

APPLICATION OF TELECOMMUNICATIONS AND COMPUTER TECHNOLOGY IN MEDICINE

Svetlana NIKOLIĆ¹, Sunčica IVANOVIĆ², Nenad MARKOVIĆ³

¹ Department for health care of students, Novi Sad, Serbia

e-mail: svetlananikolic81@gmail.com

² High Medical School of Professional Studies, Čuprija, Serbia

³ Union University Nikola Tesla in Belgrade, F@M Faculty for Management,
Sremski Karlovci, Serbia; e-mail: markovic@famns.edu.rs

Abstract—Telemedicine is one of the most important forms of practical application of information technology in medicine, and it is defined as the use of telecommunications and computer technology along with medical expertise in the purpose of remote applications of medical services. Another definition is that telemedicine represents a way of providing medical services without a direct contact between the physician-patient. This detail is extremely significant when taking the fact into consideration that the funds allocated for health and social care is often insufficient to provide the basic health care, and besides that, in some regions due to inaccessibility and long-distance of the nearest health institution, population is almost completely deprived of this type of assistance. In the study will be presented the possibilities of radiology and its importance, as well as the abilities of telemedicine in the purpose of exercising specialist-consulting activities with an emphasis on video conferences.

Keywords—telemedicine, health, social care, teleradiology, video-conferences.

I. INTRODUCTION

UNDER information we understand a set of knowledge, data and messages indispensable for decision-making. We consider the medical information in the same context, as a set of necessary data aimed to solve the medical problems. The specificity of medical information is relating to still insufficient terminology compliance and a number of present used synonyms. Biomedical information tends at finding the most appropriate way of collection, exchange and storage of information, which will make them available and relatively easy to use. Of course, thereby is endeavoring that the applied procedures to be as rational as possible, and accordingly to facilitate the implementation of the required objectives at minimum costs.

II. THE CONCEPT AND IMPORTANCE OF TELERADIOLOGY

Teleradiology is a form of medical information exchange which means the application of telecommunications systems in the form of satellite, mobile telephony, internet and computers aimed to exchange data, images, audio and video records and other forms of radiological information to remote locations [1]. The application of information technology in this field of medicine is of great importance, which is confirmed in everyday practices. Implementation of the system that will allow the computerization and digitalization requires significant investment, both in terms of equipment and personnel that will be trained to work on them, but the provided advantages are multiple, which at a later period allows substantial savings in time and funds, including a high quality of provided services. In fact, often in everyday practice physician is in a position to require consultations with experts in the particular fields, including a number of difficulties not only for the purpose of organizing these meetings and the necessary funds, but more importantly is to consider the time factor that we have at our disposal to solve the specific problems, which can often be crucial. In this way is greatly simplified the specialized-consulting activity among physicians in remote locations, in addition to significantly reducing the costs, which is certainly very important due to the fact that spending on health and social care is an extremely high burden on the budget even to the most developed countries. Also, it should be borne in mind that the development and availability of health care are not at the satisfying level everywhere, which significantly complicates the provision of health services and the achievement of the desired results. The next problem that needs to be mentioned is the lack of adequately trained experts in a particular field. Data from literature affirm that the American hospitals, saving money on radiologists who already are insufficient, hire professionals from India to remotely diagnose their patients. For errors in diagnosis

no one would be responsible, because there is no international legal framework that would regulate this issue [2].

PACS (Picture Archiving and Communication System) is a system of computerized management, archiving and distribution of diagnostic images. The incorporation in PACS is carried out either in digital images, or images obtained by classical way that are

later converted to digital form. Images in digital form greatly facilitate their use, archiving, relocation and transfer [3]. In this way is enabled and the smaller rural communities, that do not have adequate clinical support to carry out consultations with relevant institutions and obtain indispensable professional assistance.

