

Apps for Radiation Oncology. A Comprehensive Review¹



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Abstract

Introduction: Software applications executed on a smart-phone or mobile device (“Apps”) are increasingly used by oncologists in their daily work. A comprehensive critical review was conducted on Apps specifically designed for Radiation Oncology, which aims to provide scientific support for these tools and to guide users in choosing the most suited to their needs. **Material and methods:** A systematic search was conducted in mobile platforms, iOS and Android, returning 157 Apps. Excluding those whose purpose did not match the scope of the study, 31 Apps were methodically analyzed by the following items: Objective Features, List of Functionalities, Consistency in Outcomes and Usability. **Results:** Apps are presented in groups of features, as Dose Calculators (7 Apps), Clinical Calculators (4), Tools for Staging (7), Multipurpose (7) and Others (6). Each App is presented with the list of attributes and a brief comment. A short summary is provided at the end of each group. **Discussion and Recommendations:** There are numerous Apps with useful tools at the disposal of radiation oncologists. The most advisable Apps do not match the more expensive. Three all-in-one apps seem advisable above all: RadOnc Reference (in English), Easy Oncology (in German) and iOncoR (in Spanish). Others recommendations are suggested for specific tasks: dose calculators, treatment-decision and staging.

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Introduction

Apps (abbreviation for applications) are pieces of software that can run on web browsers, computers, mobile phones and other electronic devices as tablets; though colloquially, an *app* typically refers to software used on a Smartphone or mobile device (Android, iPhone, BlackBerry, iPad) i.e. “mobile app” or “iPhone app.” They are simple, self contained programs that allow user to perform specific tasks, hopefully in a simple, user friendly way.

Thousands of apps have been developed in recent years, dealing with all fields of entertainment, business and sciences. Oncology has not been an exception [1–4]. Taking advantage of its functionality and portability, many oncologists use these applications every day to perform simple tasks, like calculating a body surface or the biological effective dose (BED) of radiation. In this paper we perform a comprehensive review of this kind of tools developed for Radiation Oncology, which aims to provide scientific coverage for the analyzed apps and to guide users in choosing the most suited for their needs.

Material and Methods

A systematic search was conducted in each main mobile platform:

- Play store (Android, Google) [5].
- App Store (iOS, Apple) [6].

We use a convenient device for each one: Samsung Galaxy S2 and Sony Xperia Z3 Compact with Android; iPhone 4 and iPad mini (2nd generation) with iOS.

The following keywords were introduced:

- *radiation oncology*
- *radiotherapy*
- *radiation therapy*
- *oncología radioterápica*
- *radioterapia*

Search results returned 46 apps in iOS and 111 apps in Android, 157 total; many of them repeated in both Android and iPhone stores.

Additionally, the terms “oncology” and “radiation” were separately introduced to pick up some other apps whose name made them suitable of interest, obtaining a total of 195 apps.

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Free apps were directly downloaded to its corresponding device. Companies with costly apps were asked for a free sample. If the answer was negative or absent, applications were downloaded after disburse the involved cost. Search was conducted in June 2015, for both Europe and USA stores.

131 out of the 195 results were excluded for the following reasons:

- 19 were dedicated to recompile articles.
- 25 were patient focused.
- 12 were made for hospitals to arrange meetings.
- 34 which topic was not about Oncology at all.
- 2 were made for working with Aria network.
- 11 had learning techniques for students' exams.
- 11 were devoted only to chemotherapy or target therapy.
- 11 were about congress schedules.
- 5 were in one language not included in our criteria: Neither English, German nor Spanish.
- 1 did not work.

Additionally, 33 apps were also excluded because their content, in many cases of interest, did not fit the purpose of this study: not being clinical tools for professionals of radiation oncology, or having worthless or minimum content.

