

Assessment of Critical Reading Ability in Cardiology Residents

Evaluación de la habilidad de la lectura crítica en residentes de cardiología

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ABSTRACT

Background: In recent years there has been a strong emergence of the outcome-based education concept emphasizing the benefit of clearly establishing the professional capabilities to be achieved. Current regulations specify the ability to interpret the results of a research and make a critical reading of scientific publications as one of the cardiologist's competencies.

Objective: The aim of this study was to investigate the capacity of residents to interpret the statistical tests most frequently used in research studies.

Method: A questionnaire of 17 multiple-choice questions, developed and validated by Pizarro et al. was used. The maximum possible score was 17 points.

Four levels of critical reading skills were established according to the number of correct answers: none (less than 5 points), deficient (between 5 and 9 points), good (between 10 and 14 points) and very good (15 points or more).

Results: In May 2016, 169 cardiology residents answered the questionnaire anonymously and voluntarily. In 29% of cases they mentioned previous training in the subject and 88% of them said that bibliographic meetings are regularly carried out in the residency.

- Range of correct answers: 0-15.
- Mean: 7.56 ± 1.66 .
- Median: 7 (interquartile range 4-8.5).
- Cronbach: 0.81.

On average, 44% of the questionnaire was answered correctly, with no significant differences between men and women (45% vs. 43%, $p=0.34$) or between those who had or did not have previous statistics training (45% vs. 43%, $p=0.39$). A significant difference was found between Argentine and foreign university graduates (45% vs. 36%, $p < 0.045$).

Conclusions: In 73% of the residents, the level of necessary knowledge to interpret research studies was unsatisfactory.

The results are similar to those of other published studies. It would be interesting to review teaching strategies and analyze their effectiveness.

Key words: Evaluation - Internship and Residency - Scientific and Technical Publications - Critical Reading

RESUMEN

Introducción: En los últimos años ha surgido con fuerza el concepto outcome-based education, que enfatiza la conveniencia de establecer con claridad las competencias profesionales a lograr. En la normativa vigente se especifica la habilidad para interpretar los resultados de la investigación y hacer una lectura crítica de las publicaciones científicas como una de las competencias del médico cardiólogo.

Objetivo: Indagar la capacidad de los residentes para interpretar las pruebas estadísticas más frecuentemente utilizadas en los trabajos de investigación.

Material y métodos: Cuestionario de 17 preguntas de selección múltiple, desarrollado y validado por Pizarro y colaboradores. Puntaje máximo posible: 17 puntos.

Se establecieron cuatro niveles de dominio de la habilidad para la lectura crítica según cantidad de respuestas correctas: ninguna (menos de 5 puntos), insuficiente (entre 5 y 9 puntos), bueno (entre 10 y 14 puntos) y muy bueno (15 y más).

Resultados: En mayo de 2016, 169 residentes de cardiología respondieron el cuestionario de forma anónima y voluntaria. El 29% menciona formación previa en el tema, el 88% dice que en la residencia se realizan regularmente ateneos bibliográficos.

- Rango de respuestas correctas: 0-15.
- Promedio: $7,56 \pm 1,66$.
- Mediana: 7 (intervalo intercuartil 4-8,5).
- Cronbach: 0,81.

En promedio, se respondió correctamente el 44% del cuestionario, sin diferencias significativas entre hombres y mujeres (45% vs. 43%; $p = 0,34$) ni entre los que tenían y los que no tenían formación previa en estadística (45% vs. 43%; $p = 0,39$). Se encontró diferencia significativa entre egresados de universidad argentina y de extranjera (45% vs. 36%; $p < 0,045$).

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Conclusiones: El 73% de los residentes mostraron un nivel insuficiente de conocimientos.

Los resultados son similares a los de otros estudios publicados. Sería interesante revisar las estrategias de enseñanza y analizar su grado de eficacia.

Palabras clave: Evaluación - Internado y residencia - Publicaciones científicas - Lectura crítica

INTRODUCTION

In recent years, there has been a strong emergence of the outcome-based education concept advocating the need to clearly, specifically and concisely establish the skills that a licensed health practitioner or physician will have achieved at the end of each of his training periods.

*“Professional skills are the **integrated set of elements** (knowledge, abilities, skills, attitudes and values) that the subject applies in the performance of his activities and functions.”*(1)

Both undergraduate and graduate levels emphasize the importance of developing the capacity to critically read scientific publications. In Resolution No. 1314/2007, the Ministry of Education, Science and Technology-Standards for the accreditation of the medical career specifies the physician’s competencies. The 40 activities are grouped in four dimensions (Figure 1).

