

# OPHTHALMOLOGY AND INFORMATION TECHNOLOGY IN TUZLA CANTON HEALTH CARE SYSTEM

Jasmin Zvornicanin<sup>1</sup>, Edita Zvornicanin<sup>2</sup>, Zekerijah Sabanovic<sup>3</sup>

Eye Clinic, University Clinical Centre Tuzla, Tuzla, Bosnia and Herzegovina<sup>1</sup>

Public Health Institute of Tuzla Canton, Tuzla, Bosnia and Herzegovina<sup>2</sup>

Faculty of medicine, University of Tuzla, Tuzla, Bosnia and Herzegovina<sup>3</sup>

Corresponding author: Jasmin Zvornicanin, Eye Clinic University Clinical Center Tuzla, Tuzla, BiH, 75000 Tuzla, Trnovac b.b., Bosnia and Herzegovina. Tel: 387 61 134 874. E-mail: zvornicanin\_jasmin@hotmail.com

## Original paper

### SUMMARY

**Purpose:** To analyze organization of ophthalmology health care in Tuzla canton and use of information technologies (IT). **Introduction:** IT in ophthalmology is the technology required for the data processing and other information important for patient and essential for building an electronic health record (EHR). IT in ophthalmology should include the study, science, and solution sets for all aspects of data, information and knowledge management in health information processing. **Material and methods:** We have analyzed organization of

ophthalmology health care in Tuzla canton. Data relevant for this research were acquired from annual reports of Tuzla Canton health ministry. All institutions and ambulances were visited and all health care professionals interviewed. A questionnaire was made which included questions for health care professionals about knowledge and use of computers, internet and information technology. **Results:** Ophthalmology health care in Tuzla canton has paper based medical record. There is no information system with any possibility to exchange data electronically. None of the medical devices is directly connected to the

Internet and all data are typed, printed and delivered directly to the patient. All interviewed health care professionals agree that implementation of IT and EHR would contribute and improve work quality. **Conclusion:** Computer use and easy information access will make a qualitative difference in eye-care delivery in Tuzla canton. Implementation phase will be difficult because it will likely impact present style of practice. Strategy for implementation of IT in medicine in general must be made at the country level.

**Key words:** Ophthalmology, Information Technology, Health Record, Tuzla Canton.

## 1. INTRODUCTION

Ophthalmology is the branch of medicine that deals with the anatomy, physiology and diseases of the eye (1). It is medical specialty dealing with the diagnosis and treatment of diseases and disorders of the eye (2). Information technology (IT) is technology used for the study, understanding, planning, design, construction, testing, distribution, support and operations of software, computers and computer related systems that exist for the purpose of data, information and knowledge processing (3). IT in Ophthalmology is the technology (hardware and software) required for the processing of data and other information important for patient and essential for building of electronic health record. Electronic health record (EHR) is longitudinal electronic record of patient health information

generated by one or more encounters in any care delivery setting (4).

Ophthalmology is a field of medicine that is strongly related with images of the eye in order to establish a diagnosis and provide appropriate therapy. Ophthalmologic practice is considerably modified by the use of computers for eliciting medical histories and physical signs with the introduction of "smart" measuring devices, expert systems for teaching and patient management (5). IT in ophthalmology should include the study, science, and solution sets for all aspects of data, information and knowledge management in processing of health information. IT has already has a substantial impact on diagnostic medicine, especially in imaging techniques and maintenance of medical records (6). Tele-ophthalmology is part of IT and telemedicine, it includes interactive commu-

nication technologies which allow people in different locations to meet for a range of clinical applications within the health field of eye care. Progress and development of telecommunications technologies like email and videoconferencing, made transfer of eye images and other important information's simpler and easier (7, 8, 9).

This article analyses present organization of ophthalmology care in Tuzla canton and use of IT, with special overview on possibilities and practical advantages of IT appliance in everyday practice.

