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Research Article

RBApp: Creation and Patterns of Use of an Educational Mobile Application for Radiobiology Calculations in Radiation Therapy

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ABSTRACT

Introduction: RBApp is an educational software program that calculates the biologically effective dose and equivalent dose in 2-Gy fractions, permitting conversion between dose-fractionation schemes in radiation therapy. The purposes of this study were to describe the adoption and current patterns of use of this tool and evaluate user satisfaction with RBApp.

Methods: RBApp is available as a native app for Android and BlackBerry and a web app for iOS and other devices. User and device characteristics were collected from app store dashboards and server logs; expected values were retrieved from StatCounter Global Stats. A voluntary web-based questionnaire was created to evaluate the patterns of use of RBApp. This questionnaire collected information on user demographics, purpose of use, and user satisfaction.

Results: Over a 2.75-year period, there were 2,291 installations on Android and BlackBerry devices; 8,074 unique visits were logged to the web app; and 25 respondents completed the web-based questionnaire. Among this group, RBApp was used by radiation oncologists (44.0%), physicists (32.0%), and resident physicians (24.0%). It was used for clinical decision making by 78.3% of users, education and training by 43.5%, and research by 30.4%. Twenty of 22 users (90.9%) were satisfied with RBApp. A greater proportion of web app users used obsolete software to access the application compared with the rest of the global Internet population; 15.2% (95% confidence interval, 12.3%–18.6%) used Windows XP, and 16.0% (95% confidence interval, 13.0%–19.5%) used Internet Explorer 8.0 (expected global proportions 8.5% and 3.1%, respectively).

Conclusions: In this study, a mobile application for radiobiology calculations and its adoption by the radiation oncology community was evaluated. Users were satisfied with RBApp, and this tool is used for both clinical decision making and educational purposes. However, legacy software use remained prevalent, which may have implications for information security.

RESUMÈ

Introduction : RBApp est un logiciel éducatif qui calcule la dose biologiquement efficace et la dose équivalent en fractions de 2 Gy fractions, permettant la conversion entre différents programmes de fractionnement en radiothérapie. Les buts visés par notre étude étaient a) de décrire l'adoption et les modèles d'utilisation actuels de cet outil et b) d'évaluer le degré de satisfaction des utilisateurs de RBApp.

Matériel et méthodologie : RBApp est une appli disponible sous Android et BlackBerry et aussi disponible comme application Web pour iOS et d'autres appareils. Les caractéristiques des utilisateurs et des appareils ont été colligées sur les tableaux de bord des boutiques d'appli et les registres de serveurs; les valeurs attendues proviennent de StatCounter Global Stats. Un questionnaire Web volontaire a été créé pour évaluer les modèles d'utilisation de RBApp; ce questionnaire permettait de recueillir des données démographiques sur les utilisateurs, ainsi que des données sur le but de l'utilisation et la satisfaction des utilisateurs.

Résultats : Sur une période de 2,75 années, l'application a été téléchargée 2 291 fois sur des appareils Android et BlackBerry. 8 074 visites uniques ont été faites sur l'application Web. Nous avons reçu 25 réponses au questionnaire Web; au sein de ce groupe, l'appli RBApp a été utilisée par des radio-oncologues (44,0 %), des physiciens (32,0 %), et des physiciens résidents (24,0 %). L'appli a été utilisée pour la prise de décisions cliniques par 78,3 % des utilisateurs, à des fins d'éducation et de formation par 43,5 %, et à des fins de recherche par 30,4 %. Vingt utilisateurs sur 22 (90,9 %) se disent satisfaits de RBApp. Une proportion plus élevée des utilisateurs de l'application Web ont utilisé un logiciel obsolète pour y accéder comparativement au reste de la population Internet globale: 15,2% (intervalle de confiance 95 % [CI] 12,3-18,6 %) ont utilisé Windows XP et 16,0 % (95 % CI 13,0-19,5 %) ont utilisé Internet Explorer

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8.0 (proportion attendue dans la population globale de 8,5 % et 3,1 %, respectivement).

Conclusion : Cette étude a porté sur une application mobile de calculs en radiobiologie et son degré d'adoption par la communauté de la radio-oncologie. Les utilisateurs sont satisfaits de RBApp et cet outil est utilisé pour la prise de décisions cliniques et à des fins éducatives. Cependant, l'utilisation de logiciels anciens reste élevée, ce qui peut avoir des implications en matière de sécurité de l'information.

