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ORIGINAL PAPER

Making Use of H-index: the Shape of Science at the University of Sarajevo

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ABSTRACT

Introduction: Quantifying science and scientific contribution has become one of the main tasks in evaluating researchers and their impact. How do we value research and science in Bosnia and Herzegovina (BIH)? Scientific community has mostly agreed upon that one of the best ways to value researchers is through their h-index value. However, there are many databases and services from which h-index can be retrieved. **Aim:** To describe different databases and services such as Google Scholar, Web of Science, Scopus and Researchgate in evaluating the researcher. An additional aim of this paper is to present "the shape" of science at the University of Sarajevo and to examine what are the best predictors of h-index. **Materials and methods:** We analyzed the data from 100 Google Scholar Profiles of researchers from University of Sarajevo. **Results:** The study showed some benefits and shortcomings of mentioned databases and services. Most researchers in the sample were from natural sciences, in particular from the field of medicine. The mean value of h-index in relation to the researcher's gender was not statistically significant. We conclude the article with some ideas on how to improve the visibility of researchers from BIH.

Keywords: h-index, databases, Google Scholar, University of Sarajevo.

1. INTRODUCTION

Publish or perish. Most researchers are reminded of this hamletian dilemma every time a promotion at the department or a national project application is supposed to take place. Researchers are aware that without valuable scientific output the chances for tenure, promotion and "academic fame" are significantly reduced. Thus, the need to publish in journals that are scientifically visible is becoming a must for a scientist. Although, the practice of quantifying researcher's influence has a long tradition in developed countries, it is increasingly being used in countries on a scientific periphery such as Bosnia and Herzegovina (BIH). Scientific periphery is the term used by Marusic and Marusic (1) for countries formed after the fall of communism but also many other countries that lag behind in research production. The task of quantifying and valuing research output has become a serious endeavor being imposed by funding agencies, promotion committees and employers (2). Measuring and quantifying academic accomplishments has become a "fact of scientific life" (3). Currently there is no universally accepted, international standard procedure for evaluating researchers based on their scientific output (4).

However, there are some methods for measuring scientific impact such as the number of citations that a publication receives (5). One of the most cited measures, although not without flaws, in measuring scientific output is h-index. Hirsch (6) proposed a single number that will be useful in measuring scientific output of a researcher. H-index, as proposed by Hirsch, is the number of publications that have that many number of citations. So, we can see that this metrics is influenced by both, researcher's productivity and the impact that research had on his/her peers. The h-index has achieved significant acceptance as a measure of individual research achievement and it has several advantages as it combines scientific productivity with scientific echo and is not susceptible to extreme values (7). It is important to note that h-index is not without its critics and numerous other indexes have been proposed in-

stead such h (bar) index (8). However, for the purposes of this study we will stick to the h-index. Studies have shown that researchers with higher h-index are generally more likely to obtain grants and fellowships (9).

Scientific community in BIH has slowly begun to accept h index as an indicator of researcher's output. However, which h index will be used remains a dilemma. For example, for promotion purposes should the promotion committee look at h index from Google Scholar, Researchgate, Web of Science or Scopus?

Google Scholar and Researchgate are free-of-charge services that look at researchers output and can be used in analyzing citation index of an author. Google Scholar is probably the largest scientific database that combines content from several large databases unavailable to the public web, plus academic web documents from the Google search engine (10). Google Scholar covers a large number of journals and other publications. Researchers have the option to create their Google Scholar Profile, which has all the papers that the researcher authored, which can be automatically retrieved by Google or can be manually added by the researcher. The papers can be manually added and show to the public research that is not covered by Google search engines. However, the citations cannot be manually added and they are retrieved by Google. So, the Google Scholar automatically counts all the citations it can find for the author and creates their h-index. However, although very useful, the accuracy of the Google Scholar services is often inconsistent (11).

On the other hand, Researchgate (RG) is a social network for researchers in which they can list their publications and interact with their peers (12). Benefits of RG is that it is quite easy to access and use and has the potential to become the library of the 21st century (13). RG creates a list of citation based on the papers that are uploaded on its site. Researchers registered on RG can also add their papers manually or RG can find papers belonging to them. Just like in Google Scholar, RG automatically finds citations for the papers that are uploaded on its platform. However, many papers citing someone's work have not been uploaded to the platform and thus the number of potential citation is probably reduced.

Let us now point to the potential academic misuses of the Google Scholar and Researchgate services. We already mentioned that one can manually add papers to Google Scholar Profile. Potential misuse of this option is when the authors add papers that are not theirs. For example, in the first 120 ranked researchers affiliated with the University of Sarajevo, profiles of 8 authors (7%) contain papers that they did not write or co-authored but are in their Scholar Profile. Very often these papers are highly cited and Google adds these citations to the author's Scholar Profile. It is not clear whether the authors do this inadvertently or deliberately but in such a way their h-index is artificially increased. This is one of the potential misuses of Google Scholar service.

The similar misuses can happen in RG as well. The paper can be added that does not belong to the author and the impact (or RG score) of the author will be increased. Or the author can decide to share his/her work on RG that has not been published before. It is perfectly legitimate to do this, but the author can use this option dishonestly and in that way increase their number of citations and h-index.

Let us now turn to the commercially available databases such as Web of Science and Scopus. Web of Science covers journals published from 1900 to present and Scopus covers journals covering the period from 1966 to present (11). Although they are only commercially available, they do not suffer from some of the shortcomings mentioned earlier for RG and Google Scholar. Authors cannot add papers manually to WOS and Scopus nor can they manipulate the numbers of citations and h-index as they can in Scholar and RG. Therefore, WOS and Scopus are more accurate but there can be a long time lag between publication of the paper and its visibility on WOS and Scopus databases.

Discussion of which of the h-indexes can be used in evaluation of the researcher probably left us with more dilemmas than definitive answers but it also pointed to certain areas in which RG and Google Scholar can be improved. Is it better to use Google Scholar h-index or WOS h-index? The answer is: It depends. It would probably be the best to evaluate as many of these indices as possible, and if large discrepancies exist, that can be a reason for more in-depth analysis.

The second part of this paper deals with the "shape" of scientific output of the researchers from University of Sarajevo, BiH. University of Sarajevo is a state-funded University and is, by large margin, the best University in Bosnia and Herzegovina. According to Webometrics, University of Sarajevo is ranked on 1881st place in the world rank, and second and third best Universities from BiH are ranked on 3655 and 3660 positions respectively (14).

2. AIM

The specific aims in this study are:

- To examine gender distribution of 100 researchers from University of Sarajevo;
- To investigate what are the scientific fields that the researchers are coming from;
- To determine what are the best predictors of h-index.

3. MATERIALS AND METHODS

For the purposes of this analysis, we analyzed the scientific output of 100 researchers from University of Sarajevo ranked between 11th and 110th position on the Google Scholar. The researchers are ranked according to their number of citations. We did not present or analyzed the scientific output of the first 10 ranked researchers separately, as they present significant outliers. So, we picked researchers who had less than 1000 citations in their Google Scholar Profile on the date of 24.07.2017., and the first researcher who had less than 1000 citations was ranked 11th on Google Scholar list.

4. RESULTS

In relation to the gender, among the researchers from 11th and 110th position, there were 51 females (51%) and 49 males (49%). As a note let us mention that among the first 10 ranked researchers, according to Google Scholar Profiles for University of Sarajevo, there were 9 males and 1 female.

In relation to the total number of citations, there were no statistically significant differences between males and females. The numbers are presented in Figure 1.

Figure 1. Mean number of citations of males and females

The mean number of citations for females was 255.6

(SD=137.9) and for males it was 292.1 (SD=183.6). According to the t-test results, there were no statistically significant differences in the mean numbers of citations for males and females (t(1,99)=1.1; p=.27) in the sample.

Next, we wanted to examine from which scientific fields these researchers are coming from. These results are shown in Table 1.

Field	Count	%
biology	5	5
chemistry	6	6
electronics and IT	15	15
genetics	7	7
mathematics	4	4
medicine	30	30
other	7	7
pharmacy	8	8
physics	6	6
social_sci	12	12
Total	100	100

Table 1. Scientific field of the researchers from University of Sarajevo ranked between 11th and 110th place on Google Scholar

As can be seen from the table, majority of researchers come from natural sciences, and only 12% come from social sciences. Most researchers are in the field of medicine, followed by merged category of electronics and IT.

The final goal of this paper was to examine what are the best predictors of h-index. As potential predictors, we put following variables in the model: gender, scientific field, h10 index, total number of citations, number of citations in 2016 and number of citations in 2017. The results are shown in Table 2.

