

**Конфликт интересов.** Все авторы заявляют об отсутствии потенциального конфликта интересов, требующего раскрытия в данной статье.

**Вклад авторов.** Все авторы внесли равноценный вклад в разработку концепции, выполнение, обработку результатов и написание статьи.

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## MOBILE APPLICATIONS IN THE PRACTICAL WORK OF A RADIOLOGIST IN DIAGNOSING DISEASES

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### Abstract

Today the field of radiation diagnostics is rapidly developing and improving. That is why it is very important not only for the new generation of radiologists who grew up in the digital era and are fluent in gadgets, but also for experienced specialists to keep up with this pace.

The purpose of this research is to find suitable modern radiological resources in the form of specialized applications for more productive study and perception of information, including diagnosing of various pathologies.

For this article, we consulted popularity lists and independent research to find the most interesting and useful apps for radiologists. And also represent the existing advantages and disadvantages of each.

**Keywords:** mobile apps, imaging (radiology), social networks.

### Introduction

Nowadays, the use of mobile applications is rapidly gaining momentum, so it is important to highlight the most useful and applied ones for the practice of a doctor. According to a 2020 Research Now Group survey of 500 U.S. physicians, 16 % of physicians currently use mobile medical applications in their professional practice, while 46 % plan to do so in the next five years [1]. Considering that there are more than 100,000 mobile healthcare ap-

plications on the market, it is not an easy task to figure them all out. For this article, we have reviewed popularity lists and independent research to find the most interesting and useful applications for radiologists. Also check out the list of the best Diagnostic Imaging applications for 2016-2022 [2; 3].

Given the continued growth in the number of radiological studies in the healthcare system and the constant flow of digital radiological images, the workload of a radiologist has increased markedly in

the last 5 years [4]. However, today, with the advent of smartphones and the development of more and more advanced applications, doctors of radiation diagnostics (X-ray, CT, MRI PET) can remain at the level of their workload and provide a high level of patient care from almost anywhere in the world. The overall goal is to have access to work data at the specialist's fingertips, helping him to be as productive and integrated as possible.

Today, the field of radiation diagnostics is rapidly developing and improving. That is why it is very important to keep up with such a pace not only for the new generation of radiologists who have grown up in the digital age and are freely guided by gadgets, but also for experienced specialists [5-7]. For more productive study and perception, it is necessary to use modern resources in the form of specialized applications [8-10].

The purpose of the review is to find suitable modern radiological resources in the form of specialized applications covering the spectrum of various diseases for more productive study and perception of information.

Radiology residents of the National Cancer Research Center reviewed ten applications designed to keep diagnostic imaging specialists in touch with patients, attending physicians and medical institutions.

This review article presents a selection of useful applications for radiologists, an overview of

the applications that are among the ten most used by radiologists in the world:

1. Radiology Rounds (RR) is an application for radiologists and young residents where they can share and learn from clinical cases. This resource can be used not only by certified radiologists, but also by others. You can upload images and share cases with your colleagues, as well as receive feedback from them (Figure 1 a-d).

RR is a modern analogue of a social network for radiologists. Its main purpose is mutual assistance and joint training of specialists in this field [11].

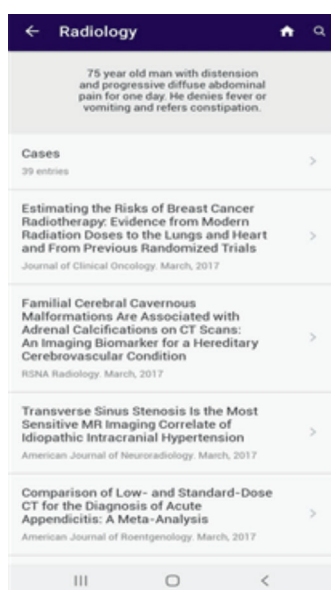
Advantages:

- Free app
- Strict moderation in case selection
- High level of reliability of information

Disadvantages:

- Suitable only for Android
- Small user base
- Rare information updates

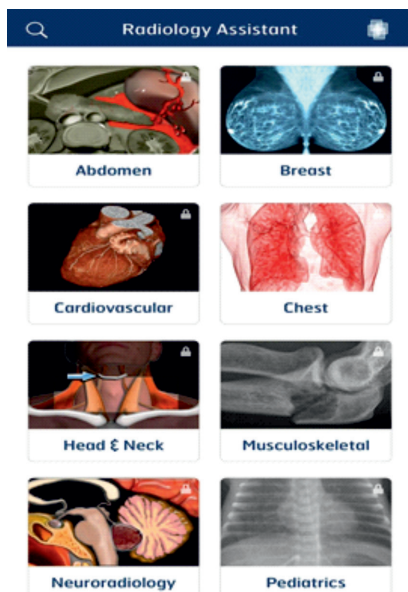
2. Radiology Assistant 2.0. This application is a direct continuation of the web version of the website of the same name. Here you will find not only basic courses in CT, MRI and X-ray anatomy, but also be able to familiarize yourself with the cases of real patients. The application contains many visual and applied images that are sure to be found in clinical practice (figure 1b-d). It is perfect for both novice radiological service specialists to



**Figure 1a.** Examples of cases  
Source: [11]



**Figure 1b.** Example of a presented case for discussion with colleagues  
Source: [11]



**Figure 1c.** List of sections on normal and pathological anatomy  
*Source: [11]*



**Figure 1d.** Useful sections in the application – Terms of Use, Tips & Tricks, Guidelines for authors  
*Source: [11]*

replenish the pool of knowledge, and experienced radiologists to consolidate and repeat them.

Also in this application there are sections Terms of Use, Tips&Tricks – they will help you navigate the terminology used, which you can correctly apply in the future [12].

Advantages:

- Covers many common pathologies
- A good base on normal anatomy
- High quality images
- Free access
- User-friendly interface

Disadvantages:

- Compatible with iPhone and iPad only
- Content is rarely updated
- There is practically no information on nuclear medicine

3. OsiriX is an image processing application for the Apple macOS operating system designed for DICOM images obtained using radiological equipment (MRI, CT, PET, PET-CT). It allows you to track not only the functional state of the selected anatomical zone in various dimensions (using 2D, 3D, 4D Viewer), but also to analyze it in real time (using Cardiac-CT).

OsiriX Cloud allows healthcare professionals and patients to instantly access medical images from anywhere in the world. OsiriX Cloud was designed to facilitate the sharing and storage of medical images, which is especially important for radiologists.

This greatly simplifies the work and ensures close contact between the patient and the doctor [13].

Advantages:

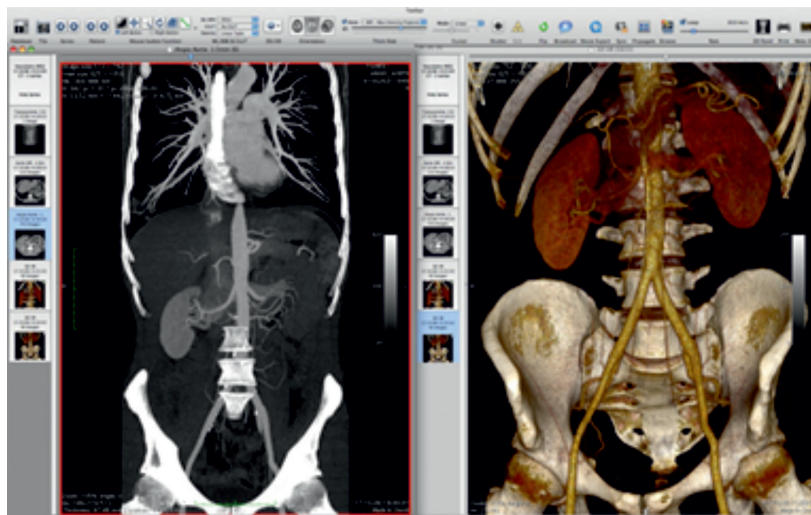
- Advanced 3D visualization
- Can process ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET) images in their native standard DICOM format.
- Supports multiple DICOM network protocols: C-STORE SCP, C-MOVE SCU, C-FIND SCU, C-GET SCU WADO.