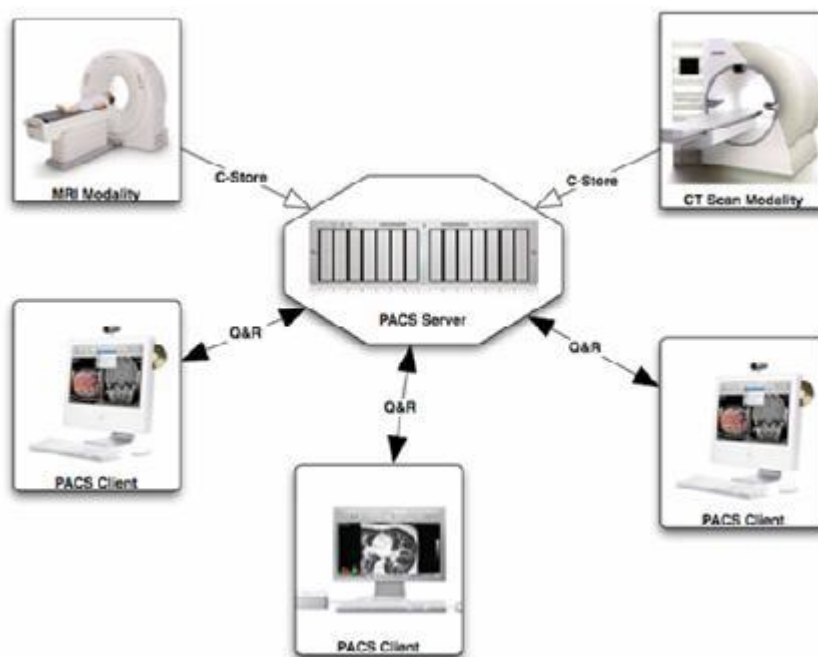


Fig. 1: Classical PACS architecture [4]

III. ADVANTAGES OF PACS

What is the advantage of this type of computerized management, distribution and archiving of diagnostic images?

1. Evidence of work engagement
2. Consistent record of review and patients
3. Records and control of expenditures and procurement of materials
4. Digital archiving
5. Statistical processing of data
6. Lower doses of radiation for patients and personnel
7. Savings in film, chemicals and the like
8. Improvement of image quality of the older devices
9. Digital image processing for the purpose of faster and more accurate diagnosis
10. Standardization
11. Possibility of transferring images remotely fast and lossless
12. Reduction of maintenance costs of apparatus and devices [5].

Of course, every innovation in addition to a series of advantages has its **disadvantages**, which in case of PACS are related to:

- High initial costs
- Large memory requirements
- Possibility of information loss when compressing images
- Conversion of old films into digital form
- Transfer of images between the devices of various manufacturers (DICOM)
- **RIS** (Radiological Information System) implies a software system that allows computerization of all stages of the radiological department, starting with the scheduling of patients, admission and registration, recording, processing, reading and printing of findings, archiving and their distribution as needed. In this way is enabled the rational use of available resources with greater efficiency and quality of provided services to the smooth flow and exchange of information that are always available.
- **CR** (Computed radiography) uses very similar equipment as conventional radiology, besides that instead of film use panels made of photo-stimulating phosphorous stored in special cassettes. While classical radiology, for the purpose of film development uses a darkroom and film developers, in

case of CR films are read by means of CR readers and laser scanners [6].



Fig 2: Computed Radiography Scanner [6]

Advantages of CR:

1. The silver-based developers are not applied in order to get recordings.

2. Reduce the cost of storage of recordings and risk of loss and damage.
3. In classical radiography there is often the need for repeated recording increasing patient's exposure to radiation.
4. Recordings are available less than 15 seconds.
5. Adjusting the brightness and contrasts in one act is possible to examine the layers of different thickness unlike conventional radiology where each would request a new exposure which would further increase the patient's exposure to radiation and the time required to perform the recording.
6. Images can be digitally improved which facilitate their interpretation and drawing of conclusions.
7. Images are stored on disks, and there is a possibility of their subsequent analysis or exchange in the purpose of further consultations, even whether the experts are in remote locations.