In the Scientific thinking and research dimension, the following skills, among others, are specified:

- *“It uses critical thinking, clinical reasoning, evidence-based medicine and scientific research methods in the management of information and in the approach of medical and health problems.”*
- *“It critically analyzes the scientific literature.”*

In addition, Resolution No. 1001/2016 of the National Ministry of Health - Reference Framework for medical residency training -Cardiology specialty- de-

finies the cardiologist as the physician specialized in the prevention, diagnosis, treatment and rehabilitation of cardiovascular diseases in the different stages of life. The skills of the cardiologist are listed in great detail and the following is established for example, in the dimension of clinical practice:

- *“He/she indicates and interprets complementary tests taking into account the sensitivity, specificity, positive predictive value and negative predictive value of each test and its cost-to-benefit ratio for the patient.”*
- *He/she indicates the corresponding treatments of acute and chronic heart diseases, considering the best evidence available in terms of safety, efficacy, co-to-benefit ratio and contraindications.”*

Given the biases and multiple interests that prevail in the world of medical research, it is essential that professionals develop a critical attitude in order to recognize and judge methodological deficiencies and limitations of the research papers published. Without this capacity for critical reading professionals would indiscriminately employ the new information in clinical practice.

The **purpose of this study** is to investigate, in resident physicians, their level of ability to interpret the statistical tests most frequently used in clinical research.

METHODS

Population: Cardiology resident physicians who attend the Biannual Course of Cardiology taught in the Argentine Society of Cardiology, divided into two groups: Group A: residents attending the first year and Group B: residents attending the second year.

Instrument: Questionnaire of 17 multiple-choice structured questions with four options, developed and validated by Pizarro et al. (2)

Before presenting the knowledge test questions, residents answered some inquiries that allowed the identification of the respondents’ profile, explore the residents’ self-assessment on their ability to interpret the results of the investigations and estimate their interest in the subject.

Knowledge, at a comprehension and application level, on subjects such as: central tendency measurements, standard deviation, confidence intervals, types of variables, effect and impact measurements, relative risk and attributable benefit, odds ratio, sensitivity and specificity of diagnostic tests, interpretation of multivariate analysis and survival results were assessed. (See examples of questions in the Annex)

Responses were recorded on ad hoc forms that allow electronic reading and data tabulation.

Each correct knowledge question was valued with 1 point. Maximum possible score: 17 points. The number of correct answers was ordered into four categories or mastery levels of critical reading ability (Table 1).

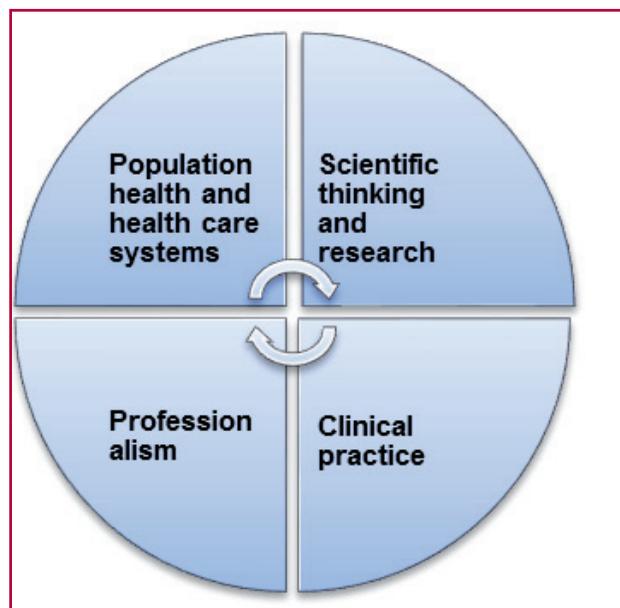


Fig. 1. Dimensions of the physician professional skills according to Resolution No. 1314.

To evaluate the quality of knowledge questions, a qualitative-quantitative analysis was performed using the Galofré Quality Index, which considers 10 criteria (4) and the Difficulty Index (5) (Table 2).

Statistical analysis

Data on responders' profile were tabulated accumulating frequencies. For the statistical analysis, tests for continuous or categorical data were used, as appropriate. When more than two groups were evaluated, ANOVA or the Kruskal-Wallis test was used, as appropriate. STATA 12.0 statistical software was employed to analyze the data. In order to evaluate the reliability of the test results, Cronbach's alpha coefficient and item-total correlations were used.