Keywords: Educational technology; mobile applications; professional practice; radiobiology; radiotherapy dosage

Introduction

The practice of medicine in the 21st century is aided by a range of technological tools. Given the wide availability of mobile electronic devices for use in clinical settings, access to medical reference tools and calculators is facile for practicing clinicians and learners [1–4]. However, there are few published works describing how mobile devices are being used in medicine and medical education [5]. There are some descriptive studies in this area, but many of them include a small sample size, have low response rates, or were published several years ago [6, 7]. Furthermore, they do not necessarily describe perceptions of device use or impact on work flow [2, 8]. To our knowledge, there are no studies on how mobile applications (''apps'') affect oncology education, cancer care delivery, or radiation medicine.

The concept of the biologically effective dose (BED) aims to quantify the biological effect of different radiation treatments and is based on the linear quadratic model of cell killing by radiotherapy [9–11]. The original formula incorporated a time factor to account for overall treatment time and repopulation after the start of treatment [9]. The following simplified formula that omits the time factor is frequently used [10, 11]:

$$\mathrm{BED} = \mathrm{D}\cdot(1 + (\mathrm{d}/(\alpha/\beta)))$$

where D is total dose, d is the dose per fraction, and α/β is the alpha/beta ratio. For a scenario in which one wishes to report a total dose in 2-Gy fractions that would be biologically isoeffective to any arbitrary dose fractionation, the following equation may be used to calculate the equivalent dose in 2-Gy fractions (EQD_2) [12]:

$$\mathrm{EQD}_2 = \mathrm{D}\cdot([\mathrm{d} + (\alpha/\beta)]/[2\ \mathrm{Gy} + (\alpha/\beta)])$$

These formulas are useful to compare different dose-fractionation schemes. Radiation therapy for cancer is traditionally delivered using a fractionated schedule of 1.8–2 Gy per fraction over 5–7 weeks. Recently, there has been renewed interest in altered fractionation regimens including hyperfractionation (used to treat some lung and head and neck tumours) [13, 14] or hypofractionation (used to treat some lung, liver, and prostate cancers) [15, 16]. These treatment schedules use 1.5–20 Gy per fraction. Treatment with higher dose per fraction is more potent; thus, conversion to BED [11, 12] or EQD_2 [12] is helpful to compare different treatment schedules.

In 2012, we created RBApp (RadioBiology Application), a freely available radiobiology calculator that automatically calculates BED and EQD_2 when given details of a fractionation scheme (total dose, number of fractions, dose per fraction, and α/β ratio). Because novel dose-fractionation schemes should be validated clinically before use, the calculator was intended for education and training purposes and should not replace clinical judgement [11]. The target audience for RBApp includes radiation oncologists, physicists, therapists, dosimetrists, radiobiologists, and trainees.

We present a description of how RBApp was created, evaluate user satisfaction, and describe current patterns of use by the radiation oncology community.

Materials/Methods

Creation of RBApp

The initial goal of RBApp was to make the app as widely available and accessible to different users and learners as possible. Therefore, RBApp is available as a native software program for Google Android and BlackBerry devices. It is also available as a web app for any Internet-enabled device, including Apple iOS and any desktop or mobile computer. The calculator includes an ''advanced mode,'' which allows a user to solve for any variable in the BED or EQD_2 equations. Furthermore, there is an equivalent dose-fractionation version, which facilitates conversion from any arbitrary dose-fractionation to another dose-fractionation with a user-defined dose per fraction. Continued availability and reliability of RBApp are maintained by the authors through regular use and monitoring of user feedback.

Google Android

The development of the Google Android version of RBApp was performed using MIT App Inventor Classic version 1 (Massachusetts Institute of Technology, Cambridge, MA), a freely available online tool for creating mobile apps. This cloud-based tool permits the input of computer logic via a graphic interface using a Java-enabled web browser. The computer code was assembled via block-based programming without the use of a traditional written programming language. For details, readers are referred to available online documentation (http://appinventor.mit.edu/).

The application package (.apk) file exported from MIT App Inventor was then processed using AppToMarket version 3.2 (M. Hossein Amerkashi), a freely available Windows