

Designing a mobile application for field use on dairies experiencing a toxicologic event

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Abstract

Large-scale toxic events on dairies can be difficult emotionally and financially. Many diseases of animals manifest over predictable time frames, whereas toxic events can appear quite suddenly and unexpectedly. Severity of toxic signs can range from non-clinical to clinical. Mortality rates can vary, but in today's concentrated animal feeding units high mortalities can be quite devastating. In addition to the potential disruption of milk shipped and cows lost, a toxic event also presents a possible food safety and public health issue that potentially erodes consumer confidence. Quick and accurate assessment of a toxic event is crucial for the health of both the animals and people consuming products derived from affected animals. The objective of this paper is to describe a smartphone or tablet application (app) that can be downloaded to assist field personnel investigating a toxic event.

Key words: dairy, toxic, mobile app, app

Résumé

Les épisodes toxiques à grande échelle dans les fermes laitières peuvent être taxant émotionnellement et financièrement. Plusieurs maladies se manifestent dans un laps de temps prévisible mais les épisodes toxiques peuvent apparaître très subitement et de façon inattendue. La sévérité des signes toxiques peut varier de non-clinique à clinique. Les taux de mortalité varient mais dans les systèmes actuels d'alimentation d'animaux à très haute densité la mortalité peut atteindre des niveaux dévastateurs. En plus de perturber l'expédition du lait et d'engendrer des pertes de vaches, un épisode toxique peut avoir des conséquences au niveau de la sécurité alimentaire et de la santé publique qui vont miner la confiance des consommateurs. L'évaluation rapide et précise d'un épisode toxique est cruciale pour la santé

des animaux et des gens qui consomment les produits provenant d'animaux atteints. L'objectif de cette présentation est de décrire une application téléchargeable pour téléphone intelligent ou pour ordinateur tablette dont le but est d'assister le personnel sur le terrain enquêtant l'épisode toxique.

Introduction

No mobile applications are currently available to veterinarians for food animal diagnostics. Using data from the California Animal Health and Food Safety (CAHFS) laboratory system, a mobile app was designed to assist veterinarians to diagnose the most common causes of large-scale toxic events on California dairies. This app provides practitioners an opportunity to harness the power of the web to address a toxic event better than ever before. Such an app may help resolve a toxic event rapidly and confidently; minimize suffering or losses of animals; mitigate risk of public health/food safety issues; and bolster consumer confidence in the dairy industry. The objective of this paper is to describe a smartphone or tablet application (app) which can be downloaded to assist field personnel investigating a toxic event.

Background

The CAHFS Toxicology Submission Guide mobile application is a tool for the dairy industry using today's mobile computing technologies. It is designed to provide easy access to pertinent, abridged toxicology information for field use to provide improved diagnostic assistance, ensure the best sample submissions, and maintain the highest milk quality. As described further in this paper, the mobile application was designed using a simple drag-and-drop desktop application for novice app designers.

Smart devices and their apps have already proved their value in human medicine, and new uses are devel-

oped regularly. These devices and apps have the ability to force multiply with minimal monetary expense. For example, a physician can only be in one place at a time, but with a smart device equipped with some of the newer diagnostic apps, a physician or his or her staff can consult with many more patients than before. Furthermore, integrating text messaging provides medical services to people unable to afford or travel to the nearest medical facility.^{6,10} Veterinary medicine and dairy production can similarly benefit from mobile apps. For instance, dairies occasionally experience large-scale medical emergencies involving toxin exposures.⁷ Key to resolving a possible toxic event is rapid recognition. Faster recognition by management or labor improves the chances of implementing corrective measures, possibly acquiring an available antidote, and delivering a viable sample to the diagnostic laboratory where the toxin can be detected and identified. The CAHFS toxicology guide provides information on the most commonly documented toxins affecting multiple cows on California dairies, and assists users to focus their efforts on these toxins.

Accuracy of samples collected is equally important for a rapid diagnosis. Knowing the correct samples to collect reduces time spent collecting unneeded samples during an initial investigation, or necessitating the practitioner to return at a later time for additional sampling when the toxin may no longer exist.

Improving awareness and accuracy ultimately reduces losses and costs associated with animal losses, milk losses, the potential for a public health incident, and loss of consumer confidence.