The remaining 31 apps, which are the subject of the study, were analyzed in the following items:

- Objective features: name, developer, price in Euros and Dollars, analyzed version, memory size, initialization time, language, in-app purchases, log-in requirement, online connection required, bugs or hangs, and working links
- List of functionalities
- Consistency in outcomes
- Usability, as assessed and rated by two trained radiation oncologist

Results

The 31 apps obtained by the above method are described below. They are presented in groups of functionalities, with a brief summary. All of them are in English, except when another language is described in *Comments* section.

When a rate is given, the higher the better. For instance, an app with 4/5 in Design is better in our opinion than another with 3/5.

Dose calculators

Name: BED Calculator radiation dose

Platform: iOS

Functionalities: Calculates BED according to alpha/beta.

Equivalence according to fraction size.

Size: 149 Kb

Procurement: Free

Opening speed: < 1 s

Fluency: 5/5

Design: 2/5

Ease of use: 4/5

Connection required: No

Functioning and updated links: No

Errors/reboots: No

Bibliographic support: Yes "Based on LQ model".

Comments: alpha/beta list incomplete. Visually appealing.

Name: EQD2

Platform: iOS

Functionalities: EQD2 calculator able to add courses with different fractionation.

Size: 2.6 Mb

Procurement: 0.89 €/0.99 \$

Opening speed: <1 s

Fluency: 4/5

Design: 3/5

Ease of use: 3/5

Connection required: No

Functioning and updated links: Yes.

Errors/reboots: No

Bibliographic support: No

Comments: Includes a section with complete information to understand the functionalities of the application. Not very complete.

Name: Radiation Oncologist Tool

Platform: iOS

Functionalities: Calculates several radiobiological parameters for clinical use, as GAPs. Many calculators not in others.

Size: 935 Kb

Procurement: Free

Opening speed: <1 s

Fluency: 3/5

Design: 2/5

Ease of use: 2/5

Connection required: No

Functioning and updated links: No

Errors/reboots: No

Bibliographic support: Displays algorithms

Comments: Well presented, with simplicity. It's the only one with gap calc and other useful functionalities.

Name: RBApp

Platform: Android

Functionalities: Calculates BED; EQD2

Size: 1.3 Mb

Procurement: Free

Opening speed: <1 s

Fluency: 4/5

Design: 2/5

Ease of use: 3/5

Connection required: No

Functioning and updated links: Yes.

Errors/reboots: No

Bibliographic support: Yes. Bibliographic reference of algorithms

Comments: It does not provide enough info about using the app.

Name: eLQ*Platform:* iOS; Android*Functionalities:* Calculates BED according to alpha/beta.*Size:* 2.9 Mb*Procurement:* Free*Opening speed:* 1.5 s*Fluency:* 5/5*Design:* 3/5*Ease of use:* 4/5*Connection required:* No*Functioning and updated links:* Yes*Errors/reboots:* No*Bibliographic support:* Yes "Based on LQ model"*Comments:* Includes app tutorial, LQ model, complete list of alpha/beta and interesting links.**Name: LQ Model***Platform:* iOS*Functionalities:* dose equivalence between any fractionation. Tissue tolerance.*Size:* 914 KB*Procurement:* 3.59 €/3.99 \$*Opening speed:* <1 s*Fluency:* 4/5*Design:* 2/5*Ease of use:* 3/5*Connection required:* No*Functioning and updated links:* Yes*Errors/reboots:* No*Bibliographic support:* Yes*Comments:* It is the only one with SBRT estimation.**Name: TDFCalc***Platform:* iOS*Functionalities:* calculates BED according to size and number of fractions.*Size:* 134 KB*Procurement:* 8.99 €/9.99 \$*Opening speed:* <1 s*Fluency:* 3/5*Design:* 1/5*Ease of use:* 2/5*Connection required:* No*Functioning and updated links:* No*Errors/reboots:* No*Bibliographic support:* No*Comments:* similar but less comprehensive than many others, focused in Time Dose Fraction factor.

