Public medication errors including calculation complexity, variation in weights/doses, lack of formulations, and communication (Ameer et al., 2014). At the bedside, a frequently cited issue is visual identification and differentiation between drugs with similar appearances but different clinical uses (Keers et al., 2013). Standard references lack sufficient resolution to aid identification. This gap motivated developing an innovative tool to improve bedside medication identification.

Improving Safety

Strategies such as computerized order entry, barcode scanning, inventory management, and parent engagement help prevent errors (King et al., 2006; Miller et al., 2006). However, nurses still rely heavily on visual inspection at the bedside, requiring appropriate cognitive aids. Mobile applications represent promising tools providing point-of-care information resources.

Rationale for Mobile App Tool Development

This study developed and tested a tailored mobile application to assist nurses in accurate visual identification of Public drug products as a strategy to improve medication safety and reduce errors. The app aims to address the gap in appropriate, accessible tools to support drug product differentiation at the bedside.

Research Aims

1. To develop a mobile app-based visual tool to assist nurses in accurately identifying common Public drug tablets/capsules.

2. To evaluate the usability and perceived utility of the app among Public nurses at the point of care.

3. To assess the impact of app use on efficiency and accuracy of medication identification compared to standard references.

Conceptual Framework

The study was guided by a user-centered design process focused on creating tools optimized for end-user needs (Aitken & Marshall, 2018).

Methods

Setting and Participants

Nurses were recruited from the Public inpatient unit of a 400-bed hospital in Riyadh, Saudi Arabia. Inclusion criteria were:

-Registered   nurse
->1   year   Public   experience
-Involved in bedside medication administration

Prototype App Development

An Android prototype app was developed through an iterative user-centered design process. It provided:

-High-resolution images of 50 common Public drugs

-Smart search and navigation features

-Offline access with automatic updates

Testing Procedures

A convenience sample of 15 nurses tested the prototype app. To assess identification accuracy, nurses utilized the app and standard references to identify 15 unlabeled drug samples. Time-to-identification was recorded. Ademographic survey, usability scale, and semi-structured interview were also administered.

Analysis

Accuracy was analyzed using percentage correct. Efficiency was evaluated via time-to-identification. Qualitative data was analyzed using content analysis for key themes. Demographics were analyzed descriptively.

Ethical Considerations

Institutional review board (IRB) approval and informed consent were obtained. Participation was voluntary and data confidential.

Results

Participant Characteristics

The sample included 15 Public nurses with a mean age of 30.4 years (SD 4.1) and mean experience of 4.7 years (Table 1). All regularly administered medications at the bedside.

Table 1. Participant Demographics

Demographic	Mean (SD) or n (%)
Age in years	30.4 (4.1)
Female sex	12 (80%)
Years of experience	4.7 (2.9)
Highest nursing degree:	
-Diploma	8 (53%)
-Bachelors	5 (33%)
-Masters	2 (13%)

Identification Accuracy

The app significantly improved accuracy identifying unlabeled drugs compared to standard references (mean 92% vs 71% correct, $p<0.05$). All participants had higher accuracy rates using the app (Table 2).

Table 2. Identification Accuracy Results

Reference	Mean % Correct (SD)
Standard	71 (12)
App	92 (8)

Identification Efficiency

Mean time required for successful identification was 47 seconds with the app compared to 85 seconds with standard references, a 55% reduction ($p<0.01$).

Perceived Utility

All participants rated the app as extremely or very useful for supporting bedside medication identification. Reported benefits included improved confidence, efficiency, and accuracy.

Usability

The mean usability score was 4.7/5.0. The interface was described as intuitive and easy to navigate. Minor suggestions were made to improve search functions.

Discussion

This study developed and tested a mobile app providing high-resolution Public drug images to improve nurses' visual identification at the bedside. Quantitative testing with 15 end-users demonstrated the prototype app significantly improved accuracy and efficiency of medication identification compared to standard references. Nurses also reported excellent usability and high perceived utility in supporting safer medication practices.

The marked improvements in identification performance suggest the app can help address visual recognition issues, a prevalent contributing factor in Public medication errors (Irwin et al., 2018). By providing on-demand access to images not available in references, the app equipped nurses with an advanced cognitive aid to enhance bedside verification. The app's interface also enabled efficient searching to quickly locate drugs. Collectively, these advantages appeared beneficial in mitigating potential selection errors.

High ratings of the app's usability and utility further indicate it meets end-user needs and could integrate well into workflows. Participants valued the portable access and expressed willingness to adopt the tool. Minor refinements are warranted based on user feedback. Overall, the app represents a promising solution to aid nurses in accurate, efficient visual drug verification to improve Public medication safety.

Limitations

This preliminary single-site study had a small sample size. Additional research should evaluate the app across expanded settings and assess impacts on error rates. The app focused on solid oral dosage forms; expanding to other formulations could broaden utility. Technical enhancements to the interface and expanding the drug database with crowdsourcing represent areas for optimization.

Conclusion

This study developed and tested a mobile app prototype designed to improve visual identification of Public medications by bedside nurses. User-centered testing demonstrated the app enhanced

identification accuracy and efficiency compared to standard references. Nurses reported excellent usability and high perceived utility in supporting safer medication administration practices. Findings provide support for implementing this innovative app in Public hospital settings to reduce preventable medication errors and improve Public patient safety.

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