Disadvantages:

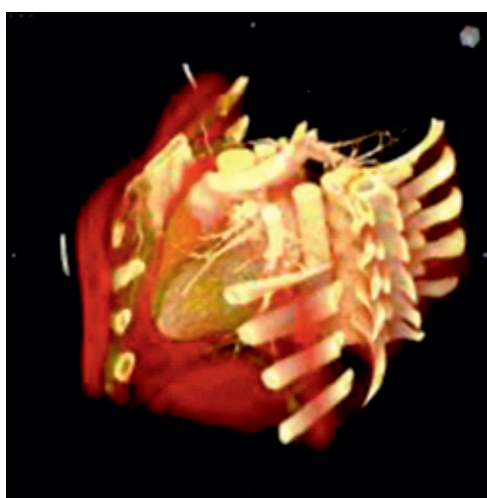
- Only suitable for iOS
- Limited support and features when using the free version
- Limited integration with other systems and software

4. Musculoskeletal Radiology is an educational application containing more than 3,000 anonymized case studies on the visualization of the musculoskeletal system, selected from the materials of the teaching staff of the Royal Orthopedic Hospital of Birmingham, United Kingdom. Special attention is paid to the X-ray and MRI.

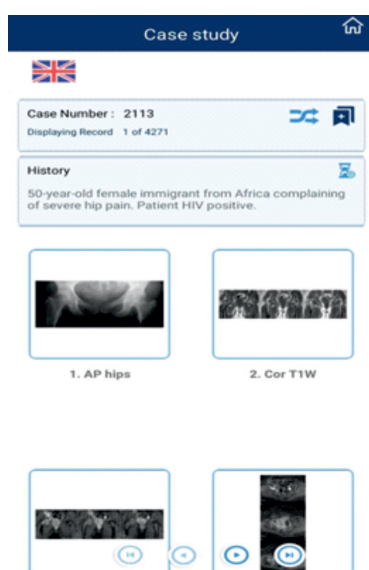
The application database is regularly updated so that you will work only with up-to-date information. For your convenience, there are several search engines available here - Search by Anatomy, Pathology, Keywords, Case Number and name (Figure 2a-d). At the moment, this application is one of the



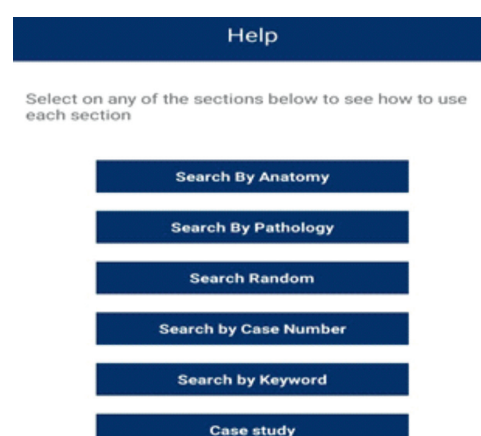
**Figure 2a.** Example of software operation - 2D Viewer and 3D Viewer  
Source: [15]



**Figure 2b.** 3D visualization over time with tracking of functional state  
Source: [15]



**Figure 2c.** Example of a case with attached images  
Source: [15]



**Figure 2d.** Variety of search engines  
Source: [11]



largest resources covering such a wide range of pathologies of the musculoskeletal system [14].

Advantages:

- One of the most informative applications on normal anatomy and pathologies of the musculoskeletal system

- User-friendly interface
- Simplified search engines
- Regular updating of cases
- Free app

Disadvantages:

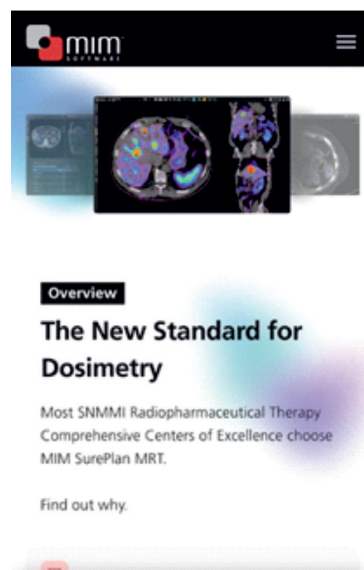
- Suitable mainly for specialists who work with the musculoskeletal system in a targeted manner

