Smartphone Applications for Use in Drug Overdose: A review

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Abstract

Background: As smartphone use increases, the use of applications (apps) regarding healthcare expands. Using medical apps has become commonplace for both medical professionals and the general public. Before apps are used it is important that the information that they deliver is accurate and can be used with confidence. Overdose is a common problem presenting to emergency departments and apps provide an opportunity to provide information to both patients and healthcare professionals regarding initial management.

Objectives: The purpose of this study is to review smartphone applications relating to overdose, and assess the level of medical professional involvement in their development.

Methods: Smartphone apps regarding overdose were identified by searching three online app stores: Apple's App Store, Blackberry AppWorld and Google Play. The search was undertaken using keywords related to overdose. Any apps not containing information relevant to management of drug overdose were not included in the review. Each app was reviewed by two authors.

Results: A total of thirteen apps were identified (Google Play=4, Apple App Store=9). Two apps were duplicated therefore eleven were reviewed. Mean app cost was $8.10. Five apps (45%) were designed for use by patients. Healthcare professional involvement was evident in five (45%) of apps reviewed.

Conclusion: This study has identified that the majority of the apps related to overdose do not have healthcare professional input. In order to improve confidence in that apps contain information that can be used reliably, a 'quality stamp' provided by an established emergency medicine body.

Keywords: Overdose; Smartphone; Apps; Paracetamol; Toxicology; Overdose; Mobile technology

Introduction

Smartphone use is increasing amongst healthcare professionals and as a result there are smartphone applications (apps) available for a variety of healthcare related tasks [1]. As smartphone use becomes ubiquitous, the general public are likely to access medical information this way [2]. Many healthcare apps have been developed for healthcare professionals and are available to download including dose calculators, reference guides and log books [3]. The ability of an app to act as an interactive tool by making calculations or seeking information 'on-the-go' in the clinical environment means it can outperform a traditional computer. Similarly, patients can access information stored on their smartphone and this can be carried with them and accessed when traditional information technology (IT) facilities are not available. Although apps are unique in their ability to perform a specific task in a streamlined way, there is currently no regulation of their content and healthcare professional involvement can be variable [4].

The management of overdose and toxicology often require calculations to determine the risk posed to patients. Smartphone apps lend themselves well to this purpose especially when there may be an element of time pressure. Overdose is a common problem seen in the emergency department (ED), and represents more than 80% of presentations of self-harm [5]. Smartphone apps may offer clinicians time efficient and reliable tools to aid with the management of these cases. Similarly, apps that provide advice on overdose, deliberate and accidental harm may be a useful resource for the general public when they are unsure if they need to seek medical attention.

We have performed a review of the smartphone apps pertaining to overdose management and toxicology which are currently available.

Materials and Methods

Smartphone apps related to drug overdose were identified on 14th November 2014. Three app stores were searched: Apple's App Store, Blackberry AppWorld and Google Play. Two of the authors of this paper undertook the search using key words related to drug overdose (Table 1). Apps that were designed for health professionals and the general public were included in the review. Apps not containing information specifically regarding any aspect of drug overdose were excluded.

All apps meeting the criteria for the review were downloaded based on their intended use. Information was taken from the app summary, including price and average rating. Any medical professional involvement was noted from developer information. The two authors responsible for reviewing the apps decided upon each app's intended audience, whether it was for the general public or the healthcare

professional. Results were tabulated using Excel 2010 (Microsoft, Redmond, WA, USA) (Table 2).

Each app was searched searching for a list of developers, and those with a medical degree were termed "medical professionals" for the purposes of this review.

Search Terms
Overdose (± drug)
Toxicity (± drug)
Poisoning (± drug)
Toxicology

Table 1: Keyword search strategy for app stores.

Name of app	Publisher/Developer	Platform(s)	Cost/US$	Target audience
ToxBase	National Poisons Information Service	iOS	0	Clinician
Tox Toolbox	Tox Toolbox, LLC	iOS, Android	0	Clinician
Emergency Toxicology	Greg Swartzentruber	iOS	0	Clinician
Paracetamol Overdose	iED Limited	iOS	2.43	Clinician
Lipid ALS	James Pearson/LJ Cubed Apps	iOS	1.12	Clinician
Acetaminophen Clinical Toxicity Tool	Richard S PRAGER MD PA	iOS	3.24	Clinician
Drug Alert	M&M Enterprises Ltd	iOS	1.12	Public use
Lifeguard Users Guide	C-Dimension Ltd	Android	0.96	Public use
Methadone and Safety	C-Dimension Ltd	Android	0.96	Public use
Drug and Poison Coach	Think Safe Inc	iOS	1.12	Public use
Opiate Overdose Response	Active Media NI Ltd	Android	0	Public use

Table 2: Results were tabulated using Excel 2010.

