

PERCEPTIONS OF SPECIALISTS IN OCCUPATIONAL MEDICINE ON POSSIBLE OBSTACLES ENCOUNTERED IN USING ELECTRONIC HEALTH RECORDS (EHR)

Dorin TRIFF

“Vasile Goldis” Western University Arad, The Faculty of General Medicine, Pharmacy and Dental Medicine

ABSTRACT. Knowledge of physicians’ opinions and expectations about EHR represents a major factor of success in its implementation in clinical practice.

The objectives of the current study were:

- to estimate individual and contextual characteristics of the population represented by occupational health physicians as well as to highlight the existence of links between them;
 - to highlight how these characteristics influence the perception of possible obstacles encountered in using Electronic Health Records. A total of 52 specialists, from five counties, agreed to answer a Pre-test questionnaire during 15.02.2010-30.03.2010 and received the Medmun, an EHR practical application for evaluation. Pre-test questionnaire aimed at OM physicians’ perceptions possible obstacles encountered in using Electronic Health Records according to physicians’ individual and contextual characteristics
- Physicians who perceive associated costs as an obstacle to the use of EHR associate it with the fear of changes in office work. The study underlines the importance of acquiring the level of training and skills in the use of EHR so as not to perceive the use of EHR in clinical practice as an obstacle. Providers of computer applications must offer OM physicians appropriate training to use these applications, an important element for successful integration of EHR in medical practice.

Keywords: Electronic health records; Occupational medicine, perception evaluation of the EHR software, Occupational Health Services, standards, classification

I INTRODUCTION

Numerous studies particularly in the United States have shown that a successful implementation of EHR in the health care depends on the doctors’ attitude towards it. (Cristina C., 2010)

By knowing the reasons that determine the doctors’ acceptance or rejection of EHR in the practice of occupational medicine (OM) can adjust the measures necessary for stakeholders in national health policies to decide large scale implementation projects of EHR. (Simon et al., 2009)

OBJECTIVES

Studies of individual and contextual factors that influence the attitude of doctors regarding adoption of electronic medical records of the survey type have been conducted by using questionnaires validated by numerous studies that included the individual characteristics of physicians: i.e. age, experience (i.e. length of medical practice), degree of computer use, and the type of computer application used to that date within the organization.

In these studies, contextual features were represented by proper training done by the software application provider, physician's decision-making autonomy, the degree of doctor involvement in

selecting the computer applications, support from the doctor’s organization management, and the doctor-patient relationship

The objectives of the current study were:

- to estimate individual and contextual characteristics of the population represented by occupational health physicians as well as to highlight the existence of links between them;
- to highlight how these characteristics influence the of possible obstacles encountered in using EHR.

MATERIALS AND METHODS

Through official enquiries sent to Public Health Departments and the Colleges of Physicians between January 1st, 2010-15.02.2010, practitioners who work in occupational medicine in the counties of Cluj, Bihor, Maramures and Satu Mare and Salaj were identified.

After this first contact, a total of 52 specialists agreed to answer a Pre-test questionnaire during 15.02.2010-30.03.2010 and received the Medmun practical application for evaluation. (Table I.)

Table 1. Number of participants in Pre-test and Post-test questionnaires and their distribution by counties

County	Number of specialists in Occup.Med.	No of OM specialists responding to Pre-test Q	Number of OM specialists responding to Post-test Q who evaluated the software
Cluj	31	30	28
Bihor	9	5	2
Maramureş	11	10	7
Satu Mare	4	4	3
Sălaj	2	2	2
Total	58	52	42

Pre-test questionnaire aimed at OM physicians' perceptions possible obstacles encountered in using

Electronic Health Records according to physicians' individual and contextual characteristics (Figure 1)