Development of science and technology makes CR more accessible than ever before. Cost analysis indicates that its acquisition and use is multiple justified, wherewith we should keep in mind that in addition to investments in such a system we also should consider and the environmental aspects and benefits to the patient and employees. (6)

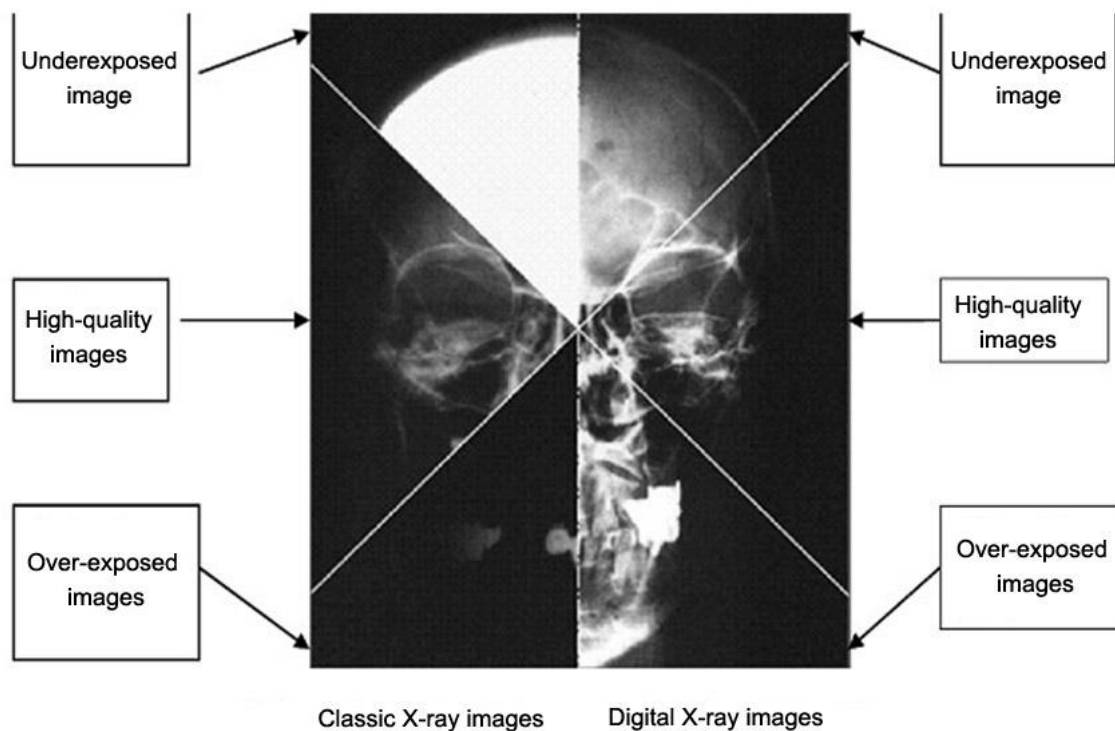


Fig. 3: Classical and digital X-ray images.