Review

Apps are categorised according to whether they are intended to be used by 1) a clinician or 2) by a member of the general public.

Apps to Be Used By the Clinician

ToxBase (Developer: National Poisons Information Service (NPIS), platform: iOS, price: free)

This app is aimed solely at clinicians. The layout is the most clear and easy to navigate of all the apps. The presentation is neat and professional. Navigation is via five icons at the bottom of the interface which are as follows: News flashes; Alerts; Poisons; More; Upgrade. The poisons section is comprehensive and includes the majority of commonly used medications. For each medication overdose the appropriate investigations and management are clearly laid out, with relevant toxic doses, physical signs and symptoms and management. The dose calculator is simple and easy to use, and again has another clear layout. The alerts tab has a little information regarding sending alerts to users when required. The news flashes tab has updates regarding topics in overdose such as illicit drug use, and appears to be an informal but informative way of educating clinicians about contemporary issues. Lothian Health Board has been involved in developing this app.

Tox Toolbox (Developer: Tox Toolbox LLC, platform: iOS and Android, price: free)

This app is aimed at the clinician. The initial menu contains the following options: common toxidromes; decontamination techniques; formulas and key info; initial approach; numbers and websites: radiation injuries; top 25 toxins; toxin calendar. Each of these menus can be entered for further subsections to navigate. The layout is simple and subsections easy to navigate, with a bold, brown font at the top of each section.

The "Formulas and Key Info" section is somewhat sparse, containing only information on how to calculate an anion gap and causes for a metabolic acidosis with a raised anion gap and could be expanded upon. Other than this section, all sections are extensive and contain ample information. References are not provided, and there is no documentation of any healthcare professional involvement.

Emergency toxicology (Developer: Greg Swartzentruber, platform: iOS, price: free)

This apps target is aimed at the clinician. The user is faced with a menu with a number of options regarding specific areas of overdose management: general management; toxidromes, common overdoses; paediatric exposures; antidotes; nontoxic ingestions; pregnancy exposures; pharmacokinetics.

The layout of the app is clear and menus simple to use. The list of medications is in alphabetical order with quick links to each letter, which makes searching simple. The list of drugs included in the pharmacokinetics section is extensive and covers most commonly prescribed medications. Headings in each submenu are clear, and font is red and bold to allow navigation of each page. Each sub-section contains a concise list of information regarding the heading. The font used for these lists however is small, and the pages lack a clear navigation system. References are not provided, thought the list of acknowledgements is comprised of medical professionals.

Paracetamol overdose (Developer: iED Limited, platform: iOS, price: $2.43)

This app is aimed at clinicians. The input screen is clearly laid out and easy to navigate. The user is prompted to enter the patient's weight, dose of paracetamol taken, blood paracetamol level and time of level. The user is also able to enter additional risk factors for a high risk overdose. The appropriate management and investigations are laid out and clearly and the likelihood of a high risk overdose is stated. Advice regarding re-assessment time is included, as are liver transplant criteria and the Rumack-Matthew nomogram. Management plans are generated swiftly, and these are exportable via email. There is no explicit evidence of medical professional involvement but iED Limited is run by consultants who contribute to app designs.

Lipid ALS (Developer: James Pearson, platform: iOS, price: $1.12)

This app is designed for use by clinicians. It provides an algorithm for toxicity caused by lipid soluble drugs, such as local anaesthetic (LA) agents. The user is initially faced with a number of options on a drop down menu including the following: Signs of LA toxicity; immediate steps; cardiac arrest management; lipid emulsion treatment; avoid the following; notes; links. The page is clearly laid out and one of the easier apps to navigate as the font is slightly larger than that used in other apps. There is a weight based dosage calculator to determine the levels of overdose. The links page offers access to information that could be used in the management of local anaesthetic toxicity. There is no documentation of any healthcare professional involvement in developing this app. This app is easy to use but a little too drug specific. Many of its aspects are covered by other apps which also provide advice regarding how to manage overdoses in other substances.

Acetaminophen clinical toxicity Tool (Developer: Richard S Prager MD PA, platform: iOS, price: $3.24)

This tool is aimed at clinicians in the U.S. and provides users with a practical way of managing patients who have overdosed on paracetamol. The tool allows the user to input a number of variables (hours since paracetamol taken, serum concentration of paracetamol) and then utilises the Rumack-Matthew nomogram to determine whether acetylcysteine administration is indicated. The tool also helps to determine the dose of acetylcysteine required for each individual patient. This app was designed by a medical professional. The layout is clear and the parameters easy to enter into the various inputs. There is limited written information included in this app and it largely serves as a calculator for common calculations involved in managing paracetamol overdose. Comparing this with the app paracetamol overdose, this app has far less information and gives no further management details other than whether to give acetylcysteine and when to perform gastric lavage.