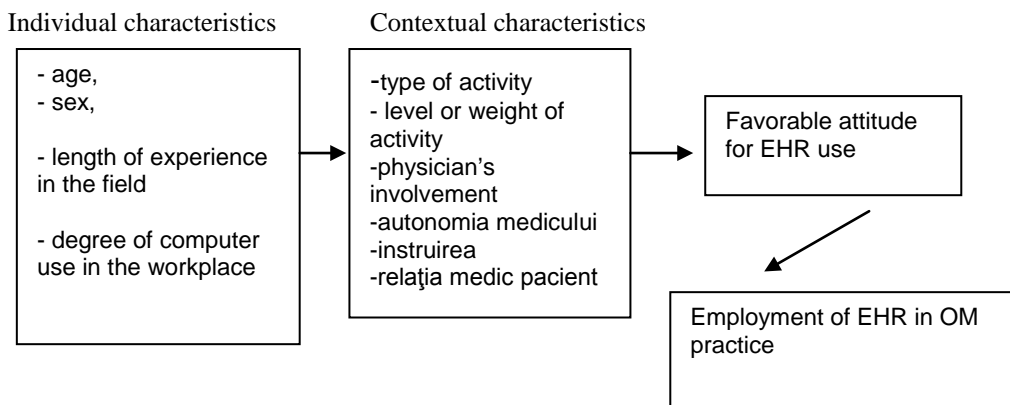


Figure 1. Attitude to EHR use as a result of physicians' characteristics and their opinions on its usefulness and ease of use

The questionnaire employed for this purpose, entitled Pre-test is presented in Table II below.

Table 2. Pre-test questionnaire Registration No.

1. -Your age in years (specify)
 2. -Gender: Female Male
 3. -Experience in the field / competence (in completed years):
 4. -Perform health surveillance for a number of workers of about:.....
- (Note: for occupational health doctors the figure covers virtually all registered workers, with or without the cooperation with company physicians)
- A below 500 B between 500-1000, C between 1000-5000, D between 5000-10000, E over 10,000 F would rather not mention
5. A. Supervision of health workers is performed in an office which is: (Choose all options that suit you)
 5. A_A Private Medical Office, 5 A_B Public Medical Office, 5 A_C Enterprise Medical office 5 A_D Grouped Medical Offices, 5 A_E associated medical offices, 5 A_F Medical Office of an Ltd, 5. A_G Medical office in a hospital Outpatient clinic, 5 A_H you are a doctor in occupational medicine department, 5 A_I You are a doctor in surveillance and control bodies, 5 A_J Other:
 - B. In this job you are (choose all correct versions):
 5. B_K employee, 5 B_L employer, 5 B_M partner
 6. At the workplace you use a personal computer to (choose all options that suit you):
 - 6A edit, view texts and images
 - 6B use the Internet, research, email communication
 - 6C patients' medical records through: text, medical images,
 - 6D electronic health records of patients
 - 6E Other(specify).....
 - 6F I do not use a computer at work
 7. In your occupational medicine activity, the use of electronic health records has the following obstacles: (Circle the appropriate option: 1 - not important, 2 – of little importance important, 3 – of moderate importance, 4 - of great importance, 5 - very important)
 - A. The costs related to copyright, installation and maintenance of EHR - - - - - 1 2 3 4 5
 - B Depreciation of investment in EHR is uncertain ----- -1 2 3 4 5

- C The use of EHR increases workload ----- 1 2 3 4 5
- D Information safety of electronic health records is low ---- - 1 2 3 4 5
- E EHR can become outdated in time, requiring a new implementation - --- - 1 2 3 4 5
- F Lack of legislation stipulating the use of EHR ----- - 1 2 3 4 5
- G Changes are required for EHR implementation in medical practice - - - - - 1 2 3 4 5
- H EHR requires compatibility with existing information systems in medical practice - 1 2 3 4 5
- I Difficulty of use ----- 1 2 3 4 5
- J Possibility of doctor patient relationship depersonalization - - - 1 2 3 4 5
- K Other - - - 1 2 3 4 5
- L Do not know -----

Individual characteristics of doctors included in the Pre-test questionnaire are:

- age in completed years, representing item 1 of the questionnaire;
- gender, item 2;
- experience in OM of the respondent, in years - item 3 of the questionnaire;
- level of computer use at work, item 6 of the questionnaire, comprises 6 questions, the first four questions were presented in order of increasing levels of computer use from writing to the use of EHR and the last two included particular cases: lack of use and particular comments on computer use.

The following were considered contextual characteristics of physicians:

- type of activity, represented by items 5 A, B.....-J of the questionnaire aimed at identifying how physicians operate in OM. The following methods of conducting the OM activity were considered: private medical practice, public medical practice, enterprise medical office, grouped medical offices, joint/associated medical offices, medical office within an Ltd company, medical office in a hospital outpatient

clinic or OM department, or specific activity in surveillance and control bodies.