Use of computer-assisted diagnostics such as this guide is not new, only more accessible to a larger audience today because of increased computer use and rapid adoption of mobile devices. Smartphone (a type of mobile device) sales have continued to increase annually since market introduction; AT&T Inc. expected to sell 26 million handsets in 2012.³ As of December 2012, over 121 million US cell phone subscribers used smartphones, and almost 90% of that market was split evenly between the iPhone® and Android®.² The choice of apps is growing as well, with over 6000 health-related mobile apps available as of 2011. Physician adoption and usage is impressive, including distance monitoring apps such as iWander®, an app for use by Alzheimers patients and caretakers, and mobile devices functioning as echocardiographs.⁹

Unfortunately, only a few dozen veterinary exclusive apps exist commercially, and all are for companion animals. Currently these authors are unaware of the availability of any food animal medicine toxicology apps, despite an obvious need for improved diagnostic tools such as could be provided by this app. Of the 1,199 suspected cattle toxicology cases submitted to CAHFS from 2000-2011, only 13% were successfully diagnosed.⁷

Computer based medical decision assistance started in the 1960s using punch-card technology to create programs to assist in interpreting radiographs. These programs used statistics in an effort to determine a diagnosis and automate the process. As computers became more powerful and multiple university researchers began exploring computer decision assistance, more robust diagnostic programs were developed. These programs incorporated specific knowledge bases against which questions could be asked to navigate that base and eventually reach an answer. The drawbacks to these new tools were that they were very disease specific, narrow in scope, and were very access limited.⁵

More recently computer size, memory, and computational speed have improved. We now have small, hand-held devices capable of storing incredibly large amounts of data, as well as accessing seemingly limitless data via the web. The iPhone® and Android® have become the devices of choice, and each have their own app stores where native and web-based apps can be purchased.

Opening access to each of the mobile devices' formerly proprietary codes changed the competitive mobile device market and allowed app developers from outside the mobile manufacturers to develop apps with greater appeal to users. Access to the codes leveraged the creative ideas of many smartphone customers, who were also capable of writing code in a 'hive mind' or crowd-sourced fashion.⁴ The large numbers of code writers resulted in increasing numbers of apps and also created increasing numbers of new mobile device customers who found usefulness of mobile devices beyond a calendar, mobile phone or calculator. Still, open access code and app development required some level of knowledge of the language used by each device, which was no small feat and kept the number of developers rather small. This impediment to app programming declined with the introduction of drag and drop development programs. These newer programs made use of the existing point-and-click desktop interface that we use every day, and encouraged the less technically savvy to create apps.

MobiOne by Genuitec LLC is one such program, and was used to develop the California Animal Health and Food Safety Toxicology Submission Guide mobile application. A screen shot of the guide's cover page is shown in Figure 1.

The CAHFS Toxicology Submission Guide Mobile Application

This program has many advantages including inexpensive entry level, intuitive widget drag-and-drop features (widgets visible on the left side of Figure 1), iPhone®, iPad®, and Android® modalities, and a realistic mobile device emulator with which to test (and debug) your program. The widgets are the various buttons that