## 2. MATERIAL AND METHODS

In our study we have analyzed organization of ophthalmology health care in North Eastern region of Bosnia and Herzegovina, more precise region of Tuzla canton. Data relevant for this research were ac-

quired from annual reports of Tuzla Canton health ministry and Federal health ministry of Bosnia and Herzegovina. For detailed analysis we visited all institutions, ambulances and University eye clinic to get insight which information technologies (hardware and software) and devices are stationed in Eye clinic and ambulances. Especially for this research a questionnaire was made which included questions for doctors and nurses (health care professionals) about knowledge and level of education in computers, internet and information technology generally, interest an experiences with electronic health record and methods for further informatics and ophthalmologic education.

**3. RESULTS**

Latest reports estimate 500 000 citizens live in this region of Tuzla Canton (10). Ophthalmology health care in Tuzla canton is realized through one University eye clinic, ten regional ambulances and two private practice offices. Six of ten ambulances work every day, and other four have mixed work schedule of three days in a week. 24 specialists, 5 residents and 72 nurses are responsible for implementation of operating and outpatient work. More than 2000 cataract operations, 300 vitrectomys, 100 oculoplastics, 400 intravitreal bevacizumab applications and 25000 specialist examinations are made every year. 18 computers with Windows operating system are available with 8 printers. Three ambulances do not have any computer or printer. Ten computers in 4 ambulances and University eye clinic have Internet and Intranet access to billing software. Region of Tuzla canton has three ultrasound machines, five auto ref topographers, two computer visual filed machines (Ocotopus 1000), two phaco machines (Infinity Alcon

Labs, WhiteStar Signature AMO), one vitrectomy machine (Accurus) and one Ocular Coherent Tomograph (Copernicus 4<sup>th</sup> generation). None of these devices are connected to the any kind of the internal network or the Internet and all data are manually typed, printed and delivered directly to the patient.

Eye clinic and all ambulances public and private have paper based medical record locally stored. There is no information system and with no possibility to exchange data electronically. There is no connection between operative and outpatient work and on the other side ambulatory and clinical work. Specialists working in ambulances have no medical records from tertiary healthcare level and they have only information returned in paper, which patient brings with him (11) (Figure 1).

Analysis of questionnaire showed that all specialists' residents and 80% of nurses do have necessary basic knowledge of computers skills (Windows OS) and use of Internet. 73% of doctors and 20% of nurses regularly check their e-mail, monitor world literature and attend training for acquisition of new skills. Continuous education is carried out mostly by using personal funds and commitments. All included health care professionals agree that implementation of IT and EHR would contribute to facilitation and improvement of work quality.

**4. DISCUSSION**

Our results show that organization of ophthalmology care in Tuz-

la canton does not use IT sufficiently. IT and computers provide faster communication, easy access to medical information, and patient satisfaction. Ophthalmology like any other part of medicine has its unique features that need to be taken into count when creating an information system. Basic ophthalmologic examinations such as slit lamp examination, keratometry, ultrasonography, fundus camera, ocular coherent tomography can be digitalized. The quality of the images captured, and hence the diagnosis, are influenced by the skills of the clinician viewing the eye and the technology used (12, 13). Currently in Tuzla canton none of numerous advantages of image digitalization are used. IT and computers have several other applications in clinical practice as shown in Table 1.)

Front office management  
 Appointment scheduling  
 Registrations  
 Bills and receipts  
 Patient details (demographics)  
 Correspondence (referral letters)

Back office management  
 Accounting  
 Purchase and inventory  
 Personnel and payroll

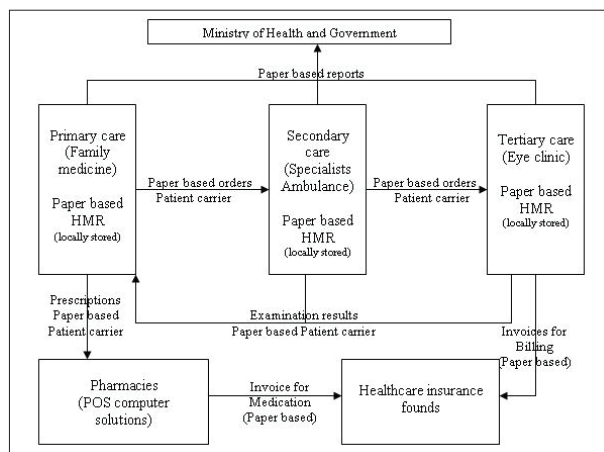
Clinical data management  
 Clinical evaluation – medical records  
 Prescriptions and dispensing  
 Image archival