In sections 5 K, 5L, 5M of the questionnaire we also followed the physician’s decision-making capacity by identifying his status of employee, employer or partner;

-the level or share of activity represented by the number of subordinated workers, on a scale of less than 500 - the question 4A to more than 10,000 - item 4E, or 4F item where the number of subordinated workers is not disclosed;

In the group of doctors participating in the Pre-test there were 34 female respondents, representing about 2/3, and 18 male respondents, i.e. approximately one third. Only 45 of the 52 participants specified the number of workers for whom they provide health surveillance.

RESULTS AND DISCUSSIONS

The average age of the entire group is 46 years old, with an average experience in the specific activity of about 15 years. (Table III.)

Table 3. Characteristics according to age, experience in the field, and number of workers for Pre-test respondents

Variable under study	No respondents	Minimum	Maximum	Average	Standard Deviation
Age	52	29	75	46,37	11,935
Experience in the field	52	1	49	14,82	11,896
Number of workers	45	250	12000	3333,33	3217,495

These variables were also studied as normality of distribution by application of Kolmogorov-Smirnov-test. According to Kolmogorov-Smirnov test, the variables age (p = 0.24) and experience in the field (p = 0.312) are approximately normally distributed, while the variable number of workers is not normally distributed (p <0.0001).

In the group of respondents, age is correlated significantly with experience (p = 0.000, Rs = 0.913). Average age is 43 years in the female group with extreme values between 32 and 62 years and mean age

is 51 in the male group with values between 29 and 75 years. (Table IV)

The average experience period is 12 years in the female group, with values ranging from 1 year up to 30 years of experience in the specialty of occupational medicine. In the group of males, the average occupational activity experience is 19 years, with values between 2 and 49 years.

The population of OM physicians is represented by approximately two thirds females having both average age and duration of experience significantly lower 7-9 years compared to males

Table 4. Characteristics related to age and experience in OM according to gender of Pre-test respondents

Gender	Age	Experience in OM
F	Average	43,76
	No of respondents	34

	Standard Deviation	8,955	8,615
	Minimum	32	1
	Maximum	60	30
M	Average	51,28	19,56
	No of respondents	18	18
	Standard Deviation	15,250	15,625
	Minimum	29	2
	Maximum	75	49

Application of ANOVA for these variables indicates that age ($p = 0.029$, $p < 0.05$) and experience in OM activity ($p = 0.035$, $p < 0.05$) differ significantly according to gender.

Section 5 of the questionnaire indicates the organization of the workplace activity, doctors being able to choose several options that correspond to all legal forms in which they operate.

Responses to question 5 options differ significantly among them ($p < 0.0001$), 5AF and 5AA being the options with most positive responses. Two responses were punctual, i.e. 5K "other" mentioned: authorized physical entity and scientific researcher, respectively.

Responses to options of question 5B differ significantly among them ($p < 0.0001$), the most common option being 5BK, representing the occupational physician's status of an employee. When choosing their professional status, 37 physicians are employees, 19 are employers, 18 partners, in the last two situations there are 5 cases in which the status of partner and employer meet.

The simultaneous status of employee in one workplace and employer in another job appears in 13 cases while the status of employee and partner in another job occurs in 11 cases. 3 doctors working in hospital outpatient clinic also have a private medical practice, while 4 physicians working in hospital outpatient clinic and 5 in a hospital clinic also work in a Ltd company office.

These results reveal the co-existence of several statuses in the same physician. The most common

ways of work organization are represented by the medical office in a Limited Liability Company, with a total of 28 respondents, representing over half of them, followed by private medical office with 15 responses representing almost a third of physicians, and work in a hospital, in the occupational health department with 10 cases, followed by hospital outpatient clinic with 8 cases.

The level of computer use at work highlighted by question 6 of the questionnaire allowed free choice of several options, covering the main computer uses by OM physicians at work.

Points A, B, C, D of question 6 represent statements in ascending order of the level of computer use at work, from its use in editing, to the use of computers as access to information, to the integrated use of medical information represented by the use of EHR.