- Limited range of applications

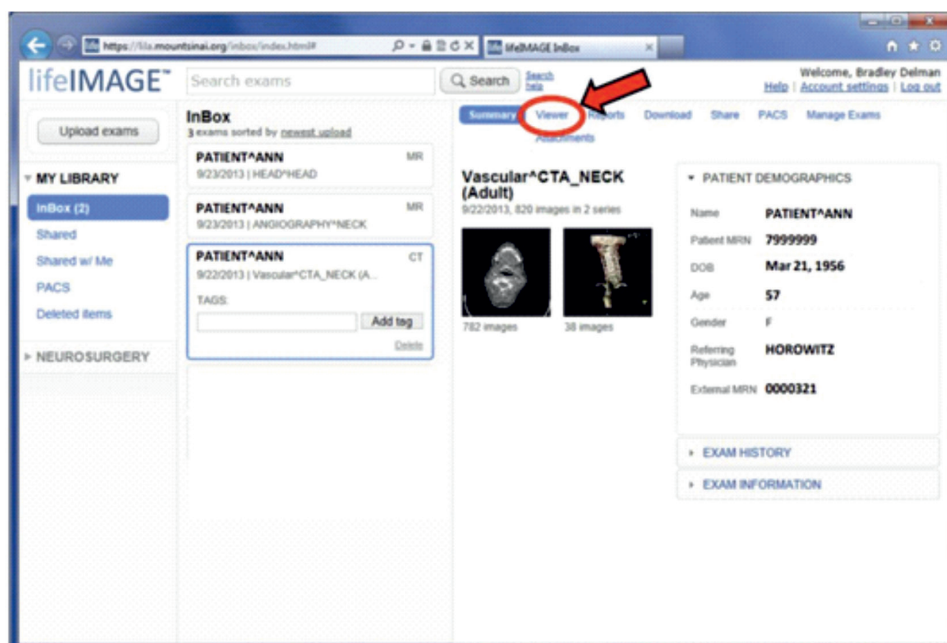
5. Medical Image Merge is an image merging product designed to register, manipulate and read DICOM images. Today, the program is used in North and South America, Asia, Europe, Africa and Australia. MIM software serves hospitals, medical centers and imaging centers, research institutes, pharmaceutical organizations, etc. (Figure 3a-c).



**Figure 3a.** DICOM visualization applications like MIM Maestro  
*Source: [15]*



**Figure 3b.** Absorbed dose calculator for radiation protection  
*Source: [15]*



**Figure 3c.** LifeImage desktop [11].  
*Source: [11]*

The aim of MIM is to create useful, targeted and life – changing products that enhance patient safety and enhance clinical effectiveness [15].

Advantages:

- A variety of possible applications: radiation oncology, radiology and nuclear medicine, dosimetry for molecular radiation therapy, planning the treatment of prostate cancer using brachytherapy, visualization and analysis of multiparametric magnetic resonance imaging of the prostate.

- Availability of a calculator - dosimeter for the absorption of radiopharmaceuticals during SPECT.

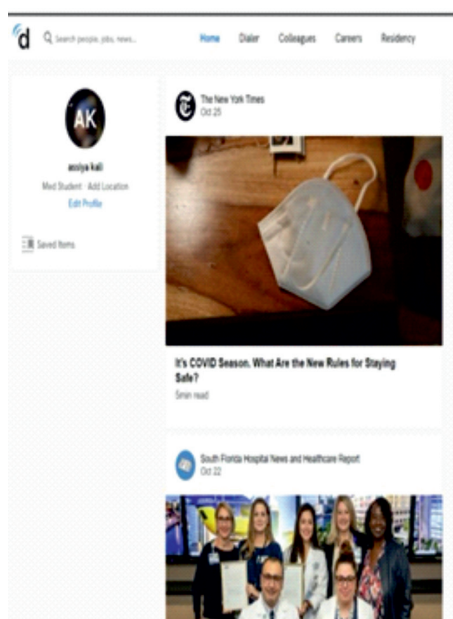
- Customer focus: A user-centered approach based on customer feedback. The company is committed to seamless user learning and support.