The internal consistency method based on Cronbach's alpha allows estimating the reliability of a measuring instrument through a set of items that are expected to measure the same construct or theoretical dimension. Cronbach's alpha is an average of the correlations among variables that are part of the scale. The alpha coefficient may be used as an internal strength index. The closer to 1 the alpha coefficient, the greater the internal consistency of the analyzed items. The consistency value that is considered adequate is 0.8 or higher. (3)

Ethical considerations

The protocol was approved by The Institutional Ethics Committee

RESULTS

In May 2016, 169 residents answered the questionnaire in the classroom, anonymously and voluntarily. Group A: 101 residents initiating the 1st year of the Biannual Course and Group B: 68 residents attending the 2nd year. It should be noted that the residents were in 3rd and 4th year of residency in 34 different health care institutions.

Table 1. Critical reading ability expertise according to the number of correct answers.

Number of correct answers	Skill expertise levels
0-4	No capacity
5-9	Deficient
10-14	Good, to improve
15 and more	Very good

Table 2. Level of question difficulty according to the percentage of correct answers.

Level of question difficulty	Percentage of correct answers
Very easy	85 and more
Easy	84-69
Medium difficulty	68-32
Difficult	31-16
Very difficult	15 and less

Responders' profile

Mean age was 29±3 years and 60% were men. In 13% of cases they have graduated as doctor in a foreign university. Thirteen percent of responders have completed the medical clinical residency before starting the Cardiology residency.

- 63% say they have often felt the need to learn statistics.
 - 29% mention that they have participated in Statistics, Epidemiology or evidence-based Medicine courses. In 36% of cases they would like to learn more clinical epidemiology and biostatistics.
- The vast majority recognizes that to properly interpret the bibliography they should know more statistics.
- Fifty percent admit that they do not understand biostatistical terms, while 40% say they understand almost all the statistical terms found in the publications.
 - Eighty-eight percent say that medical meetings are regularly held during the residency; 47% read scientific journals frequently, 35% read them occasionally, 14% read them weekly, and 2% say they never read scientific journals such as the *Argentine Journal of Cardiology* and/or *Circulation*.
 - Sixty-six percent say they use information supported by clinical studies to form an opinion or make decisions, while 36% do not trust statistical results because they consider that it is very easy to manipulate the data.
 - Forty-eight percent consider they have enough ability to understand a scientific publication, 41% consider it deficient, and 2% self-evaluate their capacity as very good.

Questionnaire of 17 knowledge questions

- Range of correct answers: 0-15.
 - Average of correct answers: 7.56±1.66.
 - Median 7 (interquartile range 4-8.5).
- When comparing the different variables, there were no significant differences in the percentage of correct answers (Table 3):
- Associated with gender (men: 45% vs. women: 43%, p=0.34)
 - Between those who participated in evidence-based Medicine courses and those who did not (45% vs. 43%, p=0.39)
 - Between Group A and Group B. (first year: 43%, second year: 46%, p<0.095)

There were also no significant differences in the average of correct answers in relation to other variables (participation in medical meetings, reading of scientific journals, among others).

Significant differences were only found among graduates of different universities (Argentine 45% vs. foreign 36%, p<0.045)

The reliability of the test was evaluated: Cronbach's Alpha was 0.81 and in all items the item/total correlation was >0.2.

According to the Galofré scale, all the questions were acceptable. Only four questions had a *defect*: they had no clinical vignettes or problems in the opening statement and they explored information; these questions corresponded to the taxonomic level of memory. All the others were comprehension and application questions.

The level of question difficulty allows confirming that, for this group of responders; the test was generally between a medium and hard level of difficulty, since several questions of medium difficulty are at the limit of that category and approaching the hard category (Table 4).

The easy questions explored the purpose of a double-blind study (question 1) and the baseline levels of C-reactive protein association with cardiovascular events (question 6) and the very hard questions inquired about odds ratio (question 9) and absolute and relative risk (question 16).

Table 5 summarizes the results on the expertise of critical reading skills by absolute number of residents and percentage of the total study participants.

DISCUSSION

In this population of physicians, who are pursuing the career of Specialists in Cardiology at the School of Medicine of UBA and attending the Biannual Course that is taught at the Argentine Society of Cardiology, only 26% of professionals had an acceptable level of ability to interpret scientific publications.

Considering that 60% of correct answers are usually established as required level to pass the examinations, the level for approval would have been, in this case, at least 10 correct answers. Only 26% of the residents scored 10 and more correct answers, meaning that three-quarters of the group would not have "passed" if it had been a test with the usual requirement level of 60% of correct answers.

