

# ASSESSMENT OF A COMPUTER BASED CURRICULUM IN EVIDENCE-BASED MEDICINE

Sorana-Daniela BOLBOACĂ

“Iuliu Hatieganu” University of Medicine and Pharmacy, 13 Emil Isac Street, 400023 Cluj-Napoca, Romania,  
Phone: +40 264 431697, Fax: +40-264-593847, <http://sorana.academicdirect.ro>

Lorentz JÄNTSCHI

Technical University of Cluj-Napoca, 15 Constantin Daicoviciu Street, 400020 Cluj-Napoca, Romania, Phone:  
+40 264 401 775, Fax +40 264 592055, <http://lori.academicdirect.org>

## ABSTRACT

**Purpose:** The aim of the paper is to present a computer-based curriculum on evidence-based medicine and its performances in medical students training.

**Materials:** A number of thirteen tutorials and six supplemental materials were assembled into a portable application using the Microsoft HTML Help program.

**Methods:** Pre- and post-study survey and tests were developed to measure the students' knowledge and attitude on evidence-based medicine. Forty medical students were enrolling voluntarily at the study and completed the pre- and post-study survey as well as pre- and post-tests at the beginning and completion of a three month period of training. Data were presented as absolute and relative frequency, with confidence intervals, and were analyzed using the Wilcoxon test.

**Results:** Most of the medical students included into the study were hear about evidence-based medicine concepts for the first time by participation of the study. Pre- and post-test evaluation results show that the computer-assisted evidence-based medicine training can improve knowledge significantly.

**Conclusion:** The developed evidence-based medicine curriculum it proved to be useful in medical students training giving them access to information in their native language and improving their knowledge, opening the way towards the use of evidence in medical decisions.

**Keywords:** computer-assisted training; interactive knowledge assessment; medical students; evidence-based medicine.

## 1. BACKGROUND

The concept of evidence-based medicine (EBM) was introduced by Guyatt & all in 1991 [1] and is defined as the *conscientious, explicit, and judicious use of the best evidence in making decisions about the care of individual patients* [2]. The education in evidence-based medicine plays nowadays an essential role in physicians' education as a necessity of integration the best available evidence in day-by-day clinical decision process. Teaching in evidence based medicine is widespread on medical students [3], resident physicians [4], as well as in continuing medical education programs [5,6].

Development of the information and communication technologies gives the possibilities of creating interactive computer-based application useful in medical education. Most of them are created for continuing medical education and has as target population the practitioners [7,8].

Using the trends in evidence-based medicine training of the students from the international flux of information [9] as starting point, the elements of evidence-based medicine were integrated into a unitary Romanian system and its effectiveness was assessed.

## 2. MATERIALS

The evidence-based medicine curriculum contains a series of tutorials, supplemental materials and evaluation systems:

- **Tutorials.** By reviewing the specialty literature, considering the experience acquired in countries all over the world in evidence-based medicine training, a series of training material components were identified, studied, and adapted in order to be useful for education of students in evidence-based medicine. There were created thirteen tutorials, each of them following the methodology: the objectives, prerequisites, training materials structured in chapters, clinical-based problems, references, and a self-evaluation test. The topics of the tutorials are presented in table 1.

**Table 1. Topics of evidence-based medicine curriculum**

Section	Remarks
Introduction in Evidence-Based Medicine	It is important to respect the accomplishing order for complete understanding of the evidence based medicine concepts
Asking Answerable Questions	
Medical Evidence	
Finding the Evidence	
Apply the Evidence in Day-By-Day Practice	
Decisions Based on Evidence*	Can be completed in any order with one exception (*) * Study Assessment of <i>Decisional Trees</i> approaching must be made after the accomplishing of <i>Decisions Based on Evidence</i>
Study Assessment of	
Therapy	
Diagnostic Test	
Screening Test	
Prognosis	
Etiology	
Economic Analysis	
Decisional Trees	
Assessment of Evidence Based Clinical Practice Guidelines	Must be approached at the end