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	3,420	0,254	13,45	<,0001*
total_cites	0,001	0,001	0,83	0,4078
field[biology]	-0,864	0,419	-2,06	0,0421*
field[chemistry]	0,107	0,379	0,28	0,7792
field[electronics_IT]	0,642	0,260	2,46	0,0157*
field[genetics]	-0,441	0,357	-1,23	0,2207
field[math]	-0,272	0,455	-0,60	0,5508
field[medicine]	0,175	0,199	0,88	0,3820
field[other]	0,525	0,394	1,33	0,1863
field[pharmacy]	-0,013	0,343	-0,04	0,9698
field[physics]	0,055	0,433	0,13	0,8999
gender[f]	0,019	0,108	0,18	0,8604
h10_index	0,631	0,038	16,74	<,0001*
n_2016	-0,007	0,011	-0,62	0,5387
n_2017	-0,001	0,013	-0,06	0,9503

Table 2. Regression analysis predicting the h-index of the researcher

As can be seen from the table, the significant predictors of h-index are h10-index and the scientific fields of biology and electronics (IT sector). To put the above results in the perspective, if the researchers are from the field of biology, they can expect to have h-index smaller than researchers from other field (all other parameters being equal). In the same line, researchers from the field of electronics (IT) have higher indexes than researchers in other fields (keeping all other parameters equal). For example, a male researcher in biology with an h10 index of 5 is predicted to have a mean h-index of 5.7, while a male researcher in electronics (IT) with an h10 index of 5 is, on average, is predicted to have a mean h-index of 7.2.

5. DISCUSSION

We described several options for using h index, including two, free-of-charge, services and two commercially available databases. It is obvious that there is still room for improvement of these services, especially in Google Scholar and RG services. The major objection for these services is their inability to recognize and prevent potentially dishonest behavior of the researchers in terms of authorship of publications. We could see that at the University of Sarajevo, there were 7% of researchers among the first 120 ranked researchers who had (deliberately or inadvertently) publications at their Google Scholar Profile that do not belong to them in the sense of authorship. This is probably the case only among the top 200 ranked researchers, and not among the weaker positioned researchers. Therefore, due to its accuracy, Web of Science and Scopus should be the primary source of evaluating someone's scientific impact. Google Scholar should definitely complement other bases such as WOS and Scopus in evaluating researcher's performance. On the other hand, RG should be limited to serve as a social network between researchers but not as a means to evaluate somebody's scientific contribution. RG allows researchers to pose questions and attract many scientists who will help them in their scientific efforts and dilemmas. However, RG scores can be artificially inflated and thus should not be used in evaluating someone's scientific impact. Some current research has already pointed to the issue of ghost academic reputation in RG scores (15).

Regarding the shape of science at the University of Sarajevo, it is a very positive trend that there is no gap in the scientific achievement in relation to the researcher's gender, at least for the researchers who are not in the top 10 list. In relation to the scientific field, we could see that majority of these 100 researchers are from the field of natural sciences, in particular from the field of medicine. As there were very few researchers from some scientific disciplines, they were all merged in a single category of Social sciences, including humanities as well. Generally, the case of uncited documents in more prevalent in certain disciplines more than in other. For example, engineering and social sciences disciplines tend to be under cited (16).

The last research question in this study dealt with predictors of h-index. It is interesting that the total number of citations was not a significant predictor of h index. It was revealed that h10 index, that is number of publications that have more than 10 citations is almost perfectly correlated with h index and thus could even be used as a proxy for h index. Gender did not have a predictive role in determining the h-index but some scientific disciplines (biology and electronics IT) were significant contributors to h index. We should immediately note the limitation of the sample size for this regression analysis. Future studies with larger sample sizes should confirm or refute the results of this regression. Another limitation is that we did not analyze the role of other potentially important demographic predictors of h-index such as age, family status etc. Of course, due to the short nature of this paper we did not analyze other, potentially equally important, measures of scientific impact such as g-index, impact factors, eigenfactors etc.

University of Sarajevo, as the largest and best rated University in BiH has only 10 scientists who have more than 1000

citations. Situation at other BiH Universities is even bleaker. Universities of Banja Luka, Tuzla, Mostar and Zenica do not have registered researchers who have more than 1000 citations. As a comparison, we will take University of Split, which, on the same date (24.07.2017), had 21 researchers with more than 1000 citations. It is obvious that state authorities in BiH, together with academic community have to do much more for the growth of science, scientific impact and visibility of universities in Bosnia and Herzegovina. One of the ways that would certainly increase visibility is for individual researchers to use social media to the maximum extent possible (17). Sustainable economic growth is heavily dependent on science and generation of knowledge (18). Investing in research universities is considered an investment in the central institutions of 21st century knowledge economies (19). Thus, the authorities in BIH need to understand this and start to invest more financial resources in science and support to scientists in BiH. Only by investments in science can BiH catch up with its European neighbors.

6. CONCLUSION

H-indexes retrieved from databases and services such as Researchgate, Google Scholar, Web of Science and Scopus can be used to assess researcher's scientific impact. Web of Science and Scopus, as commercially available databases, are more accurate than Google Scholar and Researchgate. However, Google Scholar and Researchgate can be used as a complement to provide a more detailed insight into researcher's scientific output. All academic staff at the state-funded universities should have Google Scholar Profile and Researchgate profile. This in turn will lead to better visibility of researchers from BIH and will have a positive impact on the ratings of Universities from BIH.

- All authors contributed equally in preparation of this manuscript. All authors approved the final version of this paper.
- The authors report no conflict of interest.

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Intelligent Diagnostic Assistant for Complicated Skin Diseases through C5's Algorithm

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ABSTRACT

Introduction: Intelligent Diagnostic Assistant can be used for complicated diagnosis of skin diseases, which are among the most common causes of disability. The aim of this study was to design and implement a computerized intelligent diagnostic assistant for complicated skin diseases through C5's Algorithm. **Method:** An applied-developmental study was done in 2015. Knowledge base was developed based on interviews with dermatologists through questionnaires and checklists. Knowledge representation was obtained from the train data in the database using Excel Microsoft Office. Clementine Software and C5's Algorithms were applied to draw the decision tree. Analysis of test accuracy was performed based on rules extracted using inference chains. The rules extracted from the decision tree were entered into the CLIPS programming environment and the intelligent diagnostic assistant was designed then. **Results**: The rules were defined using forward chaining inference technique and were entered into Clips programming environment as RULE. The accuracy and error rates obtained in the training phase from the decision tree were 99.56% and 0.44%, respectively. The accuracy of the decision tree was 98% and the error was 2% in the test phase. **Conclusion:** Intelligent diagnostic assistant can be used as a reliable system with high accuracy, sensitivity, specificity, and agreement.

Keywords: Knowledge representation, Computer assisted decision making, Dermatology, Expert system, C5's Algorithm.

1. INTRODUCTION

The risk of skin diseases have been reported to be up to 80% (1). According to the World Health Organization's report in 2013, the disease burden in 15 categories of skin diseases was 3-7 million (2). Utility criteria that reported the disease burden to be in the range of zero to one have been reported to be 0.640 to 1.000 for skin diseases such as pemphigus. This rate was 0.650 for HIV and 0.740 for kidney diseases (1). Skin diseases create additional problems because of their special features such as physical deformity that necessitate early detection and treatment of these patients, but the diagnosis of skin diseases is a complicated task. In such a case, widespread knowledge of skin diseases is inevitable for diagnosis and treatment of skin diseases, (3-5) which will help dermatologists in diagnosis, and can also be used in rural and remote areas where access to dermatologists is not always possible. In particular, diagnostic intelligent assistant are able to simulate and model problem-solving capabilities in a specific field. This is possible because these systems obtain knowledge from an expert and make decisions based on artificial intelligence (6). The knowledge base contains all specialized knowledge that is related to the problem and inference engine acts in a way that is similar to human reasoning (7). Inference techniques can be backward (deny or prove a pre-specified target) or forward (reach a goal that is not already known). Different methods of representing expert knowledge systems include triad of O-A-V, rules, semantic networks, and frames (7, 8).

2. AIM

The main objective of this study is to design and implement an intelligent diagnostic assistant for complicated skin diseases through C5 algorithm based on expert knowledge using the rule-based system and forward chaining inference techniques.