All those who chose as activity the use of EHR in their workplace also mentioned email usage. 20 physicians stated that they use the computer for recording medical data of patients, of whom 9 also use EHR, thus resulting that 11 respondents use the computer for recording medical data such as simple tables, data files, images, etc.

Alongside with the respondent using the equivalent of electronic medical records at work, result a number of 21 physicians using the computer for recording patient medical data. (Table V)

Table 5. Use in terms of the computer equipment endowment or interest of using it in the workplace

Use of computer in the workplace for	Number of responses
6A. Editing, visualization of text and images	42
6B. Use of the Internet, research/information, e-mail	40
6C. Records of medical patient data through: texts, medical images	21
6D. Electronic Health File of the patients	11
6E. Others	1
6F. I do not use a computer at the workplace	10

A total of 42 physicians, i.e. 4/5 of the respondents have minimum knowledge of computer use at work for editing and viewing text and images. A total of 40 physicians have knowledge of computer use that allow them to communicate over the Internet. A total of 21 physicians use the computer for recording patients' medical data. Of these, 11 physicians had been using

electronic health records in medical practice when they received the Pre-test questionnaire.

All the 11 physicians who used EHR in medical practice indicated that they use computers for writing, internet documentation, and medical data records. Two of them however, did not mention point C of the question referring to recording of medical data, which

are made through EHR. A response mentioned the simultaneous use of the computer for the Internet, for research, and email but claimed that does not use the computer at work. Perhaps in this case the computer

was used only outside the working hours. It results that a number of 10 respondents representing one fifth of the total do not use computers at work. (Table VI)

Table 6. Use of computer in the work place by OM physicians

Purpose of computer use in the workplace:	Number of options
6A. Editing, visualization of texts and images	34
6B. Use the Internet for research/information, email	35
6C. Recording of patients' medical data through: medical texts, images,	20
6D. Patients EHR	11
6E. Others	1
6F. I do not use the computer in the workplace	11

The Mann Whitney test showed that those who do not use computers at work (item 6F) were significantly older ($p = 0.023$).

Obstacles perceived by occupational physicians in their use of EHR in OM practice represented by point 7 of the Pre-test questionnaire with response options: 1 -

not important, 2 – of little importance, 3 – of moderate importance, 4 - of great importance, 5 – extremely important. The Hi-square test showed that responses to question seven options differ significantly between them ($p < 0.000000001$)