Disadvantages:

- A paid subscription is required.
- At the moment, the software is not distributed in the CIS countries.

## 6. LifeImage

Life Image is a network for the exchange of medical data and images, providing access to places of medical care and carefully selected image data. Life Image's Interoperability Suite, founded in 2008, presents this digital platform as using vendor-independent integration standards to connect medical institutions, suppliers, clinics and patients to biomedical, medical devices and telemedicine companies.



**Figure 4a.** Main page

Source: [17]

The medical imaging platform connects doctors to a powerful imaging system that works quickly, using artificial intelligence, and receives the data they need, regardless of their location (Figure 3b) [16].

Advantages:

- Reducing the radiological burden of the patient

- No CD-ROMs, the presence of a shared cloud for data storage

- Diagnosis of the patient before meeting with him

- Online consultation

- Sharing 7 billion image files

Disadvantages:

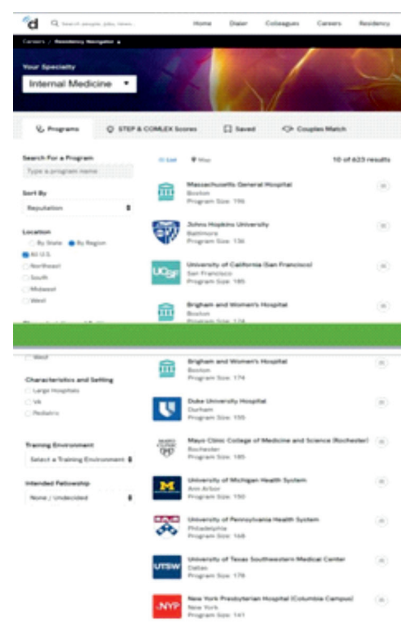
- Lack of data in medical tourism

- Time to upload data to the cloud and download it

- The Internet does not last forever.

## 7. Doximity

Doximity is a free application announced by a social network for doctors, offering several features that will help you quickly connect with other doctors through a HIPAA-protected link on your phone. With one touch, it is possible to perform a search in the directory of doctors, finding service providers by specialty and location. Using the app, you can both securely send patient data and communicate directly with the patient. Doximity can also help with job search, including salary comparisons (Figure 4a-c).



**Figure 4b.** Tab for searching residency and internship programs

Source: [17]



**Figure 4c.** Workspace: main feed, groups, and polls

*Source: [17]*

You can conveniently send and receive electronic faxes while on the go, while on duty, as well as call patients from your mobile phone, displaying your office number.

The Doximity team includes medical technology executives from institutions and employers such as the Cleveland Clinic, Stanford University, UCSF and Medscape [17].

Advantages:

- The ability to quickly communicate with doctors in other countries via audio and video calls.
- A database of internships and study grants at foreign universities.

Disadvantages:

- At the moment, the software is not distributed in the CIS countries.

#### 8. Figure-1

Figure-1 is a platform that brings together healthcare professionals from more than 190 countries for training, information exchange and collaboration. The community of trusted healthcare professionals has assembled the world's most extensive library of patient clinical cases, numbering over 100,000+. The platform is constantly growing

and has proven itself to demonstrate everything from common routine cases in practice to rare diseases. The company continues to develop innovative ways to share medical knowledge, customized videos, and more (Figure 4b) [18].