Disease	No.	Sign	Common symptoms with other diseases
BCC	1	History of prolonged exposure to the sun	MM
BCC	2	History of tanning	MM
BCC	3	History of frequent sunburn	MM
BCC	4	History of phototherapy	MM
BCC	5	History of radiotherapy	MM
BCC	6	History of exposure to chemical substances	MM
BCC	7	Papules or nodules with prominent telangiectasia and pearl	
BCC	8	Ulcerated or bleeding lesion	MM
BCC	9	Pigmented lesion	MM
BCC	10	Erythematous Plaque or macula	
BCC	11	Sclerotic plaque	
BCC	12	History of genetic diseases such as Xeroderma Pigmentosa	MM
BCC	13	Patient□s complaint of the skin ulcer	MM
BCC	14	History of the change in color or increase in the size of the mole	MM
BCC	15	Black or brown or nodules with irregular margins and multiple color	MM
BCC	16	Hemorrhagic nodule or tumor	MM
BCC	17	Brown-black plaque with irregular color and bonder on the face and sun damage skin	MM
BCC	18	Lymphadenopathy	MM, Scabies
PV	19	Irritation and pain of mucosal	LP
PV	20	Dysphagia or pain on swallowing food	
PV	21	Nasal bleeding	
PV	22	Odynophagia	
PV	23	Red Eyes	
PV	24	Skin sores and Blister	LP
PV	25	Erosions of the mucosal membranes	LP
PV	26	Skin blister	LP
PV	27	Skin ulcer and erosions	LP, Scabies
PV	28	Wet lesion	scabies
PV	29	Involvement of the skin and mucosa	LP
PV	30	Local involvement	LP
PV	31	Occurrence on the head and neck and seborrheic areas	
PV	32	Painful oral erosions with subsequent involvement of the entire body	LP
PV	33	Loose and fragile blisters on the normal skin without erythema	
PV	34	Nikolsky sign	
PV	35	Oral lesions	LP
PV	36	Vesicle	scabies
PV	37	Infected lesions	scabies
PV	38	Blister	LP
PV	39	Mucosal lesions(reticular white lines-ulceration-erosions)	LP
PV	40	Post inflammatory pigmentation	LP
Scabies	41	History of recent travel	
Scabies	42	History of imprisonment	
Scabies	43	History of itching in other members of the family	
Scabies	44	Itching	LP
Scabies	45	Itching worsens at night	
Scabies	46	Itching worsens with heat and hot baths	
Scabies	47	Symmetric lesions	LP
Scabies	48	Presence of skin barrow	
Scabies	49	Papules	LP
Scabies	50	Nodules	LP
Scabies	51	Pustule	
Scabies	52	Eczematous lesion	LP
Scabies	53	Contact dermatitis	
Scabies	54	Excoriated lesions	LP
Scabies	55	Barrow with undulating lines 1-10 mm long in the area between the fingers and wrist	
Scabies	56	Find vesicle between the fingers, wrist and hand sides	
Scabies	57	Itchy lesions	LP
LP	58	Distribution of the lesions	
LP	59	Appearance of skin lesions(itchy and purple's papules-polygonal-flat)	
LP	60	Wickham strrae	
LP	61	Scaring hair loss	
LP	62	Nail changes	
MM	63	Family history of atypical(dysplastic) moles or melanoma	
MM	64	History of multiple moles	
MM	65	Family history of melanoma	
MM	66	Pigmented bands of nails	
MM	67	Hutchinson's sign	

Table I: A detailed list of specific and common symptoms of the selected disease

3. METHOD

This applied-developmental study was done in Razi Dermatology hospital, affiliated to TUMS, at 2015.The research was conducted in two phases, which include designing knowledge Base based on dermatologists' knowledge as experts and implemented as follows:

3.1. Designing Knowledge Base

The Acquisition of knowledge was done by Delphi technique and by holding several sessions and interviews with the experts using checklists of signs and symptoms that were developed based on International Classification of Diseases 10 revision (ICD-10) and semiology book of dermatology. One coordinator organized the meetings and received dermatologists' opinions and suggestions and consulted with other professionals until a consensus was reached. A total of 106 symptoms were determined for disease diagnosis.

3.2. Extracting and Representing Knowledge

Drawing decision tree from the trained data:

First 5 class diseases consideration, and for every class, it was collect 60 medical records patient for the selected skin diseases that contains attribute of disease and patients. Then it was collect 150 medical records of the patients without have the selected skin diseases. So, there was 450 medical record for training the decision tree model as true class label.

Overall the sum of samples are 450 medical records for 6 class contains 5 disease and 1 no disease. Data of 60 medical records of the patients for each disease (a total of 300 medical records), and 150 medical records of the patients without the selected skin diseases were entered into the Excel Microsoft Office database. Knowledge representation was obtained from the train data in the database and decision tree was drawn using Clementine Software and C5 Algorithm. Accuracy and error of the drawn decision tree was calculated.

Testing and final analysis of the accuracy of decision tree:

To test the validity of the decision tree, data of 20 medical records of the patients for each of the selected diseases (a total of 100 medical records) and 50 medical records of the patients without the selected skin diseases were entered into the database and accuracy of the drawn decision tree was calculated by measuring the accuracy and error rates. Accuracy higher than 90% was considered as the precision value of the decision tree.

Extracting Rules from the Decision Tree

Rules of If/Then/Else were extracted using forward chaining inference technique from the drawn decision tree.

The Implementation of a Diagnostic Intelligent Assistant

Extracted rules from the decision tree were entered into CLIPS programming environment as RULE (Diagram 1).

4. RESULTS

According to dermatologist's view, diseases including pemphigus vulgaris (PV), basal cell carcinoma (BCC), lichen planus (LP), malignant melanoma (MM), and scabies require recognition by a diagnostic intelligent assisted.

4.1. Accuracy and Error Rates Obtained in the Training and Test Phase

No.	Diseases	No. signs
1	Basal cell carcinoma	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18
2	Pemphigus vulgaris	19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40
3	Scabies	18,27,28,36,37,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57
4	Lichen planus	19,24,25,26,27,29,30,32,35,38,39,40,44,47,49,50,52,54,57,58,59,60,61,62
5	Malignant melanoma	1,2,3,4,5,6,8,9,12,13,14,15,16,17,18,63,64,65,66,67

Table II: Brief listing of specific and common symptoms of the selected diseases

Scabies N=60	PV N=60	MM N=60	LP N=60	Except with selected diseases N=150	BCC N=60	No. Diagnosis
0	0	0	0	0	60	Basal cell carcinoma
0	0	0	0	149	1	Except with selected diseases
0	1	0	59	0	0	Lichen planus
0	0	60	0	0	0	Malignant melanoma
0	60	0	0	0	0	Pemphigus vulgaris
60	0	0	0	0	0	scabies

Table III: Analysis of Decision Tree in Training Phase. Accuracy: %99.56 wrong: %0.44

Scabies N=20	PV N=20	MM N=20	LP N=20	Except with selected diseases N=50	BCC N=20	No. Diagnosis
0	0	0	0	0	20	Basal cell carcinoma
0	0	0	0	49	1	Except with selected diseases
1	0	0	19	0	0	Lichen planus
0	0	20	0	0	0	Malignant melanoma
0	20	0	0	0	0	Pemphigus vulgaris
19	0	0	0	1	0	scabies

Table IV: Analysis of Decision Tree in Testing Phase. Accuracy: %98 wrong: %2

In order to prepare data for drawing the decision tree, common symptoms for diagnosing the selected diseases were extracted (Table I). A summarized list of specific and common symptoms of the selected diseases (Table II) was developed. The accuracy and error rates obtained in the training phase from the decision tree (Figure 1) were 99.56% and 0.44%, respectively (Table III). The accuracy of the decision tree was 98% and the error was 2% in the test phase (Table IV). Rules were defined using forward chaining inference technique and were entered into Clips programming environment as RULE.

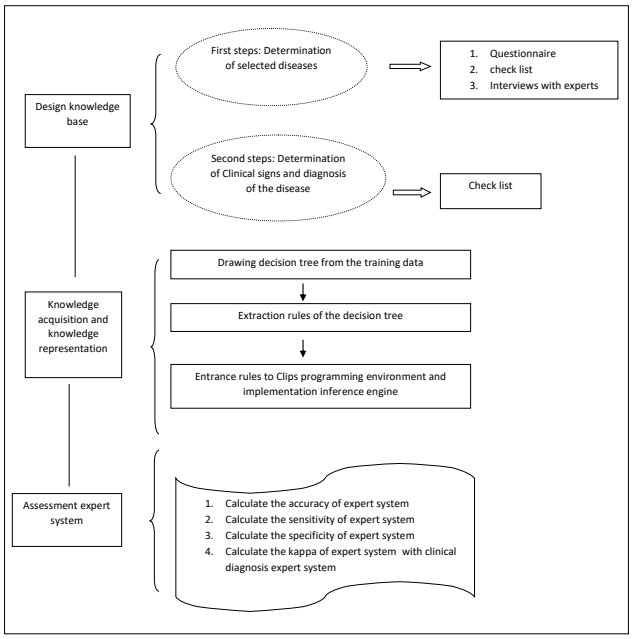

Diagram1: Process Design, Implementation and Evaluation of Intelligent Diagnostic Assistant

5. DISCUSSION

The purpose of this research was to design and implement an intelligent diagnostic assistant for diagnosis of complicated skin diseases.