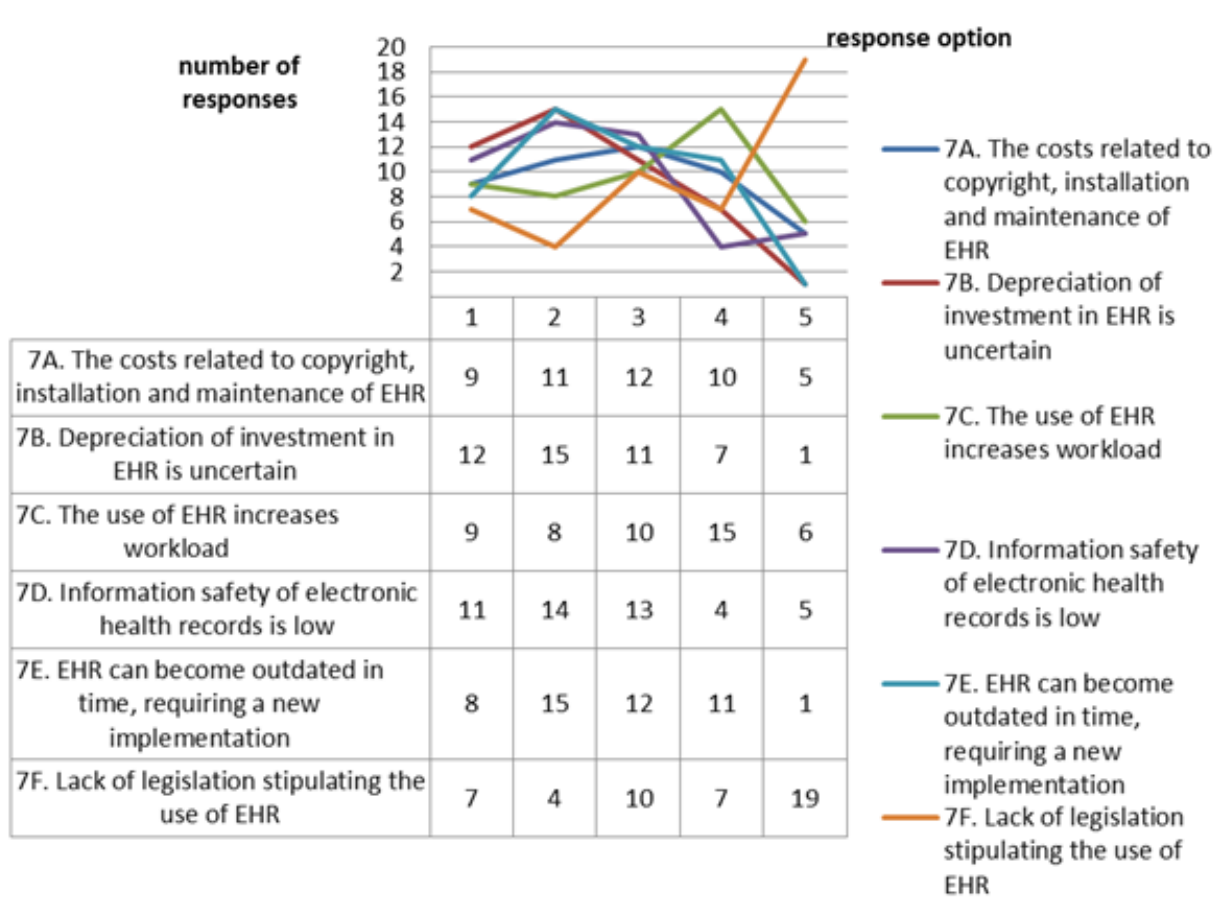


Figure 2. Graphic distribution of frequency of answers to points 7A-7F of the questionnaire, representing obstacles perceived by OM physicians for EHR use in clinical practice

For an appropriate illustration (to prevent chart overloading), the first 6 options of item 7 of the questionnaire were represented separately, the graphics

representing the response frequency for variants 1-5. (Figure 2), (Figure 3)