In order to allow the students to assess their acquired knowledge, we included to each tutorial a computer-assisted tests. The implemented methodology of the self-evaluation test is presented:

- Type of evaluation: Offline and/or online;
- Five multiple-choice questions: Every question have:
  - Five possible answers, lettered A through E;
  - One or more than one correct answer(s);
  - At least two problem-based questions.
- Avoiding of a question: Not allowed
- Test results:
  - Displaying the correct and wrong answered questions;
  - Displaying the obtained score.
- The score:
  - *All or nothing* rule:
    - Every question with a correct answer(s) has 1 point;
    - Example: if the correct answer items for a question are B and D and the user choused A, or any other combinations, the question does not have any point.
  - The score range: from 5(A) to 0(F).
- **Supplemental materials.** The resources integrated in the computer-based application as support of evidence-based medicine were:
  - The glossary component, structured alphabetically from A to Z. This includes a number of one hundred twenty-two evidence-based medicine terms with their explanations.
  - Twenty Diagnostic and Treatment Guidelines published by the Romanian National College of Physicians, available online [10];
  - Seventeen Prove Based Medicine papers published on Stetoscop Journal, available online [11];
  - CATRom [12,13,14] - a software tool for assisted creation of for treatment, diagnostic and prognosis Critical Appraised Topics (CAT);
  - Guidelines(ONLINE) [15] - a software tool for assisted creation of guidelines models and guidelines. The software include four predefined models for the followings: Two well known wide use (at international level) clinical practice guidelines; Romanian Diagnostic and Treatment Guidelines; A proposed structure of Romanian Evidence Based Guidelines.
  - BinomialDistribution - a software tool for proportions confidence interval calculation with direct application to medical key parameters [16-26]. The software uses an original algorithm of optimization with two triangulations and provides confidence interval boundaries and experimental true errors for sample sizes from 2 to 506.
- **Tutor-assisted evaluation test.** The proposed methodology of the tutor-assisted test it fits on specifications with self-evaluation test, except:
  - Type of evaluation: In-person.

- Forty-five multiple-choice questions:
  - The questions are choose randomly from a database;
  - At least fifteen problem-based questions;
- Avoiding of a question: Allowed
- Test results:
  - Displaying the final mark;
  - Displaying the text of the avoided questions;
  - Displaying the text of the wrong answered questions;
- The score:
  - *all or nothing* rule;
  - Range: from 45 to 0;
- The mark:
  - Compute based *on* the following formula: **Final mark = 1 + nCA·0.9**, where the nCA is the number of the questions at which the user gave a correct answer;
  - Range: from 10 to 1;
- Condition for pass the final exam: Every must prove that acquired at least 80% of presented information in order to pass the exam (that means a score greater than or equal with 8, and a final mark greater than or equal to 8.20).

By use of HTML Help Workshop (version 4, Microsoft ©, free to use) the EBMRom system was assembled into a Windows help application, and act as tool for computer-assisted training in evidence-based medicine. The HTML Help Workshop (HHW) generates CHM files (from Compiled Hypertext Markup language) from HTML (Hyper Text Markup Language) and other dependency file types. 1997 marked the first appearance of THML Help (HH) together with Internet Explorer 4.0 (IE4). Nowadays, the CHM files are supported and displayed on both Linux and Windows - like platforms.

### 3. METHODS

The above described evidence-based curriculum in evidence based medicine was studied and assess on a sample of students. The target population of this study was represented by the students at Faculty of Medicine; students which are in the second cycle of study (perform practice in hospitals and in dispensaries). Available population was represented by the students at Faculty of Medicine, Iuliu Hatieganu University of Medicine and Pharmacy, Cluj-Napoca, Romania. Through an aleatory process there was choused first the year of study (from fourth, fifth and sixth year of study) and after that a series of students (one out of five). In the series of students choused aleatory for the study there were presented the aim and the objectives of the study. Because participating at the study suppose to allocate time for a topic that is not included into the obligatory medical curriculum the students enroll voluntary to the study. A number of forty students were enrolling into the study.