Summary: **eLQ** is the most complete, self explained app, including a vast estimation of alpha/beta per tissue. **Radiation Oncologist Tool** includes unique formulas, as gaps calculators, and **LQ Model** is the only one that features SBRT calculations. The recommended apps are free except **LQ Model**.

Clinical calculators**Name: iDcalc***Platform:* iOS*Functionalities:* List of radioactive isotopes.

Calculates several physical parameters of radiation.

Size: 917 KB*Procurement:* 2.69 €/2.99 \$*Opening speed:* <1 s*Fluency:* 3/5*Design:* 2/5*Ease of use:* 2/5*Connection required:* No*Functioning and updated links:* Yes*Errors/reboots:* No*Bibliographic support:* No*Comments:* Interesting for medical physicists. Less useful for physicians.**Name: GOGScore***Platform:* iOS*Functionalities:* GOGScore calculator (risk of relapse cervical uterine cancer after surgery).*Size:* 689 KB*Procurement:* 0.89 €/0.99 \$*Opening speed:* <1 s*Fluency:* 4/5*Design:* 2/5*Ease of use:* 1/5*Connection required:* No*Functioning and updated links:* No*Errors/reboots:* No*Bibliographic support:* No*Comments:* Limited specificity. Characters hard to read.**Name: Onco Calc***Platform:* iOS*Functionalities:* calculates BSA, BMI, Cl Cr; AUC and correspondence with Carboplatin dose.*Size:* 385 KB*Procurement:* 1.79 €/1.99 \$*Opening speed:* 3 s*Fluency:* 4/5*Design:* 1/5*Ease of use:* 3/5*Connection required:* No*Functioning and updated links:* No*Errors/reboots:* Yes. It freezes easily.*Bibliographic support:* No*Comments:* Limited usefulness, just for calculating carboplatin doses.

Name: **OnCalc**

Platform: iOS, Android

Functionalities: Calculates BSA, BMI, Cl Cr, area under the curve (AUC).

Size: 2.54 Mb

Procurement: Free

Opening speed: 2 s

Fluency: 4/5

Design: 4/5

Ease of use: 5/5

Connection required: No

Functioning and updated links: No

Errors/reboots: No

Bibliographic support: No

Comments: In Spanish.

Name: **Stagelt – Lung Cancer Staging**

Platform: iOS

Functionalities: Staging of lung cancer based on questions and answers.

Size: 1.2 Mb

Procurement: Free

Opening speed: <1 s

Fluency: 2/5

Design: 2/5

Ease of use: 3/5

Connection required: No

Functioning and updated links: No

Errors/reboots: No

Bibliographic support: Yes

Comments: It frequently recommends checking out a book.

Summary: There is a wide diversity of clinical calculators in the apps stores, increasing in number as days pass. OnCalc is free, and has everything needed. GOGScore is really unique as a calculator. Anyway, these Calc apps functionalities are usually included in multipurpose ones.

Staging

Name: **IASLC Staging Atlas in Thoracic Oncology**

Platform: iOS

Functionalities: Lung cancer atlas, nodal map, explained TNM, CT Atlas.

Size: 3 Mb initially, then requires another in app download of 33 Mb

Procurement: Free

Opening speed: 3 s

Fluency: 5/5

Design: 4/5

Ease of use: 4/5

Connection required: Yes. Only once, to download content

Functioning and updated links: Yes.

Errors/reboots: No

Bibliographic support: No

Comments: language can be selected. It requires a code to be accessed. This code can be found in the official webpage. Fantastic and really compelling app of thoracic cancer pathology.

Name: **TNM Classification of Malignant Tumors, 7th edition**

Platform: iOS

Functionalities: TNM classification and stages.

Size: 2.9 Mb

Procurement: 44.99 €/49.99 \$

Opening speed: 2 s

Fluency: 3/5

Design: 2/5

Ease of use: 2/5

Connection required: No

Functioning and updated links: No

Errors/reboots: No

Bibliographic support: No

Comments: The official app of the UICC/AJCC TNM. Few tools. Not interactive at all, like a book. Similar but less useful than many others.