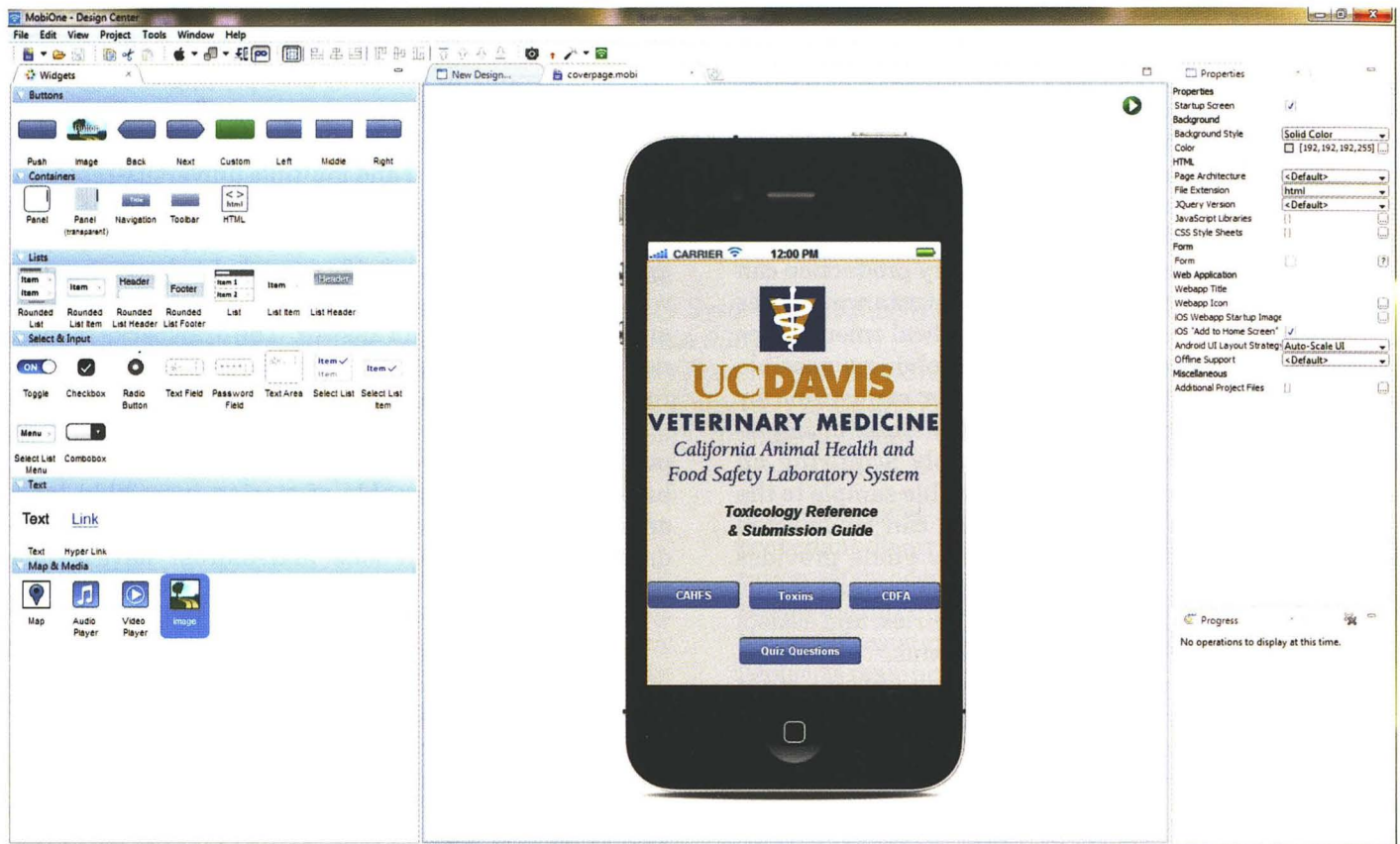


Figure 1. Desktop screenshot of design application displaying guide's opening page.

correspond to a particular task the designer wants the app to perform. Once a widget is selected, it can be placed in the app by moving the desktop cursor (drag) onto the mobile device screen displayed and clicking the computer's mouse (drop). On the far right of the screenshot in Figure 1, specific directions can be dictated for that widget. For example, a 'Push' widget button was selected and placed on the screen, then labeled as CAHFS, and designated as a 'go to' button. Another screen addressed as the 'CAHFS screen' had already been created, and the CAHFS button was instructed to display the CAHFS screen when this 'go to' button was pressed. In the same fashion, widgets can be instructed to 'go to' photos, text, or dial a phone number. Furthermore, the MobiOne application allows for the more advanced, code-fluent user to actually access and develop code when desired features are not available from the program's desktop toolbox.

Data selected from retrospective studies⁷ and CAHFS database provided the most commonly encountered toxicologic events affecting California's dairies. From these sources, a toxicologic library or database was constructed and entered into the MobiOne program as an iPhone® app. Each toxin is introduced with a single page containing a small distillation of the source, lethal-

ity, clinical signs, necropsy signs, and possible antidote. Links within the text (in blue type) can direct the user to new pages with significant photos that may assist the user in identifying a field observation. At the bottom of the toxin's introductory page are buttons that direct the user to additional information regarding a particular toxin's differential diagnosis, samples to submit for confirmation or rule-outs, tests to request, food safety concerns, carcass disposal, and an additional reading bibliography. A screenshot of a typical introductory page is shown in Figure 2.

Other pages contain buttons to link the user to contact information for the California Animal Health and Food Safety Laboratory System, California Department of Food and Agriculture, and shipping. Links within these pages automatically dial the listed contact directly when pressed. Contacting CAHFS, for instance, connects the user to the CAHFS facility. Similarly, buttons for contacting the California Department of Food and Agriculture include the state headquarters as well as the regional offices. To expedite sample shipping, direct links to major delivery companies (i.e., UPS and FedEx) provide the user with an easy way to create a parcel pickup while still in the field.