Each student participating to the study received a CD-Rom with EBMRom application for self study on a

period of three month. There were individual meetings with the students which ask for clarifications of notions.

### Pre- and post-study survey

The medical students participating at the study completed a survey at the beginning and completion of the study. The characteristics of the students and the characterization of their access to a computer and to the Internet were evaluated by the pre-study survey. The assessment of the EBMROM instrument in training on evidence-based medicine was evaluated by the post-study survey.

### Pre- and post-test knowledge assessment

All medical students participating at the study completed the tutor-assisted test on evaluation of evidence-based medicine knowledge at beginning and completion of the three-month computer-assisted training. Data were analyzed using the Wilcoxon test.

## 4. RESULTS

### Pre-study survey

The pre-study survey consisted of four questions that evaluate the followings about the students:

1. Identification data (name and first name, sex and age);
2. Their prior knowledge about EBM concepts;
3. The type of access to a computer with a CD-Rom;
4. The type of access to the Internet.

Forty (57.97%) of sixty-nine studnets in the fourth year of study participate to the study, all of them completed the pre-and post-study survey as well as the pre- and post-test survey. Twenty-seven (68%) of the students were female. The average of age was 21.87 (minimum equal with 21 and maximum equal with 23). Thirty-three medical students (82.5%) were hear the concepts of EBM with the occasion of the study.

The type of access to a computer with CD-Rom and to the Internet of the students express as absolute frequency ( $f_a$ ), relative frequency ( $f_r$ ) and confidence intervals (CI) are in table 2. The access was defined as *easy* if there was a computer in the student room or in a room from the building were the student live; *relative easy* if the same computer is shared with other people; and *difficult* if the student has the access in another building then he/she lives. Note that the confidence intervals were computed by the use of an original optimization method [16].

**Table 2. The type of access to a computer and to the Internet**

Type	Computer			Internet		
	$f_a$	$f_r$	CI	$f_a$	$f_r$	CI
Easy	16	40	[25.06-57.44]	13	32.5	[17.56-49.94]
Relative easy	15	37.5	[22.56-54.94]	11	27.5	[15.06-44.94]
Difficult	9	22.5	[10.06-37.44]	16	40	[25.06-57.44]
Total	40			40		

### Pre- and post-test knowledge assessment

Students were completed a forty-five multiple-choice questionnaire to assess the EBM knowledge's at the beginning and completion of the training period. The tests

were tutor-assisted and the students were graded by the EBMROM application in conformity with the specification described into the **Materials** section. The total numbers of correct and incorrect answers for each student, express as absolute frequency ( $f_a$ ) and confidence intervals (CI) obtained to the test from the beginning of the study as well as to the completion of the study are in table 3. The relative frequencies of correct and incorrect answers are graphically represented in figure 1. The Wilcoxon test was apply in order to test de differences between the number of correct answers at the beginning and at the end of the study (the test was apply for a significance level equal with 5%).