	RF %	p
Male	45	23-63
Female	43	19-61
Argentine public university graduate	43	21-59
Argentine private university graduate	47	24-64
Foreign university graduate.	36	12-49
With previous training in the subject	45	23-60
Without previous training in the subject	43	21-57
With complete medical clinical residency	43	21-62
Without complete medical clinical residency	41	19-58
1st year SAC Course students	43	19-61
2nd year SAC Course students	46	22-64

SAC: Argentine Society of Cardiology

Table 3. Percentage of correct answers according to residents' characteristics.

Level of difficulty	Percentage of correct answers	Number of questions in the survey that have that level of difficulty	Questions
Very easy	85 % and more	0	-
Easy	84-69 %	2	N° 1 and 6
Average difficulty	68-32 %	10	N° 2-3-4-7-8-10-12-13-14-15-
Difficult	31-16 %	3	N° 5-11-17-
Very difficult	15% and less	2	N° 9 -16

Table 4. Level of question difficulty according to percentage of correct answers.

Absolute number of residents	Percentage relative to group	Expertise level of critical reading ability	Number of correct answers
26	15%	None	0-4
99	58.3 %	Deficient	5-9
41	24.2%	Good, to improve	10-14
3	1.7%	Very good	15 and more

Table 5. Number of residents situated in the different levels of skill expertise.

The level of difficulty of the questions allows to confirm that the results obtained are showing the poor capacity of residents to interpret the statistical tests used in scientific publications and that the results obtained are not due to excessively difficult questions. Of special interest is the revision of questions 6 (easy) and 16 (very difficult) because both refer to the issue of absolute and relative risk. Question 6 describes a study of baseline levels of C reactive protein and cardiovascular disease in women and was answered correctly by 74% of the residents while question 16 that raised the benefit attributable to breastfeeding (absolute risk reduction) was only answered by 12.77%. They probably had information on levels of C reactive protein and cardiovascular disease but did not fully understand the concept of absolute and relative risk that in question 16 was presented in a non-cardiovascular context. It is noteworthy that residents who reported previous training in Statistics, Epidemiology, or Medicine evidence-based courses did not show better results than those who did not. This finding was also reported in a study of Hospital Italiano (2)

In a study carried out in Mexico City, using another evaluation instrument, (6) with 3,060 residents of five different specialties, it was seen that older residents (R4) did not answer better than younger ones (R1). In essence: more advanced career residents do not present better performances in critical reading. One might think that there are difficulties in teaching and learning this particular competence. Probably the teaching is predominantly theoretical and in practice the concepts of evidence-based medicine are not being used.

In 88% of cases, residents say that, as part of their training, they regularly participate in bibliographic meetings but, on the other hand, only 14% say they do weekly reading of scientific publications and 2% report that they never read scientific journals. What is the dynamics of the medical meetings? Why is it such an ineffective activity for critical reading training?

In this study, cardiology residents responded correctly, on average, 44% of the test. These results are similar to those of other studies. For example, in the study performed at Hospital Italiano de Buenos Aires (2), there was on average 45% of correct answers.

In the study conducted in Mexico City (6) an average of 50.23 ± 15.02 correct answers was found out of a possible maximum of 150. That is, the percentage of correct answers revolved around 30%. In all the studies that were accessed (6-10) it is concluded that the critical reading capacity of young professionals is deficient. Julio Frenk et al. (11) found that: *"Our analysis has demonstrated the scarcity of information and research about professional health education. While many educational institutions in all regions have launched innovative initiatives, there is little robust evidence regarding the effectiveness of such reforms."* Among the recommendations and reforms proposed by the Commission (11), the following is directly related to the subject of this work. *"Universities and*

similar institutions have to make the necessary adjustments to master the new forms of transformational learning made possible by the Information and Communication Technologies (ICT) revolution, going beyond the traditional task of transmitting information to the more demanding role of developing the skills to access, discriminate, analyze, and use knowledge. More than ever, these institutions have a duty to teach students how to think creatively to master large flows of information in the search for solutions."

CONCLUSIONS

It would be advisable to expand this type of studies -at the end of the career and resident level- to ascertain to what extent the medical career and resident training are offering opportunities for learning some of the skills established as essential for professional practice. Further research is needed to evaluate the effectiveness of some teaching and/or learning strategies in the training of specialists.

Conflicts of interest

None declared.

(See authors' conflicts of interest forms on the website/Supplementary material).

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ANNEX

The following questions are examples of the Questionnaire used.