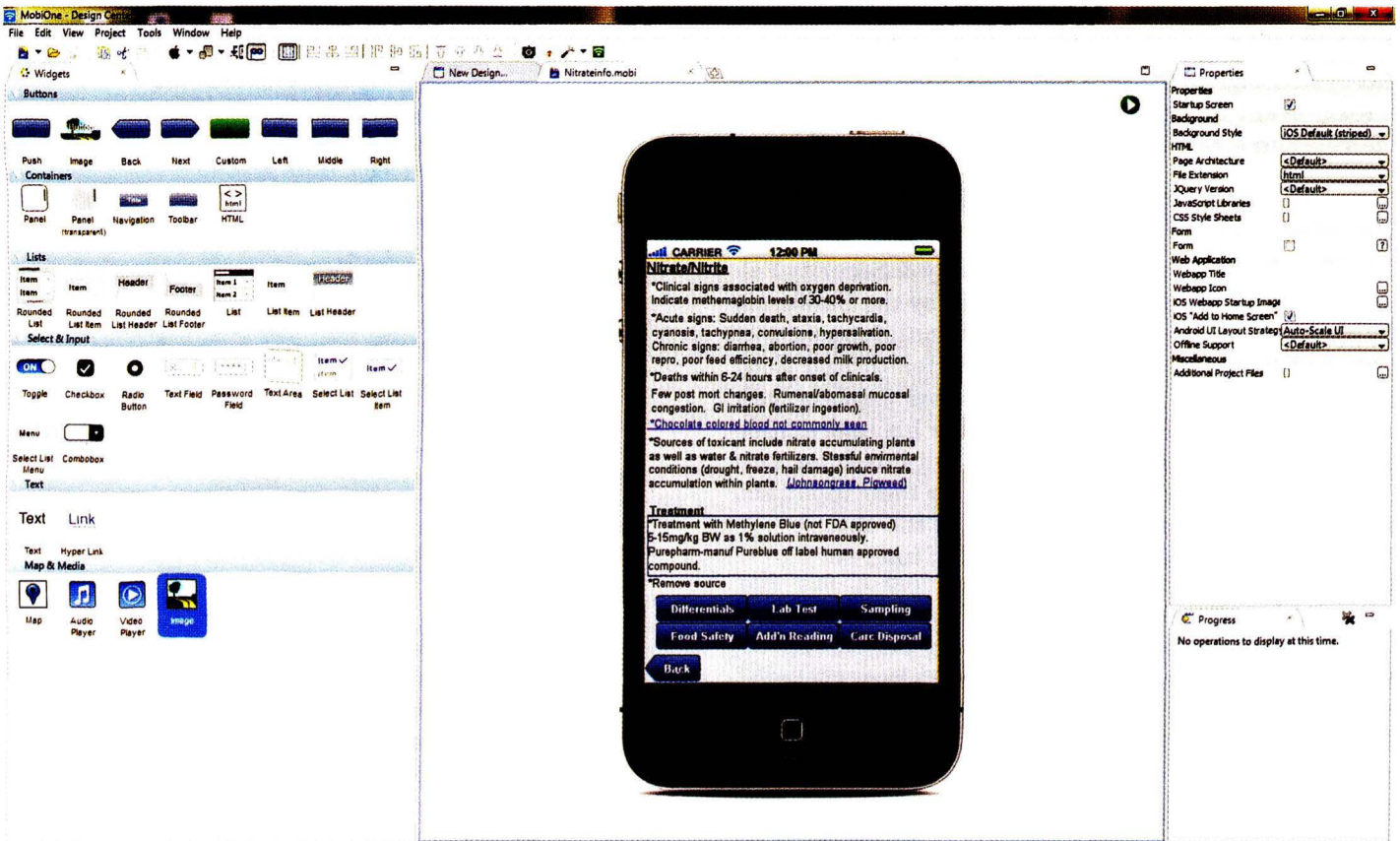


Figure 2. Desktop screenshot of design application including example toxin page.

There are additional opportunities that, if addressed, would transform the guide to an even more helpful diagnostic tool. For instance, there are several free epidemiology programs available today from designers who also make use of the Global Positioning System (GPS) and accelerometer included in the mobile device. One such app is EpiCollect from the UK's Imperial College London.¹ This app allows the user to enter data into his or her smartphone to be sent to a central server and combined with other similarly collected data entered by multiple collectors. EpiCollect allows for 2-way user interaction using Google® mail between the collector and the project coordinator; can incorporate photos; individually labels each submission with a unique identification number; and uses the phone's data to record GPS location. If outright inclusion of EpiCollect is not possible, then writing code with similar features would greatly enhance the usefulness of the CAHFS guide not only for field personnel, but also diagnosticians wanting to acquire real-time geospatial information allowing multiple outbreaks to be easily mapped out and viewed.

Another refinement would be to make use of a mobile device's video streaming that allows live viewing by an off-site observer who could provide diagnos-

tic assistance. This has appeal in that biosecurity is maintained by not having numerous people on-site, and provides a virtual toxicologist on-site for added support and consultation.

If given additional interest, numerous other apps that are species and discipline specific, such as dairy lameness, poultry or swine toxicology, and beef infectious diseases, could also be designed and made available from the CAHFS website. Foreign language versions could be created as well.

To acquire an app, mobile device users are required to download it from a website directly, such as The Apple Store. It is the author's intent to provide this app free through the CAHFS website. As of this date, legal agreements between the university and computer software manufacturers need to be reached before the CAHFS laboratory can begin offering the app on its website or through app stores.

Conclusion

Improved data streaming, storage, and mobile devices have been major reasons for their increased adoption and use in many industries, including veteri-

nary medicine. The California Animal Health and Food Safety Toxicology Submission Guide mobile application has been designed to assist field personnel encountering a toxic event affecting dairies by providing pertinent information for use with a mobile device.

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