**Table 3. Distribution of the correct and incorrect answers at pre- and post-test**

IdStd	Pre-test				Post-test			
	Correct		Incorrect		Correct		Incorrect	
	$f_a$	CI	$f_a$	CI	$f_a$	CI	$f_a$	CI
std_01	7	[6.72-28.84]	38	[71.16-93.28]	41	[77.83-97.73]	4	[2.27-22.17]
std_02	2	[0.05-15.51]	43	[84.49-99.95]	38	[71.16-93.28]	7	[6.72-28.84]
std_03	5	[4.49-24.40]	40	[75.60-95.51]	38	[71.16-93.28]	7	[6.72-28.84]
std_04	5	[4.49-24.40]	40	[75.60-95.51]	37	[68.94-93.28]	8	[6.72-31.06]
std_05	7	[6.72-28.84]	38	[71.16-93.28]	41	[77.83-97.73]	4	[2.27-22.17]
std_06	5	[4.49-24.40]	40	[75.60-95.51]	36	[64.49-91.06]	9	[8.94-35.51]
std_07	9	[8.94-35.51]	36	[64.49-91.06]	32	[55.60-84.40]	13	[15.60-44.40]
std_08	6	[4.49-26.62]	39	[73.38-95.51]	37	[68.94-93.28]	8	[6.72-31.06]
std_09	3	[2.27-17.73]	42	[82.27-97.73]	36	[64.49-91.06]	9	[8.94-35.51]
std_10	5	[4.49-24.40]	40	[75.60-95.51]	37	[68.94-93.28]	8	[6.72-31.06]
std_11	5	[4.49-24.40]	40	[75.60-95.51]	41	[77.83-97.73]	4	[2.27-22.17]
std_12	8	[6.72-31.06]	37	[68.94-93.28]	40	[75.60-95.51]	5	[4.49-24.40]
std_13	4	[2.27-22.17]	41	[77.83-97.73]	35	[62.27-88.84]	10	[11.16-37.73]
std_14	2	[0.05-15.51]	43	[84.49-99.95]	35	[62.27-88.84]	10	[11.16-37.73]
std_15	6	[4.49-26.62]	39	[73.38-95.51]	37	[68.94-93.28]	8	[6.72-31.06]
std_16	4	[2.27-22.17]	41	[77.83-97.73]	42	[82.27-97.73]	3	[2.27-17.73]
std_17	4	[2.27-22.17]	41	[77.83-97.73]	38	[71.16-93.28]	7	[6.72-28.84]
std_18	8	[6.72-31.06]	37	[68.94-93.28]	39	[73.38-95.51]	6	[4.49-26.62]
std_19	3	[2.27-17.73]	42	[82.27-97.73]	38	[71.16-93.28]	7	[6.72-28.84]
std_20	2	[0.05-15.51]	43	[84.49-99.95]	38	[71.16-93.28]	7	[6.72-28.84]
std_21	6	[4.49-26.62]	39	[73.38-95.51]	38	[71.16-93.28]	7	[6.72-28.84]
std_22	6	[4.49-26.62]	39	[73.38-95.51]	36	[64.49-91.06]	9	[8.94-35.51]
std_23	3	[2.27-17.73]	42	[82.27-97.73]	37	[68.94-93.28]	8	[6.72-31.06]
std_24	6	[4.49-26.62]	39	[73.38-95.51]	41	[77.83-97.73]	4	[2.27-22.17]
std_25	4	[2.27-22.17]	41	[77.83-97.73]	37	[68.94-93.28]	8	[6.72-31.06]
std_26	6	[4.49-26.62]	39	[73.38-95.51]	36	[64.49-91.06]	9	[8.94-35.51]
std_27	8	[6.72-31.06]	37	[68.94-93.28]	37	[68.94-93.28]	8	[6.72-31.06]
std_28	7	[6.72-28.84]	38	[71.16-93.28]	37	[68.94-93.28]	8	[6.72-31.06]
std_29	5	[4.49-24.40]	40	[75.60-95.51]	38	[71.16-93.28]	7	[6.72-28.84]
std_30	2	[0.05-15.51]	43	[84.49-99.95]	36	[64.49-91.06]	9	[8.94-35.51]
std_31	5	[4.49-24.40]	40	[75.60-95.51]	38	[71.16-93.28]	7	[6.72-28.84]
std_32	6	[4.49-26.62]	39	[73.38-95.51]	40	[75.60-95.51]	5	[4.49-24.40]
std_33	6	[4.49-26.62]	39	[73.38-95.51]	40	[75.60-95.51]	5	[4.49-24.40]
std_34	5	[4.49-24.40]	40	[75.60-95.51]	38	[71.16-93.28]	7	[6.72-28.84]
std_35	3	[2.27-17.73]	42	[82.27-97.73]	38	[71.16-93.28]	7	[6.72-28.84]
std_36	3	[2.27-17.73]	42	[82.27-97.73]	38	[71.16-93.28]	7	[6.72-28.84]
std_37	2	[0.05-15.51]	43	[84.49-99.95]	40	[75.60-95.51]	5	[4.49-24.40]
std_38	7	[6.72-28.84]	38	[71.16-93.28]	40	[75.60-95.51]	5	[4.49-24.40]
std_39	3	[2.27-17.73]	42	[82.27-97.73]	34	[60.05-86.62]	11	[13.38-39.95]
std_40	1	[0.05-11.06]	44	[88.94-99.95]	41	[77.83-97.73]	4	[2.27-22.17]