Name: **Cancer Staging and Grading/Cáncer Estadificación y los Clasificación**

Platform: iOS; Android (not anymore in Android)

Functionalities: TNM classification and stages.

Size: 347Kb

Procurement: 14.99 €/15 \$

Opening speed: <1 s

Fluency: 5/5

Design: 5/5

Ease of use: 5/5

Connection required: No

Functioning and updated links: No

Errors/reboots: No

Bibliographic support: No

Comments: Great staging tool. Clear, fast and interactive. Surprisingly, not prostate staging included.

Name: **Lung TNM Calc**

Platform: Android

Functionalities: Staging of lung cancer based on questions and answers.

Size: 1.2 Mb

Procurement: Free

Opening speed: 2 s

Fluency: 5/5

Design: 4/5

Ease of use: 4/5

Connection required: No

Functioning and updated links: No

Errors/reboots: No

Bibliographic support: No

Comments: Not visually attractive, nor really quick. In Android 5 does not work at all.

Name: Staging Cancer TNM*Platform:* Android*Functionalities:* TNM classification and stages.*Size:* 392Kb*Procurement:* 5.99 €/8.14\$*Opening speed:* <1 s*Fluency:* 4/5*Design:* 4/5*Ease of use:* 4/5*Connection required:* No*Functioning and updated links:* No links*Errors/reboots:* No*Bibliographic support:* No*Comments:* Another staging tool. Similar to others. Not the most attractive but useful enough.**Name: inPractice Oncology***Platform:* iOS; Android*Functionalities:* Digital Book on Oncology.*Size:* 1.3Gb total*Procurement:* Free. Registration required.*Opening speed:* <1 s*Fluency:* 5/5*Design:* 4/5*Ease of use:* 4/5*Connection required:* Yes. Only once, for registration and extra content downloading*Functioning and updated links:* Yes*Errors/reboots:* No*Bibliographic support:* Yes. Detailed references.*Comments:* General Oncology. No specific radiation oncology content, but really updated.**Name: TNM Cancer Staging***Platform:* Android*Functionalities:* TNM classification and stages.*Size:* 717 KB*Procurement:* 1.99 €/1.99\$*Opening speed:* <1 s*Fluency:* 4/5*Design:* 3/5*Ease of use:* 3/5*Connection required:* No*Functioning and updated links:* No links*Errors/reboots:* No*Bibliographic support:* Yes*Comments:* The fastest Staging app in Android.**Name: RadOnc Reference***Platform:* iOS; Android*Functionalities:* Calculates: BMI, BSA, PS, BED, EQD2. Genitourinary risk and outcome: D'Amico, Roach, Partin, SALVAGERT.

Breast: ASTRO, VANNUYS, B18/B27.

Hematological: IPI, FLIPI; German and EORTC), Child Pugh. CNS: Glioma RPA; metastases. Tissue tolerance: RTOG, Quantec y standard. TNM and stage Atlas for prostate, neck, gynecological, breast. ICD-9 code. Symptomatic drugs.

Size: 2.4 Mb*Procurement:* 4.49 €/4.99 \$*Opening speed:* <1 s*Fluency:* 4/5*Design:* 4/5*Ease of use:* 5/5*Connection required:* only for atlas consult*Functioning and updated links:* No*Errors/reboots:* No*Bibliographic support:* Yes*Comments:* The best compelling app in English.

Summary: In Android ecosystem, **TNM Cancer Staging** is clean and quick to use. In both iOS devices and Android you can find **Cancer Staging and Grading**, also really functional. Official TNM app is barely interactive, expensive in app terms and too sober, like the book itself. **IASLC Staging Atlas in Thoracic Oncology** is really complete in thorax area.

Multipurpose**Name: Easy Oncology***Platform:* iOS*Functionalities:* Tumors: diagnosis, treatment, follow up and staging. Treatment of emesis, anticoagulation, neutropenic fever.