Strength of this study was preparation of a preliminary checklist for skin diseases using the International Classification of Diseases 10 Revision (ICD-10). Another strong point of our study was identification of diseases according to dermatologists' preferences.

Analysis of the data showed that in the training phase, the drawn decision tree diagnosed diseases with accuracy of 99.56% and error of 0.44%. Analysis in test phase showed accuracy of 98% and error of 2%.

Expert systems can be used to assist in the diagnosis of diseases (9). One study had suggested more than 60 rules as "Then-If" using the decision trees for 9 selected diseases (3). Another study had extracted rules from the decision tree by designing an expert system that was used to diagnose neurological diseases (10). Other studies had extracted rules by a two step decision tree of training and testing (11-16) or had used the decision tree to extract the rules that were used to design neural networks and estimate the risk of preeclampsia with an accuracy of 83.6% in the training phase and 93.8% in the testing phase (17). The methods used in these studies are in line with the methodology used in the current study. However, the accuracy of the drawn decision tree in the current study appeared to be 99.56% in the training phase and 98% in the testing phase.

Seto and colleagues designed a rules-based system in their study and used 105 rules for knowledge representation. Training and testing of the decision tree were not used in this research (18). Semantic network was used in the phase of knowledge representation which revealed causal relationships between variables and symptoms (19). These studies do not match with the findings of the current study. In this study we used a semantic network to obtain causal relationships between variables and symptoms. Although the se-

mantic network is a way of representing knowledge in intelligent system, the rules extracted from the decision tree is much easier to analyze due to the simplicity and ease of comprehension by the specialists, and is therefore superior to semantic network. Given that, expert systems are to be used in disease diagnosis, paying attention to the training and testing phases and evaluating the decision tree accuracy is essential. It is recommended that emphasis be placed on the training and testing phases and evaluation of the decision tree accuracy at the phase of knowledge representation as an inseparable part implementation of these systems.

Following implementation of the intelligent diagnostic assistant, and entering of the extracted rules from the decision tree to the intelligent diagnostic assistant, rule-based method was also used and the rules of If/Then/Else were extracted from the decision tree and were entered into the system programming (CLIPS) as RULE using forward chaining inference technique.

Doniz et al. used rule-based technique to enter rules of If/Then/Else as rule in the phase of knowledge representation to the proposed intelligent diagnostic assistant. Inference technique used in this study was forward (20). In some intelligent diagnostic assistants ,rules of If/Then/Else, CLIPS programming environment and forward chaining inference technique (21,23) or C programming language (24,25) were used. The language used in both studies is consistent with our study. In one study. After extraction of "If/Then/Else" rules, the decision tree was drawn. By using forward chaining inference techniques, the selected rules were burned to reach a final diagnosis (26). CLIPS programming environment was also used (3, 10-12, 27) which is consistent with the current study.

Phase logic, decision trees and forward chaining inference techniques were used to determine the severity of preeclampsia (28). MATLAB programming environment was also applied in the intelligent diagnostic assistant for pneumonia diagnosis (29). Taking into consideration the fact that the MATLAB development environment is an interpretive language and that its execution speed is much slower than the compiled languages, it does not work so well in complex structures. In addition, its cost is high while the operating programs written in MATLAB are common and bring about essential problems (39). Therefore, in order to fix these defects, C programming language was used in the current study.

Usually, researchers use backward chaining inference technique in their studies (10) and C sharp language (30). Although some studies used the decision tree and the C language, the difference between them and the current study is the small number of tested data and the use of backward chaining in the inference engine (10, 30). Phase logic or neural network was used in designing the systems (15, 19) that is inconsistent with the current study. Given that all conditions of the current study were binary, it was not possible to use phase logic.

Some studies have used neural network in the phase of knowledge representation (17) that is not in consistence with the current study. The major problem of neural networks is that the user cannot understand the method of inference and conclusion of the system, learning system is dependent on the collection system of train data and the amount as well as the number of training courses. If train data is incomplete and inadequate or the number of training courses is too many or too few, the system cannot have a good decision. The CLIPS program was usually used to design the intelligent diagnostic assistant due to its high flexibility, expandability and low cost (20).

6. CONCLUSION

Although artificial intelligence has great potential for improving medical decision-making, successful implementation of these systems requires special attention to details including using a method that is appropriate to the system target during the phase of knowledge representation. Paying attention to the details prepares the necessary ground for the use of these systems, like making specialists and physicians aware of the advantages of the intelligent diagnostic assistant in their professional area. Implementing intelligent diagnostic assistant with a user-friendly interface to increase physician's willingness is also essential to make effective use of these systems.

- **Clinical Relevance Statement:** The result of our study demonstrate that the intelligent diagnostic assistant Can be used to determine the via Clementine Software and C5 Algorithm. Paying attention to details prepares the necessary ground for the use of these systems. Physicians should be aware of the advantages of the intelligent diagnostic assistant.
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- **Author's contribution:** Arabfard and Rangraz Jeddi conceived of the presented idea. Arab Kermany developed the theory and performed the computations. Rangraz Jeddi and Arab Kermany verified the analytical methods. Rangraz Jeddi and Arabfard encouraged to investigate and supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

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ORIGINAL PAPER

Application of Ethics for Providing Telemedicine Services and Information Technology

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ABSTRACT

Introduction: Advanced technology has increased the use of telemedicine and Information Technology (IT) in treating or rehabilitating diseases. An increased use of technology increases the importance of the ethical issues involved. The need for keeping patients' information confidential and secure, controlling a number of therapists' inefficiency as well as raising the quality of healthcare services necessitates adequate heed to ethical issues in telemedicine provision. **Aim:** The goal of this review is gathering all articles that are published through 5 years until now (2012-2017) for detecting ethical issues for providing telemedicine services and Information technology. The reason of this time is improvement of telemedicine and technology through these years. This article is important for clinical practice and also to world, because of knowing ethical issues in telemedicine and technology are always important factors for physician and health providers. **Material and methods:** the required data in this research were derived from published electronic sources and credible academic articles published in such databases as PubMed, Scopus and Science Direct. The following key words were searched for in separation and combination: tele-health, telemedicine, ethical issues in telemedicine. A total of 503 articles were found. After excluding the duplicates (n= 93), the titles and abstracts of 410 articles were skimmed according to the inclusion criteria. Finally, 64 articles remained. They were reviewed in full text and 36 articles were excluded. At the end, 28 articles were chosen which met our eligibility criteria and were included in this study. **Results:** Ethics has been of a great significance in IT and telemedicine especially the Internet since there are more chances provided for accessing information. It is, however, accompanied by a threat to patients' personal information. Therefore, suggestions are made to investigate ethics in technology, to offer standards and guidelines to therapists. Due to the advancement in technology, access to information has become simpler than the past. This has prompted hackers to seize the opportunity. **Discussion:** This research shows that the ethical issues in telemedicine can be investigated from several aspects like technology, doctor-patient relationship, data confidentiality and security, informed consent, patient's and family's satisfaction with telemedicine services. Following ethical issues in telemedicine is a primary aspect of high quality services. In other words, if therapists abide by ethical rules, they can provide better services for patients. Attention to ethical issues in telemedicine guarantees a safer use of the services.

Key words: Telemedicine, Tele-health, Ethics, Technology, Information Technology

1. INTRODUCTION

Advanced technology especially IT has increased the use of telemedicine in the treatment and rehabilitation of diseases. Therefore, the ethical aspect of these attempts becomes an issue. To ensure the confidentiality of patients' information and increase data security, there is a need to monitor cases of therapists' inefficiency and improve the quality of healthcare services, which all highlight the necessity of ethical issues in telemedicine (1, 2).

As defined by the World Health Organization (WHO), telemedicine is the provision of online healthcare services when the distance between a service provider and a patient matters(3).

On the other hand, "ethical issues in telemedicine" implies a consideration of patient's benefit or loss in receiving telemedicine services and his/her right to choose the therapy and react to dissatisfactory services(4). In fact, initial considerations of ethical issues in telemedicine began in early 1980s at the same time as the rapid growth of technology. In 2006, the American Society for Bioethics and Humanities (ASBH) was officially assigned by WHO to in-

vestigate ethical issues in telemedicine. The prerequisites were health-related body of knowledge and skills(5).

Development of guidelines on telemedicine services contributed greatly to the consistency of the services provided and ensuring patients of the security of the services. Standards set to this aim managed to raise the quality of healthcare services. The use of the internet system by 87% of adults on the one hand, and the increasing rate of receiving online health-related information (72%) on the other highlighted the role of ethical issues in telemedicine so as to raise the quality of healthcare services(6).