$n = 40, Z = 5.51, p < 0.001$

$n = 40, Z = 5.51, p < 0.001$

### Post-study survey

The post-study survey consisted of five questions that evaluate the followings about the EBMROM application:

1. The type of advantages offered by use of the EBMROM application in EBM training;

2. The grading of the usefulness of the EBMROM application;
3. The grading of the easiness of the EBMROM application;
4. The usefulness of the application in EBM training;
5. The usefulness of the application in medical practice.

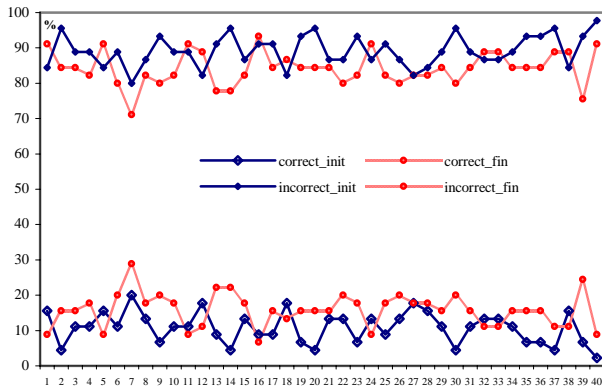


Figure 1. Distribution of correct and incorrect answers

Thirty-six (90%) of medical students consider that the application offer an interactive training environment, thirty-eight (95%) specified that one of advantage of EBMROM application is represented by the self-evaluation facilities, thirty-two (80%) identified as advantage the possibility of choosing the proper time and the place of EBM education, twenty-four (60%) consider that the application guide the access to the electronic medical journals, thirty-eight (95%) consider that the EBMROM application allows searching and retrieving the information, and thirty-nine (97.5%) consider that the application facilitate the access to the EBM resources in Romanian language.

The usefulness of the EBMROM environment was grade as indifferent by one student (2.5%), useful by twenty-eight students (77.5%), and very useful by eleven students.

The easiness of the use of application was grading as relative difficult by seven students (17.5%), as relative easy by eleven students (27.5%), as easy by eight students (20%) and as very easy by fourteen students (35%).

Twenty-four students (60%) consider that EBMROM application is a helpful instrument in EBM training and twenty students (50%) consider that is an instrument useful in medical practice.

## 5. DISCUSSIONS

The access to the evidence-based medicine knowledge is the first step in implementing of the concept at the level of medical students. The tutorial offered through EBMROM application can be taking into consideration individually, according with the specification described in the 'Materials' section. First topic provides the basic information of what evidence-based medicine is and which are the steps of practicing EBM. The next topics

provide exhaustive evidence-based medicine knowledge for the specified subject. Each topic has clinical-based problems, with solutions and explanations created in order to allow a deep understanding of the knowledge, and a computer assisted self-evaluation multiple choice test which allows the medical students to assess their acquired knowledge.

The EBMROM application provide evidence-based medicine information, allowing the increase of the medicals students knowledge and providing a training environment which allows assisting in acquiring the skills necessary in order to practice evidence-based medicine.

The advantages offered by the EBMROM application are:

- Enable just-in-time training, the medical students having the opportunity to follow the training when they consider that is needed for their medical education;
- Allows self-paced, independent training, medical students being able to tailoring the learning experience, time and place of EBM education to personal preferences;
- The costs of EBM training will decrease, because the development of the computer-assisted training system is low-cost comparing with the traditional training materials;
- The utilization of evidence-based information by anyone interested in practicing evidence-based medicine is facile, the minimum required being a computer with or without an Internet connection.