Calculators and interactive index: ECOG, Karnofsky, SIRS, body surface, creatinine clearance, steroid and opioid converter.

Patient information.

Size: 13.6 Mb*Procurement:* 7.99 €/8.99 \$*Opening speed:* 4 s*Fluency:* 5/5*Design:* 4/5*Ease of use:* 4/5*Connection required:* No*Functioning and updated links:* Yes.*Errors/reboots:* No*Bibliographic support:* No*Comments:* very comprehensive. Only in German.**Name: Oncology Pocketcards***Platform:* iOS*Functionalities:* diagnosis, TNM, staging and standard chemotherapy of several cancers.*Size:* 22.4 Mb*Procurement:* 4.49 €/4.99 \$*Opening speed:* 1 s*Fluency:* 4/5*Design:* 5/5*Ease of use:* 5/5*Connection required:* No*Functioning and updated links:* No*Errors/reboots:* No*Bibliographic support:* No*Comments:* visually appealing. Limited content whit few tumor localizations. No indications for radiotherapy.

Name: iOncoR*Platform: iOS; Android*

Functionalities: TNM and Staging, Tissue tolerance dose, BED, body surface area (BSA), body mass index (BMI), creatinine clearance (Cl Cr), performance status (PS), toxicity and nutrition scales, specific vademecum for nutrition and radiation oncology.

Size: 15.3 Mb*Procurement:* required code unpurchasable*Opening speed:* <1 s*Fluency:* 5/5*Design:* 5/5*Ease of use:* 5/5*Connection required:* No*Functioning and updated links:* Yes*Errors/reboots:* No*Bibliographic support:* No

Comments: Extremely good pack for Spanish speaking Radiation Oncologist. Endorsed by SEOR.

Name: NCCN guidelines for*Platform: iOS; Android*

Functionalities: updated treatment guidelines for quite numerous tumor sites.

Size: 4 Mb initially. More, according to downloaded guides.*Procurement:* Requires free registration*Opening speed:* <1 s*Fluency:* 4/5*Design:* 4/5*Ease of use:* 4/5*Connection required:* Yes. To download desired guides*Functioning and updated links:* Yes. NCCN.org.*Errors/reboots:* No*Bibliographic support:* Yes. NCCN*Comments:* Great for a quick view of the NCCN guidelines.**Name: Rad Onc Resource***Platform: Android**Functionalities:* BED, tissue tolerance.

Breast: recurrence risk

Prostate: Nomogram based on Partin's tables

Mortality risk estimator (for general population)

Size: 3.94 Mb*Procurement:* Free*Opening speed:* <1 s*Fluency:* 5/5*Design:* 4/5*Ease of use:* 4/5*Connection required:* No*Functioning and updated links:* Yes. Wikibooks*Errors/reboots:* No*Bibliographic support:* Yes*Comments:* Limited content, but well presented.

Summary: This category represents the all-in-one of the radiation oncologist's needs. Dose calculators, staging, clinical calculators, link to guides. There are three relevant apps that are really useful, surprisingly each one in one language: in English [**RadOnc Reference**], German [**Easy Oncology**] and Spanish [**iOncoR**]. NCCN allow the clinician to have all their guidelines updated easily. While no specific for Radiation Oncology, **inPractice Oncology** is an excellent way to be updated in cancer.

Others**Name: iTA VIEW***Platform: iOS; Android**Functionalities:* Dicom and RT images Viewer.*Size:* 10.3 Mb*Procurement:* Free but useless without network.*Opening speed:* <1 s*Fluency:* 3/5*Design:* 3/5*Ease of use:* 3/5*Connection required:* No*Functioning and updated links:* No

Errors/reboots: Yes. If you cannot load the phantom example, it freezes randomly.

Bibliographic support: No*Comments:* Useless without network. Great potential.**Name: RTOG Upper Abdomen Atlas***Platform: Android*

Functionalities: Atlas of upper abdomen, with text briefly pointing indications of localizations.