The widespread use of the internet, email, and smart phones today has further underlined the significance of ethical issues in telemedicine (7). Therefore, to ensure the security and confidentiality of patient's information, there is a severe need to set ethical rules and regulations(8). The present study reviewed and classified the body of related literature on ethical issues in telemedicine and focused on the use of telemedicine from an ethical perspective.

2. AIM

The End of this study is to gather all articles that are published through 5 years until now (2012-2017) for searching ethical issues for providing telemedicine services and Information Technology. This time was chosen for telemedicine and technology improvement through these years.

The ethical issues unique to telemedicine and technologies relate to the impact on the healing relationship, which go beyond the expected challenges of privacy and confidentiality. The loss of touch, the inequity when distributing the benefits of telemedicine services, and the burden that this form of new technology may impose on sick and dying patients are some of the ethical issues that should be considered, so this review can help health providers to be familiar with these issues.

3. MATERIAL AND METHODS

3.1. Inclusion and exclusion criteria

Inclusion criteria were extracted based on the topic of study and the ethical issues in telemedicine and IT. The full text of articles needed to be available. The articles written in English language were chosen.

3.2. Search strategy

A literature review was done on 25 July 2016 using PubMed, Scopus and Science Direct in order to peruse the relevant studies published in the past five years from 2012 to 2017.

A combination of the following MESH terms and keywords was used:

((“Telemedicine” [Mesh]) or (ethics)) and ((“Telehealth”[Mesh] or (IT) or (ethical issues).

We also set limits to our search according to the study result and language.

The present research aimed to classify the related body of literature on the ethical issues involved in telemedicine. In this study, the electronic databases including PubMed, Scopus and Science Direct were searched for the past five years. The key terms were tele-health, telemedicine, ethical issues and a combination of them. A summary of the twenty eight articles found on the topic is presented in table 1.

Ethical issue And references	Number of articles	Conclusion
Technology (9-16)	8	Advanced technology increased the significance of ethical issues.
Confidentiality and security (17-23)	7	Attention to ethical issues in telemedicine increased the significance of data security and confidentiality.
Doctor-patient relationship (24-29)	6	Use of telemedicine disrupted doctor-patient relationship which is an ethical issue.
Informed consent (30-36)	7	It is essential to provide the patient with sufficient information by submitting a form of informed consent.

Table 1: academic articles classified in terms of ethical issue consideration

4. RESULTS

According to the articles found, generally speaking, ethical issues in telemedicine can be investigated from several aspects:

- technology
- telephone
- internet
- server list (a computer program that allows for tele medicine service provision for a group of people through the net)
- email
- doctor-patient relationship
- data confidentiality and security
- informed consent
- patient's and family's satisfaction with telemedicine services(37, 38).

In fact, using technology has grown in the past decade in health-related domains especially tele-supervision and rehabilitation. Quite many academic investigations have considered the application of these technological devices in rehabilitating and taking care of patients.

Moreover, due to the lacking security, some devices need to be analyzed and evaluated in terms of ethical issues(39). Table 1 presents a classification of academic articles which considered ethical issues in telemedicine.

ETHICS AND TECHNOLOGY

In tele-radiology, tele-dermatology and tele-pathology, advanced technology has changed the form of diagnoses from authentic to digital. Therefore, using a digitizer technology requires a high quality which, in turn, requires a set of relevant guidelines and standards that support the ethical aspect. On the other hand, using ‘save and send’ option, packages and other image digitizer technologies can lead to problems such as unclear images which might cause wrong diagnoses(40). Therefore, both colleges i.e. The American College of Radiology and the U.K.’s Royal College of Radiologists provided technical guidelines and standards with this concern which need to be complemented with ethical guidelines too(41).

A new rule was made in April 1999 for the quality of healthcare services under the supervision of Trust and Health Authorities. According to this rule, doctors are accountable for the quality of services they provide. They were supposed to report regularly to Trust and health Authorities and these reports attested to the priority of quality set by the board members(42).

To this aim, in autumn 1998, “Quality Care and Clinical

Excellence" was published which mainly consisted of the following(43):

- standards
- quality provision
- quality control

Some other ethical problem has to do with the security of medical devices, formerly controlled by the "National Health Services" (NHS) and now under the supervision of the "European Union Directives" (44).

Tele-consultation is a main ethical challenge in telemedicine. That is due to the fact that:

- Doctors are required to be highly competent in service provision.
- Doctors are supposed to recognize the value of virtual communications.
- Computer systems are yet unsafe even if they are supposedly privileged with high security.
- Tele-consultation provides a full access for all to new information and skills.
- Telemedicine is growing rapidly with new relevant standards(45).

ETHICS AND DOCTOR-PATIENT RELATIONSHIP (the main ethical issue)

The ethical rule set by the ethicist Edmund Pellegrino attributes three components to doctor-patient relationship(46):

- A patient who is sick and needs help.
- A doctor who feels responsible for helping the patient
- Medical action/application of medical science

Here, the patient is supposed to voluntarily refer to a doctor whom s/he trusts. Processing the decision making is supposed to be a mutual act which requires both doctor's and patient's decision. On the other hand, the doctor is expected to respect the patient's decisions and independence. As a consequence, both the doctor and patient are mutually communicating to think of the right therapy(47). Edmund Pellegrino's ethical rule narrows down the doctor-patient relationship(46):

- Patient's respect for doctor's comments
- Doctor's respect for patient's choice of therapy
- Use of telemedicine device cuts down on this relationship. besides, to abide by ethical rules, the doctor is expected to obtain patient's informed consent

ETHICS AND SECURITY AND CONFIDENTIALITY

Using telemedicine services threatens patient's information security and confidentiality. According to the General Medical Council (GMC), clinical specialists need to make sure of the confidentiality of patient's electronic data while receiving, storing and transferring the data. They should feel responsible for the security and confidentiality of electronic data. Newton et al. observed that the foremost concern patients have about receiving telemedicine services is with the confidentiality of the information they provide. To remove the concern just mentioned, NHS has published a guideline for the Trust Committee so as to meet legal and ethical expectations(48).

ETHICS, TELEMEDICINE AND JUSTICE

Some other ethical issue arises when:

Several families are deprived of telemedicine services due to lacking knowledge or the required technology (the net) which has to do with the justice and equality aspect(49).

There are several countries with very limited internet band width to use the net(50).

Several other countries cannot afford to buy telemedicine equipment due to its high cost or they may lack the required number of specialists in this domain(51).

ETHICS AND PATIENT'S INFORMED CONSENT

One solution to prevent ethical problems is to obtain patient's informed consent in advance to any medical step to be taken. The basic components of this informed consent are(52):

- a full description of the therapy procedures
- a full description of the probable problems after the therapy and the probable risks
- a full description of the positive issues expected
- clarification of alternative processes that can be applied for that certain patient
- a demand that can be responsive to the emergence of any problem
- a procedure that can be canceled by the patient upon choice

The presence of such an informed consent not only supports patient's ethical rights but also removes any concern about the confidentiality of data. The new guidelines introduced by GMC and the British Medical Association emphasized on the essentiality of patient's informed consent so as to provide patients with adequate information. Moreover, these guidelines save patient's right to mention his/her concerns about the medical system in the letter of consent. Later on, upon the emergence of any probable problem, the patient can defend his/her rights(53).

5. DISCUSSION

Basically, in many countries the quality of telemedicine services is of a great significance. Therefore, in order to raise the quality of these services by therapists and specialists, there is a need for setting certain guidelines and standards which make the therapist responsible for what s/he does. These all help patients to get ensured of the quality of telemedicine services (54).

Alexander A. Kon and et al. describes "several models for providing expert clinical ethics support to remote facilities that lack access to qualified clinical ethicists"(48). This article shows a need to provide access to qualified clinical ethicists at a broad range of medical facilities and there are insufficient numbers of trained clinical ethicists to staff all healthcare facilities, and many facilities lack the necessary resources to hire staff clinical ethicists.

Lamas E and et al. shows assessing ethical and social issues of transtelephonic electrocardiography (TTEGG) in Chile. The aim of this study was to concentrate on the ethical issues derived from the implementation of TTECG in the public healthcare sector in Chile, studying patients and healthcare providers' acceptance and expectations concerning: (a) effectiveness and safety; and (b) data protection issues, like confidentiality, privacy and security (18).

On the other hand, to maintain the security and confidentiality of patient's information and maintain the high quality of doctor-patient relationship, considering ethical issues is of a key importance. Therefore, using certain ethical guidelines

in telemedicine can be suggested to complement the quality of healthcare services provided in this manner. The aim is to attract patients' satisfaction and trust. Moreover, these attempts help to increase the quality of healthcare services provided by the therapists(55).