Advantages:

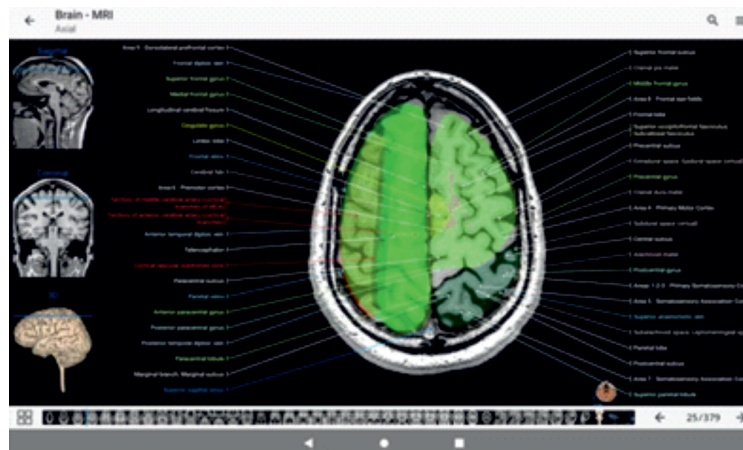
- A variety of clinical cases with a detailed description.
- Availability of tests to test knowledge.
- The ability to create communities.
- Discussion of controversial cases with experts from different countries

Disadvantages:

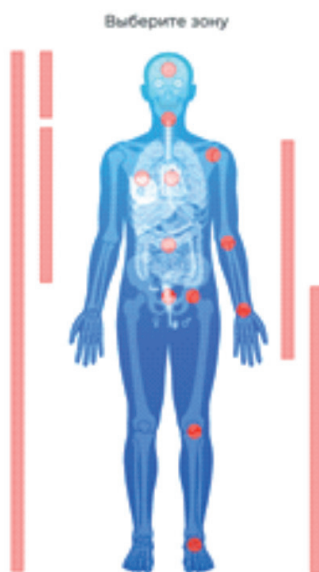
- At the moment, the software is not distributed in the CIS countries

9. IMAIOS e-Anatomy is an interactive atlas of human anatomy that combines medical images (CT, MRI, X-ray), more than 8,900 anatomical structures and 870,000 landmarks, and also has a quiz function with simple self-assessment. He is trusted by radiologists, students and specialists in the field of medical imaging. Here you can view about 26,000 visual examples for free, which will allow you to decide whether to purchase a subscription to this atlas (Figure 5a-c).

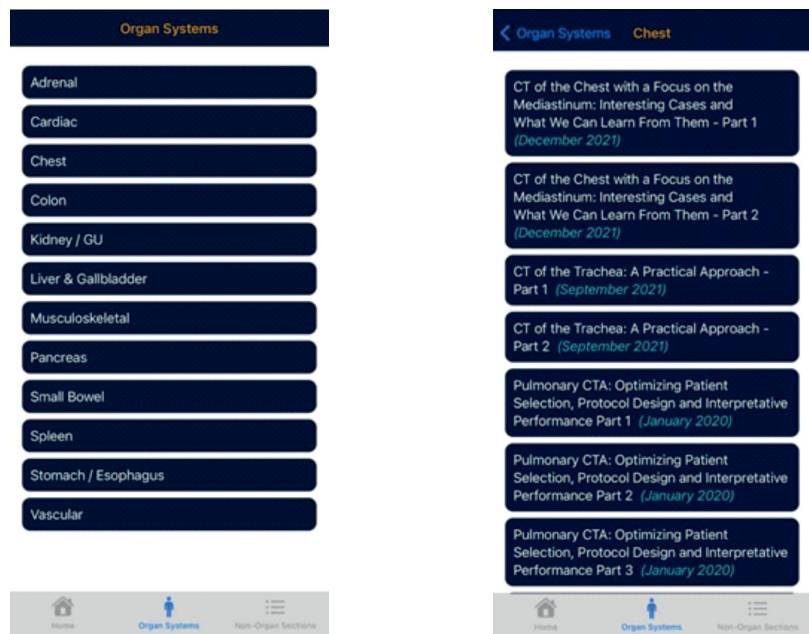




**Figure 5a.** Example of MRI anatomy of the brain, axial section  
*Source: [19]*



**Figure 5b.** Selection of the desired anatomical zone  
*Source: [19]*



**Figure 5c.** CTisus iLecture interface  
*Source: [19]*

The well-known IMAIOS application is used as the basis for this atlas, which has already established itself as a reliable and reliable assistant tool for radiologists [19].