Size: 392Kb*Procurement:* Free*Opening speed:* 4 s*Fluency:* 3/5*Design:* 1/5*Ease of use:* 1/5*Connection required:* No*Functioning and updated links:* No*Errors/reboots:* No*Bibliographic support:* Yes

Comments: Images are really tiny. As zoom cannot be adjusted, app results almost useless.

Name: Radiation Therapy Flash Card*Platform: Android*

Functionalities: tissue tolerance and histopathology. Physical parameters and data tables: photons, electrons, radioactive sources.

Size: 1.3 Mb*Procurement:* Free*Opening speed:* <1 s*Fluency:* 4/5*Design:* 2/5*Ease of use:* 2/5*Connection required:* No

(continued)

Functioning and updated links: Yes. Astro, ASRT.
Errors/reboots: No
Bibliographic support: No
Comments: advertising and publicity.

Connection required: No
Functioning and updated links: No
Errors/reboots: No
Bibliographic support: No
Comments: Very handy. Little theoretical basis.

Name: Prostate Cancer Treatment*Platform:* iOS

Functionalities: Calculates success rate for prostate cancer with different treatments (surgery, SBRT, IMRT, HDR, LDR) according to risk. Description of treatments. Comments for metastatic or recurrent.

Size: 331 Kb*Procurement:* Free*Opening speed:* <1 s*Fluency:* 4/5*Design:* 2/5*Ease of use:* 3/5*Connection required:* No*Functioning and updated links:* ClinicalTrial.gov*Errors/reboots:* No*Bibliographic support:* Yes

Comments: Review of publications with a estimation of cure probability. Not updated.

Name: Targit*Platform:* Android*Functionalities:* Indicates a patient's suitability for Targit trial.*Size:* 618 Kb*Procurement:* Free*Opening speed:* <1 s*Fluency:* 4/5*Design:* 4/5*Ease of use:* 4/5*Connection required:* No*Functioning and updated links:* No*Errors/reboots:* No*Bibliographic support:* No*Comments:* designed for a very specific task.**Name: Radonculous***Platform:* iOS*Functionalities:* Atlas for target delineation.*Size:* 49.9 Mb*Procurement:* Free*Opening speed:* 1 s*Fluency:* 3/5*Design:* 2/5*Ease of use:* 5/5

Summary: There are lots of other apps that could find a place in your phone home screen. Apps like **ITAview**, a DICOM viewer, show us a world of opportunities expanding each day. The lack of apps for contouring is striking, being **Radonculous** the sole representative.

Discussion and Recommendations

“Wait, I’ve got it in my phone” is an often-repeated phrase nowadays. At home, in the office or in the hospital, common people and professionals take advantage of the vast potential of apps as calculation or consultation tools.

There are free and paid apps, and also partially free. It is possible that the free stuff is enough for your work. Also subscription-based apps are getting more and more importance. Not always the most expensive ones are in our recommendation, coincidentally being the ones less updated.

In the first place, you can decide between an all-in-one app and a specific one. Depending on your mother language, there are three of them really useful: in English [**RadOnc Reference**], German [**Easy Oncology**] and Spanish [**iOncoR**]. A simpler alternative to these can be a dose calc, as our pick **eLQ**. For staging, **TNM Cancer Staging** for Android is clean and quick to use. In both iOS devices and Android you can find **Cancer Staging and Grading** too. We want to highlight the need of more apps like **Radonculous**, a simple contouring help. Clinical radiation oncologist needs a fast access to treatment-decision and staging references; **NCCN guidelines for, inPractice Oncology** and **IASLC Staging Atlas in Thoracic Oncology**, are good tools for these tasks.

If you are an oncologist, you are lucky to have at your disposal applications that can always go with you, shortening calculations or providing reliable information at any time. Maybe, this does not make you a better doctor, but at least it will free up time to devote to your patients. The evolving world of oncology has new instruments capable of maintaining its step.

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