Graphics  
 Patient information brochures  
 Academic presentations

Communications  
 Internet access  
 Electronic e-mail  
 Telemedicine

Medical informatics  
 Journals, Text books, Medline  
 Patient education (multilingual, multimedia)  
 Diagnostic – Intelligent systems

**Table 1.** Computer applications in clinical practice (Adopted from Rayev (6))



**Figure 1.** Data exchanging between primary, secondary, tertiary healthcare and government (Adopted from Sabanovic et al. [11])

cancellation and rescheduling and enables follow-up of patients who do not show up for appointments. All data can be collected and have information's about the number and type of performed procedures, number of patients and frequency of follow-up. This information's can be used for reorganization and improvement of work process. Ophthalmology health care in Tuzla canton does not use any of mentioned advantages and benefits, all appointments are made manually and follow up is often compromised by absence of medical documents.

Back office management includes accounts, price of materials, inventory and payroll. Most of these functions are not integrated in ophthalmologic practice and belong to the system of medical institution and Ministry of health. This system provides the funding by capitation with no practical use of Diagnosis related group systems (DRG) in accounting and payment for medical services.

Clinical data management includes collection, storage, and retrieval of clinical data including patient details and the entire medical record. The field of ophthalmology has a number of unique features compared with other medical and surgical specialties regarding clinical workflow and data management (14). This has important implications for the design of EHR systems that can be used intuitively and efficiently by ophthalmologists and that can promote improved quality of care (14, 15). Computer technology has matured to a point at which the graphical demands of the ophthalmology electronic medical record can be satisfied (15). University clinic does not possess system for storage and digitalization of images. All records are saved in paper form in patient histories and protocols.

A computerized record system provides simple access to patient information and images. Data can be retrieved and reported faster and these data take up less space and increase patient satisfaction (6, 14, 16, 17). Advantages found over paper record systems include savings in staff, time, paper storage and the ability to access records and clinical

images from multiple locations, including mobile devices (16, 17, 18, 19). Electronic medical (health) records should be standardized to provide more thorough analysis of patients' diagnosis, therapy, diagnostic procedures, complication rate (20, 21, 22). This can improve the quality of service and provide important data for the management that can be used in planning and management. The use of an electronic patient record system in ophthalmology is already possible, but still needs further tuning and improvement (23). In Tuzla canton some steps are made for implementation of EHR but no funding and education is provided by the competent authorities of the government (11).

Electronic health record can be used with mathematical algorithm based on epidemiological data on risk factors for screening of several ophthalmic diseases such as diabetic retinopathy. Information technology based on epidemiological data may facilitate individualized determination of screening intervals for diabetic eye disease and reduce number of visits up to 60% (24). Similar efforts are being made with set-up of glaucoma electronic patient record which proved to be successful in distinguishing high-risk glaucoma referrals (25). These possibilities have not been used in our practice yet.

IT technologies provide vast possibilities for creating patient information brochures and academic presentations. In countries where EHR is already implemented and available online on the Internet, most patients found the computer technology acceptable. The majority found viewing their electronic health record useful and understood most of the content, although medical terms and abbreviations required explanation (26). Some efforts have been made in order to achieve better patient awareness but there is still long way to go. For patient education and information brochures that explain common ophthalmic problems such as cataract and retinal detachment are created and distributed to local communities.

One of biggest advantages of IT is use of email and Internet. E-mail represents one of basic application of Internet which allows user to exchange information's with other users anywhere in the world. There are many discussion groups that can be found on the Internet which communicate through e-mail and can allow exchange text and multimedia messages. Ophthalmologists from around the world can consult each other by subscribing to a mailing list (6, 7, 9, 18, 20, 22). Using the Internet there can be found many web sites that can include case discussions, grand rounds, news, activities, abstracts of meetings and journals, full articles of journals that are already in print (paid access), outcomes data, clinical alerts, patient handouts, slides of interesting cases and public information material about eye care (6, 18, 20, 22)

Telemedicine is the assessment and review of patient information (history, examination, or investigations) by a health professional who is separated temporally and/or spatially from the patient (27, 28). Teleconferencing (videoconferencing) and telemedicine will be increasingly used in the coming years. Ophthalmologists can sit at computers in their own clinic and conduct discussions by exchanging messages/images through the local network, Internet, or telephone lines (6, 7, 18, 20, 22). Clinical images can be electronically transferred over long distances for expert or second opinion saving money, time and energy (29, 30).