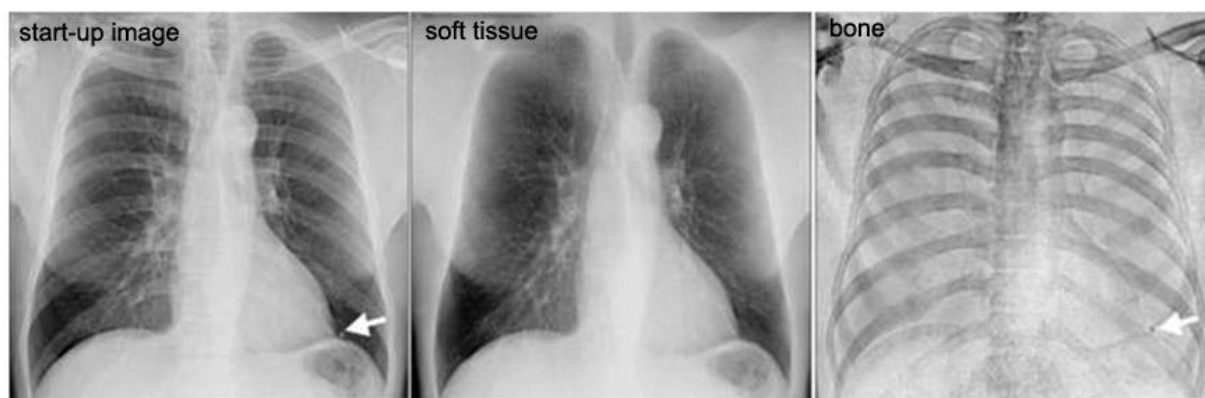


Fig. 4: Advantages of CR compared to classical film.

DICOM (Digital Imaging and Communications in Medicine) – industry standard for the transmission of radiological images and other information among the computers. In this way is enabled the transfer of data and communication among devices from different manufacturers, which until the introduction of this system represented a significant problem. This is a very comprehensive standard that formally defines the most procedures in working with digital medical data: handling, storage and transmission of data. DICOM covers the definition of the data format and protocol for network communication – application protocol based on

TCP/IP. American organization NEMA (National Electrical Manufacturers Association) is the owner of the rights to the DICOM format, which was developed by the DICOM Standards Committee. The current version of DICOM is the third, published in 1993., but with a few minor changes that were subsequently added to the standard [7]. In DICOM format all informations are prepared that are grouped into data-sets, which means that the image data are placed together with the metadata (eg. name and patient ID, date, etc.). Thus is ensured that the key data will never be seperated from the information that describes them [7].

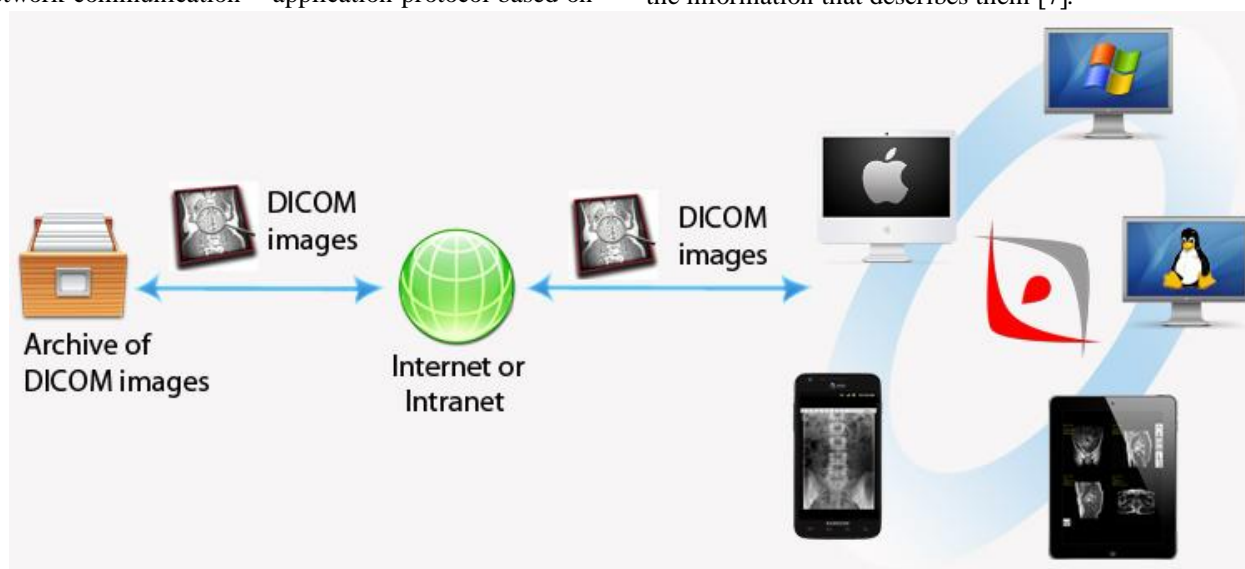


Fig. 5: DICOM [8]

HIS (Hospital Information System) is a computerized management system and governance under hospital conditions. This system enables fast, rational and efficient management of different types of data. In this way is enabled significantly higher efficiency at work, through greater quality of provided services, that under the hospital conditions is of extreme importance.