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REVIEW

Health Professionals Information for Diagnostics Related Groups (DRGs) with the Use of a Website

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ABSTRACT

In recent years the costs of hospital care in developed countries absorbed an ever increasing amount of the state total health budget. In Greece, with the establishment of the National Health System (NHS), the hospital's funding derives mainly from the state budget, and the social insurance funding. As a result the processes of hospital cost auditing is more than necessary to ensure their viability, and optimal functionality , especially at the present time when the country is overrun by the economic and physical crisis. Over the years, many factors have been mentioned regarding the increase of hospitals costs. A few of them include the rapid development of medical technology, the low level of organization of the hospital system and the minimal productivity of the human resources. The problem of rising health expenditures over the past decades is definitively a worldwide phenomenon. This phenomenon has brought about many changes in the traditional retrospective methods of financing in the hospital sector, with the adoption of new prospective financial methods that combine patient overall mixed characteristics and needs, and the productive activity of the hospitals based on the need of cost containment . The Diagnosis Related Groups have a variety of goals and a different, utilization rate, as a result of differently structured national health systems. In Greece the introduction of DRGs was adopted in 2010, but the implementation reached numerous difficulties due to the fiscal crisis embedded from seven year now overturning the daily life of the country.

Keywords. **Diagnosis Related Groups (DRGs), Hospital Reimbursement.**

1. IINTRODUCTION

The DRGs constitute of a system of prospective compensation of hospital health services . It was first introduced in the early 80s and then was adopted by other european countries which tried to run it according to their needs.. In Greece, was introduced for the first time at the end of 2011, as an alternative option for the integrated hospital care and it has being implemented so far to reduce hospital costs. Greece is one of the last countries in Europe to adopt the introduction of DRGs in the National Health System, which proved to be a difficult but inevitable task for the reduction of costs (1).

The issue of funding, allocating resources and containing the deficits of the National health system is a major and timeless problem that has, however, taken tragic dimensions and has always being at the heart of the desirable reforms.

Financing health services is the cornerstone of the health system and concerns both the payer and the mechanisms and criteria by which the health services are financed.. It is conceivable that in the midst of the economic recession the reduction of expenses and their proper management was in the past and is still nowadays the primary objective for the economic survival of the health system in Greece. As a matter of fact, the reforms that had to be achieved in the long run were implemented in a very short time , due to the pressures of the Troika, (an auditing system) (1).

Such a reform in the way in which Greek hospitals are financed by the introduction of DRGs is of great interest to the hospital sector, as there is a gradual adoption of DRG's at a global level, based on patient mix and the process of the advanced financing of the provided health services. It is also important to mention that the basic policy criteria that health services financing should take into account is equality of access, efficiency and effectiveness of services using special indicators.

In Greek hospitals, this is a major problem as the use of a fixed daily rate cost for services provided in hospitals that integrates indiscriminatively heterogeneous administrative, health and other costs into one price is not an objective criterion for measuring the efficiency of the health services provided (1, 2).

The aim of this research is to inform the health professionals about the ways of introducing and operating the DRG's system in the Hellenic National Health System, through the use of the development technologies. An effort is also made to explore the main dimensions of the implementation of the DRG's system, in specific European-Countries that have both adopted the public coverage schemes and the Bismarck health insurance institutions for countries with extensive experience in their implementation (2, 3).

2. MATERIALS AND METHODS

A review of the literature was attempted to investigate the ways of financing of the health services, and of the identification and functionality of the DRG's as well as of the methods used by European countries to investigate this prospective compensation system. An additional goal was to investigate the efforts made by the Greek health system to implement DRG;s and a final goal was the development of an informative website. Specifically, the user can obtain information on the introduction of DRG's in the health systems of selected European countries as well as in Greece. Additionally, in the website will be mentioned the general benefits of DRG;s and the role and usefulness of them in the health system nowadays (3, 4).

3. RESULTS

The efficient application of DRGs gives the possibility to improve the economic management of Greek hospitals by retaining the costs and consequently contributing to the wise and effective management of hospital expenses. Due to the economic recession in Greece, the fundamental objective of the National Health System was the reduction of costs, that led to curtailments of the hospital budgets. The consequences of this reduction created problems regarding the optimal function of the hospitals. A short training of health professionals on the importance of DRGs in the effective running of Greek hospitals, led to the development of a website. This website will give information on this new method of pricing of hospital health services provided, and will contribute to the overall improvement of health services, offered in the hospitals (4, 5).

4. CONCLUSION

The DRG's is an attempt to introduce a prospective financing and compensation system of specific health care services provided in Greek hospitals. Despite the fact that similar financing systems have been introduced in different health systems worldwide, in Greece early efforts to adopt DRG.s have partly succeeded, and therefore laborious interventions are needed to fulfill the overall efficient functionality of DRGs . With the introduction of DRGs in the National Health System in Greece, major changes have occurred in the production of health services, in relation to different kinds of health insurances covering both patients and health professionals in relation to minimal existing resources with which health personnel is obliged to work and perform efficiently. It is a fact that hospitals, transferred the costs of the drugs , the tests, the health resources and the medical appliances used to public and private insurance companies, with a fixed daily rate, which is a complicated procedure not taking into account the quantity and the prices of drugs and medical appliances used. Hopefully, the introduction of DRGs , in Greek hospitals will establish a positive condition to solve many emerging health issues and to improve the overall functionality of the health system.

Additionally, with the proper implementation of the DRG;s, the financial management of the Greek hospitals, can be improved by keeping the costs down through the proper utilization of the available resources. It is also important to mention that the DRG's have not been introduced in the National Health System in Greece in a proper way, but in a more rapid pace, without the adequate training of the health staff, as was done in other countries. This has led to different kinds of problems which at the beginning impeded the smooth functionality of DRG's in Greece.[5,6,7,8]

5. DISCUSSION

In the future, it will be attempted to enrich the electronic website with new elements deriving from data coming through evaluation of DRG's. Some suggestions include the following:

- Overall evaluation of DRG's including both the labour and technologies costs.
- Installation of modern IT systems in all hospitals.
- Creation of groupers and a software customized to Greek data i.e. a shorting algorithm available that would corresponded to various combinations of diagnosis and medical interventions.
- Proper adaptation of the ΕΟΠΠΥ for the administrative support and the efficient auditing of the procedures used in DRG's.
- Proper adaptation of DRG's in the private sector based on efficiency and effective criteria for the optical selection of patients and the cost containment.
- Continuous training of health and administrative personnel for the optimal functionality of DRG's.

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REVIEW

Managing information in Health Informatics

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ABSTRACT

Only once we agree upon our understanding of what words really mean can we debate whether a concept, represented by those words, is or not well represented significantly in specific application. Conceptual clarity and predicative/ impredicative competence are the fundamental components for managing information more effectively in Health Informatics, Healthcare and Medicine applications, while promoting innovation and creativity. Medicine was always the art and science of healing. The science became more and more a mechanistic technology in Healthcare; the art was dropped altogether. But uncertainty-as-problem in the past is slowly morphing into the evaluative concept of uncertainty-as-resource. The key change performance factor is education, distinguishing building on sand from building on rock for Health Informatics! Conceptual clarity, more than instrumental obsession is necessary. In this paper, we present the main concepts of fundamental biomedical enhanced knowledge formalization for Health Informatics and Wellbeing of the future.

Keywords: formalization of medical informatics, fundamental knowledge.

1. INTRODUCTION

Conceptual clarity and predicative/ impredicative competence are the fundamental components for managing information more effectively in Health Informatics, Healthcare and Medicine applications, while promoting innovation and creativity [1]. Challenged by conditions beyond the traditional boundary of illness, even medicine and healthcare are discovering that the living is less simple than what the traditional physics paradigm implies and this affects health informatics deeply. As far as the last decades are considered, the most pervasive development of science goes under complexity theory, however defined. Men inevitably see the universe from a human point of view, communicate in terms shaped by the exigencies of human life in a natural uncertain environment, and make rational decisions in an environment of imprecision, uncertainty and incompleteness of information. Both complexity science and chaos theory converge on showing the unavoidability of uncertainty, whether it is embedded into feedback cycles and emergence or in the infinite precision of initial conditions. But, uncertainty-as-problem in the past is slowly morphing into the evolutive concept of uncertainty-as-resource. The key change performance factor is education, distinguishing building on sand from building on rock for Health Informatics! Conceptual clarity, more than instrumental obsession (so typical of this particular time) is necessary. Furthermore, a subtler transformation is ongoing. Both linear and nonlinear techniques are forms of predicative modeling. The difference between predicative and impeditive systems (and models and definitions) is pervasive and often considered of marginal interest in the past century [2].