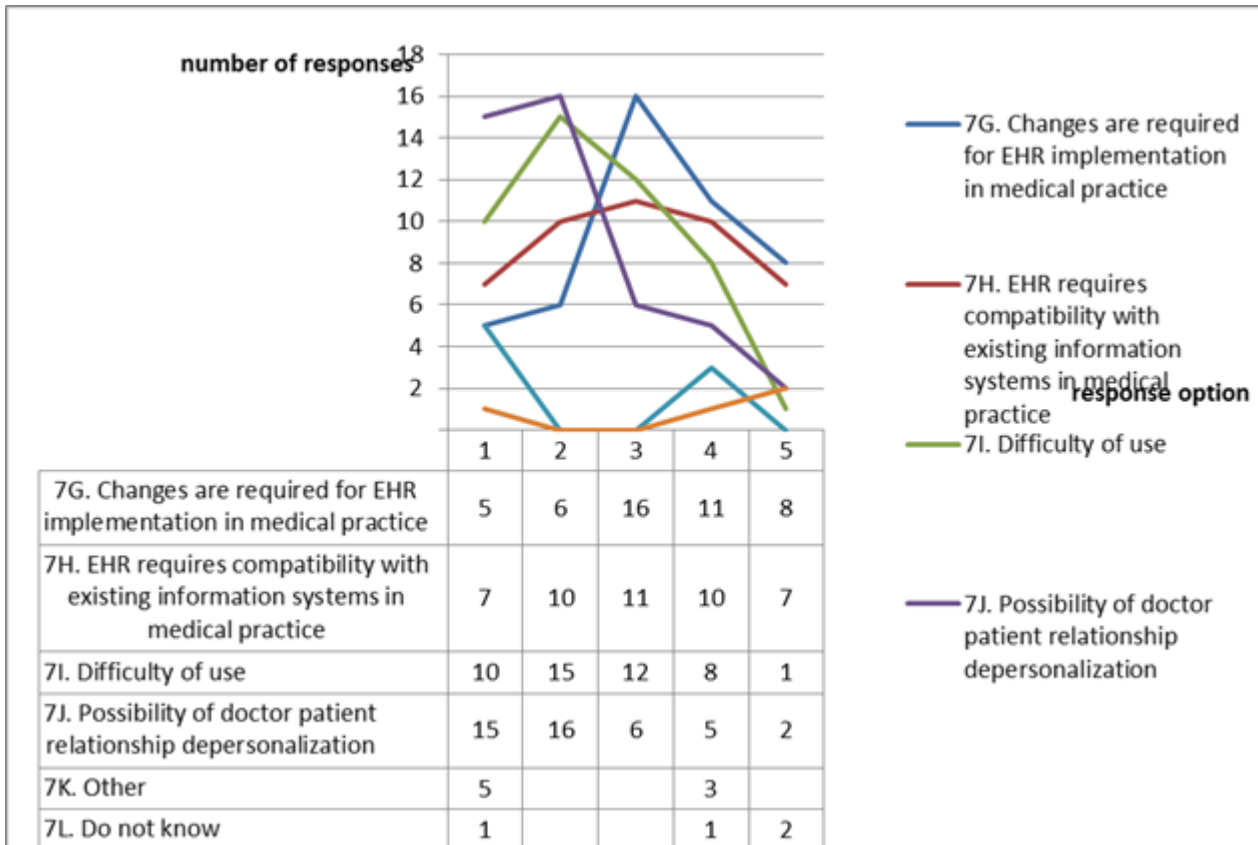


Figure 3. Graphic representation of responses to items 7G-7L of the questionnaire representing obstacles perceived by occupational physicians for EHR use in clinical practice

- graphs of response frequency to items 7I and 7J have a central maximum at option "2" indicating that the obstacle doctor-patient relationship depersonalization is minor;

- graphs of responses in sections 7K and 7L are characterized by a small number of nominated responses, indicating the absence of other perceived obstacles than those listed.

Questions of section 7 of the questionnaire, presenting obstacles to EHR use in the practice of occupational medicine, are analyzed by using

Spearman nonparametric correlations. Age, duration of experience, the number of workers, do not correlate with any item of section 7 of the questionnaire. There are the following significant correlations ($p < 0.05$) between the items of paragraph 7 of the questionnaire: responses to the question that perceived EHR copyright, installation and maintenance costs as an obstacle (item 7A) has a Spearman significant correlation with the answers to the following questions, as illustrated in the following table. (Table VII)

Table 7. Significant Spearman correlations between item 7A and other items of point 7 of the questionnaire

		7B. Depreciation of EHR investment is not certain	7E. EHR can be outdated in time	7G. Changes of activity are necessary	7H. EHR should be compatible with other software	7I. Difficulty of use
7A. Costs with EHR copy-right, installation and maintenance	Rs	,680**	,668**	,356*	,402**	,359*
	p	0,000	0,000	0,017	0,006	0,015
	N	47	47	45	45	45

Moreover, those who perceive return of investment in EHR as unsure and therefore as an obstacle (item 7B) perceive the following as obstacles in its exploitation as well:

- the workload increases ($R_s = 0.447$, $p = 0.002$), information security is low ($R_s = 0.416$, $p = 0.004$); it may become outdated over time, requiring a new upgrade ($R_s = 0.697$, $p = 0.000$); the fact that amendments are necessary in order to implement the electronic health record in medical practice ($R_s = 0.396$, $p = 0.008$), may have difficulty in using it ($R_s = 0.621$, $p = 0.000$) or that the doctor/patient relationship can be depersonalized ($R_s = 0.350$, $p = 0.020$).

Those who see that the workload increases through the use of EHR give responses that correlate with low security of information by using EHR ($R_s = 0.362$, $p = 0.011$).

Additional correlations between the latter category, expressing fears over the low safety of information through the use of EHR as well as the perception as obstacles of the following: EHR may become outdated over time, requiring a new implementation ($R_s = 0.464$, $p = 0.001$); EHR requires compatibility with existing information systems in medical practice ($R_s = 0.423$, $p = 0.004$); difficulty of use may occur ($R_s = 0.413$, $p = 0.005$); possibility of depersonalization of the doctor/patient relationship ($R_s = 0.335$, $p = 0.026$).