Question 2. In a placebo-controlled study evaluating the use of aspirin and dipyridamole to prevent coronary restenosis following angioplasty, 38% of those receiving the treatment and 39% of the placebo group experienced restenosis. The results indicate that the value of p is >0.05 .

What does this value mean with respect to probability?

- That 5% of this result may repeat.
- That less than 5% of this difference occurs by chance.
- That more than 5% of this difference occurs by chance.
- That 95% of the study is correct.

- DIFFICULTY INDEX OF QUESTION 2=58.87%. Average difficulty

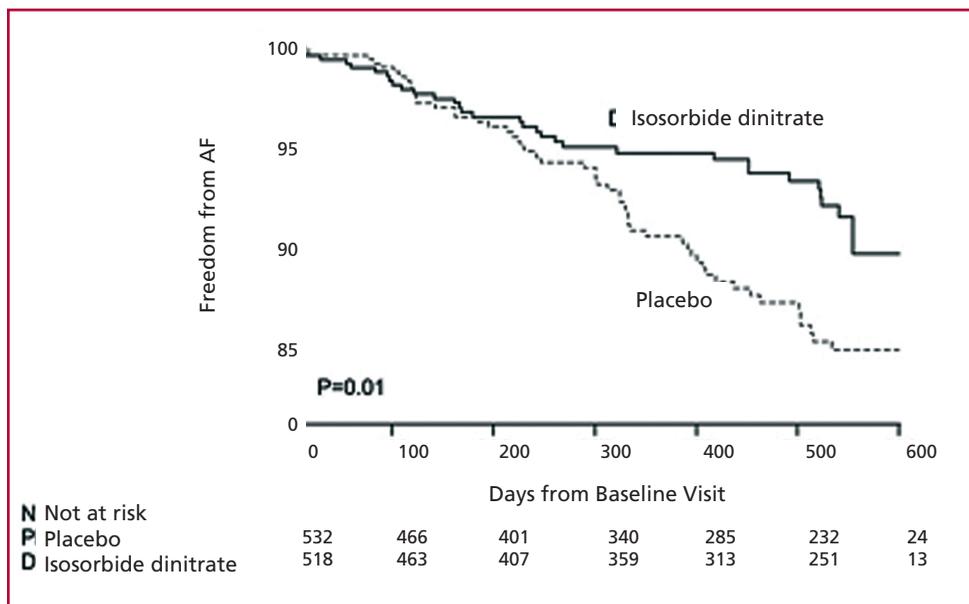
Question 13. A research wants to know the characteristics of births in a population.

What is the adequate measurement scale for the variable 'birth weight classified as low, medium and high'?

- Discrete.
- Continue.
- Ordinal.
- Nominal.

- DIFFICULTY INDEX OF QUESTION 13=48.01%. Average difficulty.

- A randomized study was conducted to determine whether nitrites (isosorbide) reduce overall mortality in coronary patients. a Kaplan-Meier analysis whose results are shown below was performed:



Question 11. Which of the following statements is correct about the overall risk of death?

- a) It is significantly lower in the treated group compared to placebo.
- b) It is significantly lower in the treated group compared to placebo if measured at the end of the study.
- c) It is significantly higher in the treated group compared to placebo at day 600.
- d) It is approximately the same in both groups.

• DIFFICULTY INDEX OF QUESTION 11 = 25.61%. Difficult question.

• The Women’s Health Initiative study analyzed the role of systemic inflammation in the prediction of cardiovascular disease in women. A prospective study with a very large sample size was carried out and, within many other determinations; baseline levels of C-reactive protein (CRP) were measured. The women were then followed for eight years and the occurrence of cardiovascular events -myocardial infarction, stroke- was evaluated. The following table shows the estimated relative risk for a cardiovascular event within five years by CRP quintiles for 30.000 women. The first quintile was used as reference category.

	PCR quintiles (mg/dl)				
	0,49	> 0.49-1.08	> 1.08-2.09	> 2.09-4.19	> 4.19
Relative risk	1.0	1.8	2.3	3.2	4.5
N° of women	6,000	6,000	6,000	6,000	6,000

Question 6. Based on the relative risk presented in the table above, what can be concluded?

- a) There is no risk of heart attack /stroke in the first quintile of CRP.
- b) Baseline CRP levels appear to be inversely associated with the risk of an acute vascular event.
- c) Baseline CRP levels appear to be directly associated with the risk of acute vascular event.
- d) There appears to be no association between CRP levels and heart attack/stroke.

• DIFFICULTY INDEX OF QUESTION 6 = 74.12%. Easy question.