Conceptual clarity and predicative competence are the fundamental components for managing information more effectively than past approaches for promoting innovation and creativity [3].

As far as the last decades are considered, the most pervasive development of science goes under complexity theory, however defined. Both complexity and chaos converge on showing the unavoidability of uncertainty, whether it is embedded into feedback cycles and

emergence or in the infinite precision of initial conditions. But, uncertainty-as-problem in the past is slowly morphing into the evolutive concept of uncertainty-as-resource by ontology uncetainty management (OUM) system [4].

However, the 2016 study appeared in the British Medical Journal brings to light some of the consequences of the obsolete, industrial-mechanistic medical practice [5],[6], anticipated by the review article "Death by Medicine", in 2004 [7] and the related book [8]. Challenged by conditions beyond the traditional boundary of illness, even medicine is discovering that the living is less simple than what the traditional physics paradigm implies [5],[6]. In this paper, we present the main concepts of fundamental biomedical enhanced knowledge formalization for Health Informatics and Wellbeing of the future.

2. MANAGING INFORMATIONS AND CURRENT HEALTHCARE UNDERSTANDING

According to Swiss clinical psychologist Jean Piaget, human adults normally know how to use properly classical propositional logic. He held that the integration of algebraic composition and relational ordering in formal logic is realized via the mathematical Klein group structure [9]. In the last decades, many experiments have shown most adults commit logical fallacies in propositional inferences, and so concluded that Piaget's claim about adults' competence in propositional logic was too much rationalist. Doing so, they forgot Piaget's rigorous and important analysis of the Klein group structure at work in logical and predicative competence. English talking people tend to treat conditionals as equivalences and inclusive disjunctions as being exclusive [10]. Nevertheless, the Klein group structure Piaget used can be reused to help us understand better what happens in spontaneous human reasoning and in the production of fallacies. In fact, in mathematics, the Klein four-group or "Vierergruppe", named by German mathematician Felix Klein in 1884, is a group of four transformations with four elements. The Klein four-group is the smallest non-cyclic group, and every non-cyclic group of order 4 is isomorphic to the Klein four-group. The cyclic group of order 4 and the Klein four-group are therefore, up to isomorphism, the only groups of order 4. Piaget applied the Klein four-group to binary connectives, so that a given connective is associated first with itself (in an identical (I) transformation) and then with its algebraic complement (its inverse (N) transformation), also with its order opposite (its reciprocal (R) transformation) and finally, with the combination of its N and R transformations to arrive to what logicians usually call the "dual" (D) transformation [10].

The Klein group structure generates squares of opposition (SOO), and an important component of human rationality resides in the diagram of the SOO, as formal articulations of logical dependence between connectives. SOO are considered as important basic components of logical competence and of human predicative rationality [11]. Treating conveniently neutral elements (I), algebraic complements (N) and order reciprocals (R) in an integrated structure, by a valid treatment of duals (D), would guarantee people to make logically valid classical inferences on propositions and to achieve higher conceptual clarity in Health Informatics. But the formal rationality provided by the SOO is not spontaneous and therefore, should not be easy to learn for adults. This is the main reason why we need reliable and effective training tools to achieve full propositional logic proficiency, and predicative competence in decision making, like the elementary pragmatic model (EPM) [12],[13]. In fact, by an abstract point of view, EPM can be even seen as the logic description of the fundamental interaction of two purposive subjects, modeled by the interaction of two Klein groups. In other words, EPM can model all the elementary narrative and rhetoric articulations between two rational, interacting subjects reliably and clearly. Currently, the notion of reasoning or conscious reason may be interpreted in terms of the reasoning process itself being itself explicitly modeled by the reasoning agent in Cognitive Informatics [14]. In this way, we can arrive to the core understanding of "the difference that makes the difference" [15].

A subtler transformation is ongoing, however: a transformation working on a deeper level than the move from linear to nonlinear models and patently much less visible than it. Both linear and nonlinear techniques are forms of predicative modeling. The difference between predicative and impredicative systems (and models and definitions) is pervasive in science and often considered of marginal interest in the past century. As a matter of fact, many disciplines, including mathematics, sociology, anthropology, biology, etc., exhibit varieties of self- reference, the primary source of impredicativity [2, p.6]. Furthermore, many natural systems do indeed show forms of impredicativity, that is the presence of self-referential cycles in their constitution. Once the supporting or enabling (as well as constraining) capacity of the related environment is provided, the impredicative cycle characterizing the system proceeds in its own way. Apart from the pioneering efforts of American theoretical biologist Robert Rosen [16], and usually without his idea that impredicativity is the next paradigmatic frontier of science, the issue of impredicativity has received little attention in the past [17],[18],[19],[20].

Unsurprisingly, many properties of impredicative systems are still unknown and suitable research programs must be developed. Specifically, from past and current scientific literature we know very little of nested or tangled impredicative systems properties, such as the organism-mind-society encapsulation [21], or the mathematics of impredicativity systems [22]. As a matter of fact, according to the author's humble knowledge, CICT (computational information conservation theory) [23] has been the only approach studying impredicative systems by an operative perspective since 1980s. The living is the domain of "repetition without repetition" [24], i.e., non-monotonic change.

Simpler explanations afford the immediacy of practical methods, sometimes informed more by urgency than by anything else. The reductionist-deterministic paradigm indeed led to significant technological and pharmaceutical progress. But this does not eliminate the need to understand complexity. Leibniz [25] seems among the first to examine science from a complexity perspective. In his view, laws should not be arbitrarily complex. If they are, the concept of the law becomes inoperative. A clear criterion (or criteria) for identifying it is more urgent than ever before, if we want medicine to overcome the limitations inherent in its mechanistic practice. However, complexity, as consubstantial with the living,

is of high-order consequence for medicine. If the living, in particular the human being, is complex, knowing the medical subject, in its complexity, is of practical importance for Health Informatics. As a matter of fact, a science of the living can only be holistic, because the dynamics of the living is the expression of its change as a whole over time. The holistic view entails the fact that the reductionist method will always return a partial understanding of the process [26]. The causality specific to interactions in the living includes, in addition to what Newton's laws describe quantitatively, the realization of meaning in connection to the possible future, i.e., anticipation [27].

However, we have to take into account that the notion of anticipation is used currently in medicine with a very precise description attached to it. In medicine, anticipation describes a genetic disorder passed from one generation to another, each time at an earlier onset (the so-called trinucleotide repeat disorders, such as Huntington disease, muscular dystrophy, etc.). For Health Informatics, the operational definition of anticipation, advanced in this paper, underlines and explains, after the fact, the choice made by medical practitioners in trying to understand how the trinucleotide repeat occurs and what is involved in the production of the mutant protein.This expression of anticipation is such that it covers the entire life of the individual: from conception to death. From this perspective, medicine, in its reductionist, industrial procedures, "heals" today and produces invalidity of deeper levels tomorrow.For the Health Informatics and Wellbeingof the future, the anticipatory endowment should translate into the practical consideration informed by the shared awareness of both the patient and physician. The surprising fact is that the idea that medicine's fundamental perspective might be deficient has not led practitioners to question it, and has not resulted in a vigorous attempt to change it.

3. CONCEPTUAL CLARITY

From traditional information modeling point of view, the main focus is on the "direct space" (DS) representation only (Euclidean space). Nevertheless, according to CICTODR (Observation-Description-Representation) approach [23] to grasp the full information content of our reality, DS is just half of the "outer universe" (OU) human representation (sharable representation) and its "co-direct space" (CS) is the other half, the DS natural closure. Coupled to the OU is the "inner universe" (IU) human representation (subjective representation), composed by the "reciprocal space" (RS) and its natural closure, the "reciprocal co-space" (RC), or the DS dual. DS and CS are the coupled, complementary, asymptotic components of the fundamental, irreducible dichotomy of our OU representation [28]. This fundamental representation is based on two root components: unfolded information (linear sharable information that can be communicated in a formal way by media) and folded information (complex subjective information that cannot be communicated by traditional media) [3]. DS, CS, RS and RC are related to the four fundamental components of the Piaget-Klein group: Identity (I), algebraic complement (additive inverse) (N), order opposite (multiplicative inverse, reciprocal) (R), and dual (D) transformations, respectively. According to CICT, this is the minimum framework required to capture and to conserve full representation information efficiently [3].

Generalizations built upon statistical averages and probability distributions defy the nature of the entity subject to knowledge acquisition. A doctor will not better address a patient's health condition based on averaging. As a sound example, we can go back to 1975 [29], with benzodiazepines, which trigger aggressiveness instead of acting as tranquillizers. It is a known fact that the same medication can be beneficial to some and (highly) detrimental to others: the "paradoxical effect" of medication. Living processes have multiple outcomes, some antagonistic to the same perturbation. These are very concrete aspects of practicing medicine without looking through the "eyeglasses" of classic physics or chemistry. The patient's unique profile should be the source for describing his condition. Medicine ought to comprehend the non-deterministic nature of both health and disease for each unique subject.