Information technology can be used as support in the area of education (31). Development of modern technology and the Internet has enabled the explosive growth of distance learning (32, 33, 34). IT and tele-ophthalmology applications comprise both clinical and educational processes between the send and receive sites (6). These can include: screening of a disease, formulation of a diagnosis and clinical management plan, secondary advice and support in clinical management plan, peer supervision and support, professional development through group discussion, lectures,

and tutorials and, research and administration activities (6, 18, 22).

Special part of IT application in ophthalmology is use of smartphones in ophthalmology. Today's smartphones are multifunctional electronic devices that can be used to perform photography, video, Internet browsing, data sharing, listening to music, and watching movies. There is applicability in virtually every part of the ophthalmologic examination (34).

## 5. CONCLUSION

In the conclusion in this study we have identified some problems that need to be solved in order to improve healthcare in Tuzla canton generally and in ophthalmology. Use of IT and computers with easy access to information will make a qualitative difference in eye-care delivery. Implementation phase will be difficult because it will likely impact present style of practice. There are many health professionals who are not educated enough in IT. Strategy at the country level for implementation of IT in medicine in general must be made. Without strategy there is no standardization and funding which leads to smaller number of IT experts and preservation of current situation. Further efforts need to be made in order to improve education of health-care professionals.

**Conflict of Interest: None declared.**

## REFERENCES

1. Wikipedia (Internet). 2009. (Cited 2012 February 01). Available from: <http://en.wikipedia.org/wiki/Ophthalmology>
2. Encyclopedia Britannica. (Internet). 2010. (Cited 2012 February 01). Available from: <http://www.britannica.com/EBchecked/topic/430067/ophthalmology>
3. International Foundation for Information Technology. (Internet). 2008. (Cited 2012 February 01). Available from: [http://www.if4it.com/SYNTHESIZED/GLOSSARY/Information\\_Technology\\_IT.html](http://www.if4it.com/SYNTHESIZED/GLOSSARY/Information_Technology_IT.html),
4. National Institutes of Health National Center for Research Resources. (Internet). 2010. (Cited 2012 February 01). Available from: <http://www.ncrr.nih.gov/publications/informatics/ehr.pdf>.
5. Arden GB. The use of computers in ophthalmology: an exercise in futurology. *Trans Ophthalmol Soc U K.* 1985;104:88-99.
6. Rajeev B. Computers in ophthalmology practice. *Indian J Ophthalmol.* 1998;46:163-168.
7. Dick B, Eisenmann D, Tekaat CJ, Grote A. Ophthalmological information exchange of letters and digital pictures via the Internet. *Klin Monatsbl Augenheilkd.* 1996;209:aA7-a15.
8. Mainster MA, Sewell JJ. Small computers in the private ophthalmic practice. Practical considerations. *Surv Ophthalmol.* 1980;24(5):315-321.
9. Wang XX, Wang QM, Bao HF. Review of the development of ophthalmic informatics. *Zhonghua Yan Ke Za Zhi.* 2006;42(5):476-480.
10. Bosnia and Herzegovina Federal Office of Statistics. First Release. Number 14.2.1. (Internet). 2011. (Cited 2012 February 01). Available from: <http://www.fzs.ba/saopcenja/2011/14.2.1.pdf>
11. Sabanovic Z, Masic I, Salihefendic N, Zildzic M, Zunic L, Dedovic S. E-Health in Bosnia—Starting from the Ground-Up. *Acta Inform Med.* 2009;17(3):135-138.