The fact that EHR may become outdated over time, requiring a new upgrade is correlated with fears that: changes in medical activity for the operation of EHR are difficult ($R_s = 0.399$, $p = 0.007$), compatibility with existing computer systems in medical practice is not assured ($R_s = 0.454$, $p = 0.002$), difficulty using this type of file is an important aspect ($R_s = 0.527$, $p = 0.000$). Other associations are represented by:

- the obstacle represented by the lack of legislation stipulating the use of EHR is correlated with the obstacle represented by the necessity of changes in activity implied by its use ($R_s = 0.396$, $p = 0.006$);

- changes of activity for EHR implementation correlate with possible lack of compatibility of this software with other software offered by medical service providers ($R_s = 0.450$, $p = 0.002$);

- this possible lack of compatibility with other information systems correlates with possible difficulty in its use ($R_s = 0.368$, $p = 0.014$);

- possible difficulty in using this type of medical records correlates with possibility of doctor/patient relationship depersonalization ($R_s = 0.507$, $p = 0.001$).

In order to detect any possible links between the type of activity by the organization of the occupational medicine and how obstacles of EHR use are perceived in clinical practice, Mann-Whitney test was applied to rank the seven points of the questionnaire for each subsection of question five.

Scores of section 7 of the questionnaire are not significantly different according to answers on the organization of activity as private medical practice, public medical practice, practice within the outpatient clinic of a hospital or those working in surveillance and

control bodies ($p > 0.05$). A similar situation occurs for the two doctors in particular situations of activity: authorize private entity and scientific researcher.

Doctors in occupational medicine departments respond significantly ($p = 0.045$) with lower scores only at 7C considering that the workload does not increase through the use of EHR, or that any additional work is not an obstacle to its use.

Only one respondent chose the organization of the medical activity as enterprise office, choosing the answer 5L "do not know" at possible obstacles in the use of EHR in practice. Organizational form of "grouped medical offices" has one respondent located at the extremes of the male group, as age i.e. 29 years old and 2 years experience and who also performs his job in the form of private individual practice with an opinion which states first of all the obstacles in EHR use: difficulty of use, lack of compatibility with other applications, depersonalization of the doctor/patient relationship

Reporting responses regarding barriers to the use of EHR to those with the most common form of organization for the medical office, i.e. within an Ltd practice, by using the Mann-Whitney test of ranks and statistics it is evident that only answer to 7D differs significantly after the response to 5AF ($p = 0.045$).

Those who have this form of organization respond significantly more often with a low score considering that the low information safety through EHR can not represent an obstacle to its use or that there is no lower level of security.

The employee status of the occupational health physician compared to responses in section 7 of the questionnaire show statistically significant answers only in section 7K ($p = 0.024$) having lower rank scores at this point, shows that these doctors do not take into account any other possible obstacles.

The status of employer of the occupational physician in terms of perceived barriers to EHR adoption shows statistically significant responses only from the perspective that return on investment is uncertain ($p = 0.03$) whereas the status of partner does not present this view as answers to 7A-7L do not differ significantly after the 5BM response ($p > 0.05$).

Comparing responses in section 7 of the questionnaire according to the use of computer at work represented by point 6 of the questionnaire shows different situations of perceived barriers to the use of EHR depending on the degree of computer use.

For those using the computer at the workplace mainly for editing and viewing text and images, for answers to paragraph 7, only answer to 7H differs significantly ($p = 0.047$) with higher rank scores indicating an important obstacle in EHR use the fact that it requires compatibility with existing computer systems in medical practice.

For doctors who use the computer mainly for research and email, only answer to 7F differs significantly ($p = 0.035$) i.e. notes of those that respond positively to 6B are significantly higher than of those

who respond negatively, indicating lack of legislation stipulating EHR use as a significant barrier.

For physicians who use the computer at work to record patients' medical data through text and images, answers to 7A-7L are not significantly different ($p > 0.05$).

Doctors who use EHR in clinical practice have statistically significant different responses from those who do not use it (6D) at item 7B ($p = 0.008$), 7J ($p = 0.007$) and 7i ($p = 0.044$). Notes on items 7B, 7J, 7i of those who have opted for a positive response to 6D are significantly lower than those with negative responses.