Indeed, changes due to physical forces applied on cells (e.g., a cut or a blow) and genetic processes governing all dynamics are interwoven. As recent, meaningful example, we can recall genetic manipulation. Shinya Yamanaka discovered in 2006 a way to reprogram adult cells into embryo like ones, called induced pluripotent stem (iPS) cells, a find that has revolutionized the stem cell field. It brought Yamanaka the Nobel Prize in physiology or medicine, in 2012. Nevertheless, physical-chemical manipulation has so far proven to be less successful. In 2014, he had to retract his findings and to apologize [30]. Conceptual clarity, more than instrumental obsession (so typical of this particular time) is necessary. Those who practice medicine, and even more those who contribute to a science of medicine meant to overcome the limitations inherent in generalizing physics (and the notion of machine) in the living domain will agree on the need for conceptual clarity.

4. CONCLUSION

The key change performance factor is education, distinguishing from classic, contemporary education and a new one, based on a more reliable control of learning uncertainty. We live in an age which is widely called the "Age of Information" and Health Informatics must capture as much as possible of it. Education has to be reconceived from the ground up: solid scientific education, in both the physics of the world and in the biology grounded in anticipation, is required. This in itself is a high-order endeavor, since schools continue to indoctrinate new generations in the classic "religion of physics". Medicine was always the art and science of healing. The science became more and more a mechanistic technology; the art was dropped altogether. Knowledge concept is useful for semantic and cognitive studies and research. It is much better to consider semantic information as a material category reflecting the level of internal structural organization of any object and interrelating with domain-dependent basic characteristics (such as the energy and mass of an object). This is the main reason why there are basic issues related to enhanced knowledge which still remain unresolved.

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REVIEW

15th International Conference on Informatics, Management and Technology in Health Care, Athens, Greece, 7-9 July, 2017

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In the period from 7st to 9th July 2017 14th International Conference on Informatics, Management and Technology and Healthcare (ICIMTH 2017) was held in Athens, Greece. The conference represents one of the largest European gathering in the field of medical informatics (Biomedical Informatics, Biomedical Engineering, Information Science, Health Informatics, Clinical Informatics, Public Health Informatics, Healthcare IT, Decision Support and Intelligent Systems, Diagnostic Technologies for Medical Decision Support, Formalisation of Knowledge, Ontologies, Clinical Guidelines and Standards of Healthcare, Telemedicine, Interoperability in Healthcare Systems, Imaging, Health Information Management, Knowledge Management, Health Technology Assessment, E-learning and Education, Robotics and Virtual Reality, Socio-Economic Issues, Standards, Social and Legal Issues).

Major focus of conference was to present applications of Biomedical Informatics from Clinical Informatics, Health Informatics to Public Health Informatics as well as on ICT applications in the Healthcare domain.

Conference was open by keynote speaker professor Christian Lovis, president of EFMI with interesting lecture's title: "Bigdata in health: Hype, Hopes and Chaleges". Professor Reinhold Haux, former president of IMIA was, also, interesting keynote speech with title "On Informatics Diagnostics and Informatics Therapeutics – Good Medical Informatics Research in Needed Here". Professor Theodoros N. Arvanitis had keynote lecture: "Digital Healthcare and Biomedical Informatics: the pathway to personalized medicine" and finaly, professor Mowafa Househ gave the lecture: Find your Passion, Lead with Purpose: a Health Informatician's Guide".

During the jubilary 15th ICIMTH Conference was organized special session: CrowdHEALTH, Holistic Health Records and Big Data Analytics for Health Policy Making and Personalized

Figure 1. Professors: John Mantas, Christian Lovis, Arie Hasman, Reinhold Haux (from left to right)

Figure 2. Paericipants of the ICIMTH 2017 Coneference in Arhens

Figrue 3. Presentation of prof. Izet Masic at ICIMTH 2017 Conference

Figure 4. Donation of prof. Masic*s books to National Library of Greece

Figrue 5. Participants of the ICIMTH 2017 Conerence in Athens

Figure 6. One of the best presenters with a gift of Biographical Lexicon of MI

with presentations of full papers and posters) and all gathered had the opportunity to learn about the latest developments in the world of biomedicine and to see many presentations about the use of information technology in the world of medicine. All papers are published in the Proceedings (IOS Press publisher) "Informatics Empowers Healthcare Transformation" and are indexed in MEDLINE. Information technology certainly have growing use in medicine and its use certainly represents the future of biomedical informatics in preclinical and clinical medicine, and also, in public health area. In this research field Special interest showed Panel Session chaired by professor Marianna Diomdous about "Education Management, Economics, Health Policy and Technology Evaluation in Healthcare".

Once again during ICITHM Conference was concluded that medical informatics, after increase in the development in late 90s and stagnation in the beginning of the 21st century, returns its direction to development, and is a field where many new achievements are possible.

The Organizing Committee, led by John Mantas and his good team, did a really good job, and we hope that this Conference next year will attract larger number of participants, because event like this certainly deserves it. Participants of the Conference had possibility to visit new opened building of National Library of Greece and author of this review gave as a gift some of his books. Also, books of professor Izet Masic ("Biographical Lexicon of Medical Informatcs" and "Contributions to the History of Medical Informatics" are given to ten best presenters of presentations during Closing ceremony.

REVIEW

The Most Influential Scientists in the Development of Medical Informatics (18): Isaacs Sedick

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ISAACK SEDICK (1940-2012)

Isaacs Sedick, PhD (1940-2012) was born and grew up in the Bo-Kaap, Cape Town, Western Cape. From an early age, Isaacs was fascinated with science and was engaged in performing science experiments at home. At the age of 13, he was involved in distributing political pamphlets and attending meetings of the Teachers League of South Africa (TLSA) and the Non European Unity Movement (NEUM). After completing his education, Isaacs worked as teacher at Trafalgar High School in Cape Town. It was while teaching at the school that he met Achmad Cassiem. Isaacs with his knowledge of explosives tried to train some of his friends in the use of this. This attracted the attention of the security police who monitored their activities. Consequently,

Isaacs, his friends Achmad Cassiem, Marnie Abrahams were arrested in 1964 following the testing of explosives at Strandfontein Beach, Cape Town. They were taken to Caledon Police Station. However, the guards caught them and as punishment their

food privileges were stopped and their supply of toilet paper withdrawn. In the ensuing 'trial held on the Island, where the he was officially 'charged' for writing unauthorised letters (related to the hunger strike), the prison authorities found Isaacs guilty and sentenced him to be flogged. Furthermore, his study privileges were also withdrawn. After his release from solitary confinement, Isaacs resumed his duties as chair of the Education Committee in prison and later the chair of the First Aid Unit. He taught mathematics and physical science to his fellow

inmates. Isaacs completed a Bachelor's degree in Mathematics while on the Island. When he attempted to enrol for postgraduate studies (a MSc degree), this was blocked. He was compelled to enrol for another undergraduate degree in Information Science, Mathematical Statistics and Computer Science. Upon his release, he became a Specialist Scientist in Medical Informatics and Statistics and then the Head of Department of Medical Informatics at Groote Schuur Hospital on Cape Town. Isaacs made five attempts to escape from the Island, albeit all unsuccessful. Upon his release, he was banned for seven years. He was even refused permission by the then Minister of Justice to attend the University of Cape Town (UCT) for postgraduate studies.

Nevertheless, he managed to register at the UCT and was forced to meet with his lecturers, clandestinely, in the Cape Town Botanical Gardens. Due to his banning orders, it was extremely difficult to obtain employment even when vacancies were open

to him. After his banning orders expired in 1986, Isaacs was elected as an Honorary Fellow of the IMIA for outstanding contribution to Medical and Health Informatics. He also obtained a visa to undertake a sabbatical in Ger-

many in 1990 where he was able to complete his PhD. He was then elected Fellow of the Royal Statistical Society and a Chartered Member of the British Computer Society. In 2010, Isaacs was elected Honorary Fellow of the IMIA and in 2011, he was nominated as a Companion of Demontford University in the United Kingdom. Again, in 2010 Isaacs was nominated as a Sports Icon by the Department of Arts, Culture and Recreation for his contribution to Sport on Robben Island. He was a driving force behind the development of health informatics in South Africa, in Africa though HELINA, and internationally–in addition to the contributions and sacrifices he made for the freedom of his country, especially during the time he was imprisoned on Robben Island. Isaacs was 23 when he began a 13-year sentence for sabotage, sharing time with Nelson Mandela, after the apartheid police captured him in 1964.

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