The presented model is only one of the forms of practical application of information technology in medical science and practice, noting that the possibilities

are almost inexhaustible. In the afore-referred text repeatedly is emphasized the importance of teleradiology in terms of faster and more accurate diagnosis, archiving and data transfer. The inevitable questions are the ethical principles of determining the diagnosis and treatment „at a distance“.

IV. VIDEO CONFERENCES

Considering the history of video conferences, there should be said that the objective possibility for their performance existed from the moment of the appearance of television receivers. NASA for its first flights to space used two radio frequencies (UHF and VHF), one for each direction in 80-ies of XX-th century. Transmission of video content was available via digital networks such as ISDN (Integrated Services Data Digital Network) which has since rapidly spread across the world. Then via an IP ([Internet Protocol](#)) can be transmitted video conferences, and in 1992. On [Web](#) appear free of charge programs such as NetMeeting, MSN Messenger, Yahoo Messenger, Skype and others that enable video conferencing [9].

Video conferences are another very important form of information technology application in medicine. In this way is enabled the exchange of expert opinions in remote locations, performance of specialist consulting services, as well as the exchange of experiences. In this way can be achieved significant fund savings, but at the same time solves the problem of organizing such meetings, both in terms of aforementioned costs and matter of time of the same, finding the most suitable locations and the like.

V. CONCLUSION

Telecommunication and information technology have become increasingly important in all segments of human activity, and in medicine. In addition to advantages of their use which have been repeatedly mentioned in the study, we need to take into consideration that their purchase and implementation requires a substantial investment in equipment and personnel training. On the other hand, the benefits either to patients or employees are multiple. Faster, more efficient and more accurate determination of diagnosis, the ability to perform consulting activities and obtaining the views of experts in the most remote locations are of inestimable importance. In this way is overcome the problem of organization and costs related to consultations, the time saving is significant which is very often in this case the most important and limiting factor. Storage and exchange of data is also in this case much easier and better. As noted above, teleradiology allows almost immediate availability of high quality images, while reducing exposure of patients and employees to radiation.

REFERENCES

- [1] Babić, R.; Milošević, Z and Stanković Babić, G: Teleradiology-radiology at distance; Scientific Journal of the Faculty of Medicine in Niš 2012;29(3):145-151.
- [2] <http://www.stetoskop.info/Teleradiologija-lecenje-na-daljini-2742-s3-news.htm> [Homepage on the Internet, cited on April 14, 2013.]
- [3] http://en.wikipedia.org/wiki/Picture_archiving_and_communication_systemhttp://en.wikipedia.org/wiki/Picture_archiving_and_communication_system [Homepage on the Internet, cited on April 14, 2013.]
- [4] <http://www.telemed.co.rs/pacs-sistemi> [Homepage on the Internet, cited on April 14, 2013.]
- [5] Marković, Lj.; Petković, G.; Toroman, D.; Bebić, M.; Vukobratović, M.; Radosavljević, A.; Raičević, R. and Čulafić, S.: Radiološki informacijski sistemi Instituta za radiologiju Vojnomedicinske Akademije; Aktualnosti iz neurologije, psihijatrije i graničnih područja; god. X, br 1-2;2002.
- [6] http://en.wikipedia.org/wiki/Computed_radiography [Homepage on the Internet, cited on April 14, 2013.]
- [7] http://bib.irb.hr/datoteka/516600.Vizualizacija_podataka_funkcijske_magnetske_rezonance.pdf [Homepage on the Internet, cited on April 14, 2013.]
- [8] <http://www.neologica.it/eng/RemotEye.php> [Homepage on the Internet, cited on April 14, 2013.]
- [9] <http://hr.wikipedia.org/wiki/Videokonferencija> [Homepage on the Internet, cited on April 14, 2013.]