Apps to Be Used By the General Public

Drug alert (Developer: M&M Enterprises Ltd, platform: iOS, price: $1.12)

This app is aimed at patients and specifically states not be used to diagnose or treat any medical condition. The app contains and alphabetically ordered list of medications is comprehensive and easy to navigate with quick links to each letter. The colourful fonts make for easy identification of the desired medication. Side effects listed are extensive, and the number of adverse events reported is also documented. There is a guide to overdose symptoms for each particular medication. There is no guide to overdose management, but as aforementioned this app is not designed to be a guide to managing overdose. Users of this app have the option to report and adverse event to the food and drug administration (FDA) if appropriate. There is no documented medical professional input into this app.

Lifeguard users guide and methadone and safety (Developer: C-Dimensions Ltd, platform: Android, price: both $0.96)

These apps are aimed at the general public. They explain signs to look out for in case of recreational drug overdose, and appropriate initial management steps. There is no documentation regarding whether the information is written by a medical professional. The information is generally well laid out and easy to read, and simple enough for people who are not medically trained to understand. The apps contain brief information, and resemble electronic leaflets.

Drug and poison coach (Developer: Think Safe Inc, platform: iOS, price: $1.12)

This app is designed to help members of the public with no medical knowledge manage overdose situations prior to hospital care. It is not intended to be a reference guide. The interface comprises of a series of YES or NO questions to help the user identify management priorities. The commands are clear and easy to use due to large, colourful fonts. There is no specific overdose advice regarding specific drugs, rather the approach is generic for an unknown overdose. Details of how to perform cardiopulmonary resuscitation (CPR) are also included in within this app, along with the ability to locate the nearest emergency department. The app is not internet dependent and so can be used when internet is not available. The app is rather limited regarding information about specific overdose scenarios, and is rather like a life-support tool in that respect. There is no clear evidence of medical professional involvement in the development of this app.

Opiate overdose response (Developer: Active Media NI Ltd, platform: Android, price: free)

This app is not intended for healthcare professionals, and is aimed at the general public in order to aid their initial management of an opiate overdose. The app includes advice regarding how to recognise opiate overdose and implement any initial management. Advice comes in visual and audio form. The text is rather small, and they do not convey any additional information. The initial menu is clearly set out, and allows easy navigation. There is no documentation of how the information was collated, and no evidence of medical professional input.

Discussion

As smartphone use continues to increase, the way in which patients and clinicians access information is evolving. It is unlikely that apps will replace computer programmes due to the limited screen size of most smartphone. However, apps are proving to be valuable when used for specific tasks and offer a simple and efficient user interface.

This review identified eleven apps pertaining to overdose advice and management, of which six had evidence of healthcare professional

involvement. It is important that healthcare professionals are involved in the development of apps in order to ensure they are reliable sources of information. A low level of healthcare professional involvement in app design has been described in other specialties and content within these apps has been found to lack academic reference and occasionally to mislead [6-8]. Draft guidelines have been published by the U.S. Food and Drug Administration (February 2011) specifying that some apps are classed as 'medical devices' and therefore require regulation [9].

Two simple measures could be implemented to improve the confidence with which patients and clinicians use apps related to overdose. Firstly, a "quality stamp" reviewed by the American Academy of Clinical Toxicology (or similar body) in a process that would be similar to that of external peer review of research articles. Secondly, insistence that with this 'quality stamp' full authorship including the involvement of health professionals should be disclosed. These recommendations have been proposed previously [6,10], and would provide assurance to consumers that the information on offer was of sufficient scientific quality.

There are two notable limitations of this study. Firstly, healthcare professional involvement may have been underestimated. Identifying authorship disclosure within product summaries and apps themselves can be difficult. It seems likely however, that if apps did have expert input, then this would be made explicitly clear to users as a positive feature. In addition, smartphone app development proliferates at such a rate that by the time this review is published the range of apps available may have changed, and therefore the review will not describe current availability.

Conclusion

We identified eleven apps relating to drug overdose and toxicology currently available for download by clinicians and the public. Five were designed for use by the general public, and six for use by medical professionals. Just four of the eleven apps reviewed had documented evidence that medical professionals were involved in developing the advice they provided. The establishment of a quality mark would allow consumers to be confident of the validity of the information provided.

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