This application is perfect even for beginners, because it contains detailed images of anatomical areas in various projections and sections. The big advantage is that you can examine the same organ in different types of examination (MRI, CT, PET, radiography).

All names of anatomical units (and there are more than 967,000 of them) are presented in several languages of the world. You can select the area of interest and the modality of the images.

Advantages:

- One of the most detailed atlases with high-quality images
- Convenient to use on different operating systems - Android / iOS
- Materials are available in 12 languages
- Contains valuable graphic content, especially from the point of view of medical imaging

Disadvantages:

- Paid subscription \$12.99 per month, \$89.99 per year
  - Complex interface
10. CTisus iLecture is a comprehensive



educational program designed for all professionals interested in radiology. Developed by Elliot Fishman, this iPhone app offers a wide range of lectures covering 23 different topics, including organ systems such as pancreas, liver and kidneys, as well as additional topics such as protocol development and 3D visualization (Figure 5b).

Thanks to the CTisus iLecture series, users can access lectures, which allows them to conveniently explore and update their knowledge base. Lectures are regularly updated, new content is added every week, which allows users to keep up to date with the latest developments in the field of radiology. The lectures are designed in such a way as to evolve in accordance with changes in the field, including new knowledge and technological developments [20].

#### Advantages:

- Whether the user is a medical student, resident, or practicing radiologist, the CTisus iLecture series provides a valuable resource for expanding the understanding of radiology.

- Easy search for lectures.

- Free access.

#### Disadvantages:

- Available only for the iOS platform.

#### Conclusions

Radiologists in modern conditions need to quickly navigate and be in the trend of the latest developments in digital technologies, especially with a variety of diseases. The purpose of this article was to make an overview of the 10 most popular and, most importantly, applied applications for specialists in the field of radiology. We hope that analogues of these applications will soon appear in Kazakhstan, which will be successfully used by our colleagues.

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## АУРУЛАРДЫҢ ДИАГНОСТИКАСЫНДА ДӘРІГЕР-РАДИОЛОГТЫҢ ТӘЖІРИБЕЛІК ЖҰМЫСЫНДАҒЫ МОБИЛЬДІ ҚОСЫМШАЛАР

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### Андатпа

Бүгінгі таңда сәулелі диагностика саласы қарқынды дамуда. Сондықтан цифрлық дәуірде өскен, жаңа технологияларды жетік меңгерген радиологтардың жаңа ұрпағы ғана емес, тәжірибелі мамандардың да осы қарқынға ілесуі өте маңызды.

Мақсаты. Ақпаратты, соның ішінде аурулардың диагностикасы жайында, нәтижелі және сапалы меңгеруге қол жеткізетін заманауи радиологиялық ресурстары бар қосымшаларды табу.

Бұл мақала үшін біз танымал және тәуелсіз зерттеулермен танысып, ең қызықты әрі пайдалы қосымшалармен таныстық. Сонымен қатар, бұл қосымшалардың артықшылықтары мен кемшіліктерін атап өттік.

**Түйін сөздер:** *мобильді қосымшалар, радиология, әлеуметтік желілер.*

## МОБИЛЬНЫЕ ПРИЛОЖЕНИЯ В ПРАКТИЧЕСКОЙ РАБОТЕ ВРАЧА-РАДИОЛОГА ПРИ ДИАГНОСТИКЕ ЗАБОЛЕВАНИЙ

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### Аннотация

На сегодняшний день сфера лучевой диагностики стремительно развивается и совершенствуется, особенно в области цифровых технологий. Именно поэтому очень важно поспевать за такими темпами не только новому поколению радиологов, выросших в цифровую эпоху, но и опытным специалистам.

Цель. Найти подходящие современные радиологические ресурсы в виде специализированных приложений для более продуктивного изучения и восприятия информации.

Для этой статьи мы ознакомились со списками популярности и независимыми исследованиями, чтобы найти наиболее интересные и полезные приложения для радиологов, а также оповестить коллег об имеющихся преимуществах и недостатках каждого из них.

**Ключевые слова:** *мобильные приложения, радиология, социальные сети.*

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