We choused to perform the pre- and post-test knowledge assessment assisted by a tutor in order to avoid the cheating and collaborations. Even if the assessment through online tests can impose the time for evaluation (the proper time it is one hour for a test with forty-five multiple-choice questions), the time between two evaluation (for example two weeks), the medical students identification (through first name, surname, personal number, et cetera) can not identify the person which performed the assessment or the collaboration between medical students.

Most of the medical students included into the study were hear about EBM concepts for the first time though participation of the study. Because of the social and economical difficulties of Romania, even if most of the medical students had an easy or relative easy access to a computer, most of them had a difficult access to the Internet and from this point of view to the online medical databases. Pre- and post-test knowledge evaluation results show that the computer-assisted EBM training can improve medical students' knowledge and give the information necessary in order to use the best available evidence in day-by-day decisions making. Looking at the results (see table 3 and figure 1) it can be observed that the percent of the correct answers from the pre-test evaluation are similar with the percent of the incorrect answers from the post-test evaluation while the percent of the incorrect answers from the pre-test evaluation are similar with the percent of the correct answers from the



post-test evaluation. This observation is sustained also by analysis of the confidence intervals and by the results of the Wilcoxon test (see table 3).

It is obvious that having EBM knowledge do not means that they are use in medical practice, but is the first step in formatting the future physicians in the spirit of practicing evidence-based medicine. Future studies are necessary in order to assess the influence of the acquired EBM knowledge in formulating the clinical questions, creating the strategy of searching the best available evidence, assessment of the validity and relevance of evidence and integrating the evidence into medical decision.

## 6. CONCLUSION

The proposed computer based curriculum can be offered as optional topic to the medical students and as continuing medical education course, being a real solution for Romanian educational needs in EBM training, allowing tailoring the learning experience, time and place of education to personal preferences, improving the quality of health care services, and avoiding the interruption of day-by-day activities.

## 7. ACKNOWLEDGEMENT

The research was partially supported by UEFISCSU Romania through project ET46/2005.