12. Bernardes R, Serranho P, Lobo C. Digital ocular fundus imaging: a review. *Ophthalmologica.* 2011;226(4):161-181.
13. Paunksnis A, Barzdukius V, Jegelevicius D, Kurapkiene S, Dzemyda G. The use of information technologies for diagnosis in ophthalmology. *J Telemed Telecare.* 2006;12(1):37-40.
14. Chiang MF, Boland MV, Brewer A, Epley KD, Horton MB, Lim MC, et al. Special requirements for electronic health record systems in ophthalmology. *Ophthalmology.* 2011;118(8):1681-1687.
15. DeBry PW. Considerations for choosing an electronic medical record for an ophthalmology practice. *Arch Ophthalmol.* 2001;119(4):590-596.
16. Aylward GW, Parmar DN. Information technology in ophthalmology—experience with an electronic patient record. *Br J Ophthalmol.* 1999;83(11):1264-1267.
17. Henkin RE, Harolds JA. Health information technology and the electronic medical record. *Clin Nucl Med.* 2010;35(10):788-789.
18. Clark BJ. Information technology in ophthalmology. *Br J Ophthalmol.* 1998;82:984-986.
19. Chiang MF, Boland MV, Margolis JW, Lum F, Abramoff MD, Hildebrand MF, et al. Adoption and perceptions of electronic health record systems by ophthalmologists: an American Academy of Ophthalmology survey. *Ophthalmology.* 2008;115(9):1591-1597.
20. Sangwan VS. Information technology and ophthalmology. *Indian J Ophthalmol.* 2000;48:169
21. Pandza, H. Minimal Data Sets for Electronic Medical Records in Hospital Settings. *Acta Inform Med.* 2009;17(2):71-73.
22. Prasad S, Nagpal M, Sharma OP, Nagpal PN. The impact of information technology on the practice of ophthalmology. *Indian J Ophthalmol.* 2000;48:237
23. Kuchenbecker J, Behrens-Baumann W. Use of an electronic patient record system at the Department of Ophthalmology, Otto-von-Guericke University of Magdeburg. *Ophthalmologie.* 2004;101(12):1214-1219.
24. Aspelund T, Thornórisdóttir O, Ólafsdóttir E, Guðmundsdóttir A, Einarssdóttir AB, Mehlsen J et al. Individual risk assessment and information technology to optimise screening frequency for diabetic retinopathy. *Diabetologia.* 2011;54(10):2525-2532.
25. Imrie F, Blaikie A, Cobb C, Sinclair A, Wilson D, Dobson S, et al. Glaucoma electronic patient record—design, experience and study of high-risk patients. *Eye (Lond).* 2005;19(9):956-962.
26. Pyper C, Amery J, Watson M, Crook C. Patients' experiences when accessing their online electronic patient records in primary care. *Br J Gen Pract.* 2004;54(498):38-43.
27. Murdoch I. Telemedicine. *Br J Ophthalmol.* 1999;83:1254-1256.
28. Lamminen H, Voipio V, Ruohonen K, Uusitalo H. Telemedicine in ophthalmology. *Acta Ophthalmol Scand.* 2003;81(2):105-109.
29. Chew SJ, Cheng HM, Lam DS, Cheng AC, Leung AT, Chua JK, et al. OphthWeb—cost-effective telemedicine for ophthalmology. *Hong Kong Med J.* 1998;4(3):300-304.
30. Davis RM, Fowler S, Bellis K, Pockl J, Al Pakalnis V, Woldorf A. Telemedicine improves eye examination rates in individuals with diabetes: a model for eye-care delivery in underserved communities. *Diabetes Care.* 2003;26(8):2476.
31. Sabanovi Z. Information technology as a support in the area of education. *Med Arh.* 1999;53(2):113-116.
32. Pandza H, Masic I. Distance Learning Perspectives. *Acta Inform Med.* 2010;18(4):229-232.
33. Masic I. E-Learning as New Method of Medical Education. *Acta Inform Med.* 2008;16(2):102-117.
34. Benjamin L. Selection, teaching and training in ophthalmology. *Clin Experiment Ophthalmol.* 2005;33(5):524-530.
35. Lord RK, Shah VA, San Filippo AN, Krishna R. Novel uses of smartphones in ophthalmology. *Ophthalmology.* 2010;117(6):1274-1274.