Doctors who used EHR have significantly different responses compared to those who have not implemented this feature in medical practice in that they believe that the following obstacles are of little importance: return on investment in this type of file is not safe, there can lead to depersonalization of the doctor/patient relationship or that they may encounter difficulties when using EHR.

Responses to 7A-7L do not differ significantly after the response to 6E ($p > 0.05$). Just answer to 7C differs significantly after answer to 6F ($p = 0.028$). Among the obstacles imposed on the use of EHR, doctors who do not use a computer at work find it significant that the workload would increase through the use of electronic health records.

Knowledge of physicians' opinions and expectations about EHR represents a major factor of success in its implementation in clinical practice. Significantly increased age in those who do not use a computer at work is a result similar to that in other studies, however, male users had higher levels of computer use than females. In our study gender does not influence the level of computer use at work. (Meade et al., 2009)

Graphic distribution of frequency responses in points 7A,...7F can be grouped into two categories:

- graphic representation of frequency distribution of responses to items 7C and 7F shows an upward trend, i.e. answers with predominantly higher scores due to the negative form of the question, the fact that through EHR use the workload increases and lack of legislation stipulating its use are shortcomings that determine EHR not to be used in medical practice.

Perception that the workload increases through the use of EHR occurs without being influenced by the level of computer use at work, results which are consistent with other studies and representing an obstacle of its use. (Kemper et al, 2006), (Baron et al, 2005)

- graphs representing the frequency distribution of responses to items 7A, 7B, 7D, 7E have central maximum, signifying a predominant score around responded 2-3 and representing a relative lack of perception of EHR copyright, installation, and maintenance costs as well as return on investment, information safety, and the need for periodic update of the software application as obstacles in the use of EHR.

These results differ from results of a similar study on the initial perception of doctors about the use of EHR for medical data from The United States, where the main obstacle was represented by costs represented by the use of EHR. Similarly to the same study, in our study those who perceive costs as an obstacle to the use of EHR have answers significantly associated with fear for the need of changes in the office activity. (Patel et al, 2011) Graphic representation of responses to the questionnaire items 7G-7L can be grouped into three categories:

- graphs of answers to 7G and 7H have a distribution of slightly increasing response frequency, leading to the perception of the necessity of changes brought to the work in private practice and the fact that for a proper functioning of EHR interoperability with other applications is necessary, as barriers.

In our study this obstacle represented by the lack of standards and interoperability with other EHR is not associated with age, a result different from a study showing the same concern as obstacle of use but where the physicians' lower age was a predictor of the doctors' use of EHR. The result should not be surprising: in our study, because of shortcomings related to a low level of EHR implementation, fear represented in item 7H is independent of age. (Kaushal et al., 2009)

It is noted that occupational medicine physicians often work simultaneously in several places. The most common professional status of occupational medicine physician is that of employee.

Those who perceive copy-right installation and maintenance costs of EHR as obstacles, with good Rs consider that: the return on investment is not secure (7B); they believe that EHR may become outdated over time, requiring a new implementation (7E).

While those with a significant weak Rs, have the following correlations: they perceive the necessity to make changes in their activity for EHR implementation as a shortcoming(7G), besides the lack of compatibility with existing computer systems in medical practice (7H); they also consider difficulty of use as an obstacle (7I).

The obstacle represented by changes at work needed for EHR implementation, indicate a similar result to that of a survey in the United States that placed the difficulty represented by appropriate modifications of current activity and concerns about the lack of interoperability with other systems as obstacles of adopting information systems. (Ross et al., 2010)

CONCLUSIONS

Doctors who do not use a computer at work are on the average of an older age.

In our research the level of computer use does not depend on gender.

Perception that the workload increase through EHR use is not related to the level of computer use.

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Costs related to the use of EHR do not represent an obstacle to its use by OM physicians. Physicians who perceive associated costs as an obstacle to the use of EHR associate it with the fear of changes in office work.

The obstacle in the use of EHR represented by the lack of standards and interoperability with other information applications is not influenced by the doctors' age.

The study underlines the importance of acquiring the level of training and skills in the use of EHR so as not to perceive the use of EHR in clinical practice as an obstacle.

Providers of computer applications must offer OM physicians appropriate training to use these applications, an important element for successful integration of EHR in medical practice.

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