## 8. REFERENCES

- [1] Guyatt GH. Evidence-based medicine. ACP J Club 1991;114:A-16.
- [2] Sackett DL, Rosenberg WM, Gray JA, Haynes RB, Richardson WS. Evidence-based medicine: what it is and what it isn't. Br Med J 1996;312(7023):71-2.
- [3] Cayley JrWE. Evidence-based medicine for medical students: introducing EBM in a primary care rotation. WMJ 2005; 104 (3): 34-7.
- [4] Nicholson LJ, Shieh LY. Teaching evidence-based medicine on a busy hospitalist service: Residents rate a pilot curriculum. Academic Medicine 2005; 80 (6): 607-9.
- [5] CASP: Evidence-based Health Care Workbook and CD-ROM [online]. ©Copyright Update Software [cited November 2005]; [about two screens]. Available from: URL: <http://www.update-software.com/publications/casp/>
- [6] Mayo School of Continuing Medical Education [online]. ©2002 [cited December 2005]; Mayo Foundation for Medical Education and Research [about six screens]. Available from: URL: <http://www.mayo.edu/cme/sct-courses.html>.
- [7] Evidence-Based Medicine and the Medical Librarian [online]. ©2004 [cited September 2005]; UNC-Chapel Hill [about four screens]. Available from: URL: [http://sils.unc.edu/programs/continuing\\_ed/ebm.html](http://sils.unc.edu/programs/continuing_ed/ebm.html)
- [8] Greenhalgh T, Toon P, Russel J, Wong G, Plumb L, Macfarlane F. Transferability of principles of evidence-based medicine to improve educational quality: Systematic review and case study of an online course in primary health care BMJ 2003; 326: 142-5.
- [9] Dorsch JL, Aiyer MK, Meyer LE. Impact of an evidence-based medicine curriculum on medical students' attitudes and skills. J Med Libr Assoc. 2004;92(4):397-406.
- [10] CMR.ro [Internet home page]. România: Colegiul Medicilor România, NGO; ©2004 [cited 2005 Aug]. Available from: <http://www.cmr.ro>.
- [11] Stetoscop.ro [Internet home page]. România: Antaeus Publ House, Ltd; ©2002-2005 [cited 2005 Aug]. Available from: <http://www.stetoscop.ro>.
- [12] Bolboacă S, Jäntschi L, Drugan T, Achimaş Cadariu A. Creating Therapy Studies Critical Appraised Topics. CATRom Original Software for Romanian Physicians. Applied Medical Informatics 2004;15:26-33.
- [13] Bolboacă S, Jäntschi L, Achimaş Cadariu A. Creating Diagnostic Critical Appraised Topics. CATRom Original Software for Romanian Physicians. Applied Medical Informatics 2004;14:27-34.
- [14] Bolboacă S, Jäntschi L, Achimaş Cadariu A. Creating Etiology/Prognostic Critical Appraised Topics. CATRom Original Software for Romanian Physicians. Applied Medical Informatics 2003;13:11-6.
- [15] Bolboacă S, Jäntschi L, Achimaş Cadariu A. Assisting creation of guidelines models and guidelines. Applied Medical Informatics 2006; In press.
- [16] \*\*\* BinomialDistribution [online]. ©2005 [cited January 2006]; Lorentz JÄNTSCHI & Sorana BOLBOACĂ [about two screens]. Available from URL: [http://vl.academicdirect.org/applied\\_statistics/binomial\\_distribution/](http://vl.academicdirect.org/applied_statistics/binomial_distribution/)
- [17] Drugan T, Bolboacă S, Jäntschi L, Achimaş Cadariu A. Binomial Distribution Sample Confidence Intervals Estimation 1. Sampling and Medical Key Parameters Calculation. Leonardo Electronic Journal of Practices and Technologies 2003;3:47-74.
- [18] Bolboacă S, Achimaş Cadariu A. Binomial Distribution Sample Confidence Intervals Estimation 2. Proportion-like Medical Parameters. Leonardo Electronic Journal of Practices and Technologies 2003;3:75-110.
- [19] Bolboacă S, Achimaş Cadariu A. Binomial Distribution Sample Confidence Intervals Estimation 3. Post and Pre Test Odds. Leonardo Journal of Sciences 2003;3:24-46.
- [20] Bolboacă S, Achimaş Cadariu A. Binomial Distribution Sample Confidence Intervals Estimation 4. Post Test Probability. Leonardo Journal of Sciences 2003;3:47-70.
- [21] Bolboacă S, Achimaş Cadariu A. Binomial Distribution Sample Confidence Intervals Estimation 5. Odds Ratio. Leonardo Journal of Sciences 2004;4:26-43.
- [22] Bolboacă S, Achimaş Cadariu A. Binomial Distribution Sample Confidence Intervals Estimation 6. Excess Risk. Leonardo Electronic Journal of Practices and Technologies 2004;4:1-20.
- [23] Bolboacă S, Achimaş Cadariu A. Binomial Distribution Sample Confidence Intervals Estimation 7. Absolute Risk Reduction and ARR-like Expressions. Leonardo Electronic Journal of Practices and Technologies 2004;5:1-25.
- [24] Bolboacă S, Achimaş Cadariu A. Binomial Distribution Sample Confidence Intervals Estimation 8. Number Needed to Treat/Harm. Leonardo Journal of Sciences 2004;5:1-17.
- [25] Bolboacă S, Jäntschi L. Binomial Distribution Sample Confidence Interval Estimation for Positive and Negative Likelihood Ratio Medical Key Parameters , American Informatics Medical Association Annual Symposium on Biomedical and Health Informatics from Foundations to Applications to Policy, Washington D.C., U.S.A., 2005, October 22-26, Conference Proceedings, p. 66-70, 2005.
- [26] Bolboacă S. Binomial Distribution Sample Confidence Intervals Estimation 10. Relative Risk Reduction and RRR-like Expressions. Leonardo Electronic Journal of Practices and Technologies 2005;6:60-75.