

Clinical Reasoning Models Used By Medical Students and Physicians in a Public University in Mexico

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Abstract: Clinical reasoning (CR) is a central part of medicine where the knowledge, skills and techniques of the physician are solidified in practice. The epistemological bases of CR are those that support the way that the physician utilizes knowledge. Three models of CR have been identified: intuitive, empirical and theoretical; the efficiency and type of reasoning will depend on the model adopted. A survey was carried out in six populations with different educational degrees, from undergraduate students to postgraduate physicians. The results indicated that the theoretical model is the prevailing model with the highest level of affinity by the subjects in the study. It was also revealed that there are significant differences in theoretical and empirical models, but not in the intuitive model. Furthermore, it was identified that a negative correlation exists between the levels of education and the models of reasoning: physicians with more advanced degrees, which translated to more years of experience, have a lower affinity for the theoretical and empirical models.

Keywords: Clinical reasoning, reasoning models, intuitive model, empirical model, theoretical model.

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I. INTRODUCTION

CR is an important aspect of the profession that helps faculty solve medical problems, draw conclusions and consciously learn from the facts, establishing necessary causal and logical connections between them^[1]. CR is the foundation for a physician's decision-making; it has a vital impact, since the quality of life of patients is determined by a physician's diagnosis and treatment^[2-4].

CR combines medical and clinical knowledge, but it can also present an inherent problem in that it is never finished, but rather an act of continuous improvement. The job of the professional is to adopt an effective form of CR, while the teachers in the health sciences are responsible for transmitting, developing and refining that reasoning^[1], so any attempt to enrich it is valuable.

The epistemological basis of CR allows to recognize the nature of knowledge, involved in the process of obtaining the medical diagnosis. Two of the major problems of epistemology, namely, the possibility and origin of knowledge^[5] are present in CR. The first epistemological problem is clearly resolved, physicians consider that it is possible to know, otherwise, medical work would not make sense, since doctors assume that they can identify the disease that people suffer or, therefore less, it is possible^[6]. The second problem, corresponding to the origin of knowledge, questions whether this process arises out of reason, experience or intuition?

The possible answers to this question have been addressed in the models, specifically in the so-called Clinical Reasoning Models (CRM), which are commonly divided into the two groups of analytical and non-analytical models^[7,8], but there are elements which suggest the intuitive model^[9] is a third option.

The analytical CRM (also known as theoretical) carefully analyze the relationship between symptoms and signs, to obtain an objective diagnosis derived from some verifiability test^[2]. The characteristics of this model are that it uses hypothetical-deductive thinking and it is slow in arriving at the diagnosis, given the level of care and attention it requires and the series of systematic steps that must be taken. In addition, the analytical model must be based on scientific evidence^[10-16].

The non-analytical CRM (also called the empirical) refers to the model centered on the physician's experience as a source of knowledge and guidance for CR. It is characterized by the recognition of patterns obtained from the experience of practicing medicine. In addition, it is a fast and semi-automatic process, which may not require full consciousness, which puts it at a greater risk of error^[2]. This is the model of medical expertise which is usually associated with the most experienced, long-term doctors^[12-16], in whom repeated

exposure to diseases makes them recognize it more easily and quickly in other people^[17]. As for the intuitive CRM, it is identified as an irrational model^[8], which means that it does not depend on any cognitive process, but is based on intuition, that is, immediate, exact and complete knowledge^[18]. Normally, intuition “is attributed when it is said to know something without being aware of the reasons why it knows”^[19]; in other words, being able to solve the problem, but failing to understand why or how. The main characteristic of the model is that it relies on any methods, including speculation, which will help to arrive at a diagnosis in situations of uncertainty^[20]. In this context, the following research question arises: What model of CR are medical students and physicians more drawn to for solving problems in practice?

II. MATERIAL AND METHODS

TheAn observational, prospective, transverse and correlational study was performed, in which 180 people participated in six groups – three groups of students and three groups of physicians.

- a) Students in the 5th semester of a Medical Bioengineering degree (SMB)
- b) Students in the 4th semester of a Medical surgeon degree (SMS4)
- c) Students in the 8th semester of a Medical surgeon degree (SMS8)
- d) Interns with medical degrees who perform social service (MDS)
- e) Medical surgeons without graduate studies (MS)
- f) Medical surgeons with postgraduate studies (MSP)

The study used a 47-item questionnaire, which was divided in two sections and elaborated on with a 5-level Likert scale. The first section was an identification form and the second section pertained to the models of CR (17 items for the intuitive model, 12 for the empirical and 18 for the theoretical).

Using the following criteria, the questionnaire determined whether the students and physicians had high or low affinity for the different types of CRM:

- When using a Likert scale the results were added (i.e., the degree of affinity for each of the items were added to obtain a result).
- Each model had specific questions, so only those items of the same CRM were added.
- The highest possible score was used to establish the ranks. In this case, a score higher than half the highest possible score meant a high affinity level; otherwise, it was identified with a low affinity
- Before its application, the questionnaire was validated by a panel of experts and externally validated by a pilot test, obtaining a Cronbach alpha of 0.852^[21].

For the statistical analysis, a database was prepared in Spss, Version 23. Subsequently, the descriptive statistics were calculated. The statistical tests used were normality test, Man Whiney U and Spearman correlation. It should be noted that both the validation test and the application of the questionnaire to all study groups had the consent of the participants and was approved by the Ethics Committee of the University where the study was carried out.

III. RESULTS

A total of 180 participants were evaluated, in which a greater proportion of women (54.4%) were observed. The population was divided into six groups of 30 participants each. The years of clinical practice were considered in the years of experience variable, but the student groups were expected to have no experience. It is up to the MDS group in which he referred a year of experience. The range of experience for the MS group was 6.3 ± 5.02 years and for the MSP group was 15.50 ± 11.31 years, making it the group with the most years of experience. Table 1 presents the frequencies resulting from the research instrument (n = 180), on the high affinity level of each of the models.

Table 1. High affinity of groups, according to CRM

Group	N	Males (%)	Female (%)	years of experience	DE
SMB	30	50	50	0	0
SMS4	30	36.7	63.3	0	0
SMS8	30	33.3	66.7	0	0
MDS	30	46.7	53.3	1	0
MS	30	40	60	6.3	5.02
MSP	30	66.7	33.3	15.50	11.31
Total	180	45.6	54.4	3.80	7.57

Table 1 shows that all groups had a low affinity for the intuitive model, all groups had a high affinity for the theoretical model, and the empirical model showed a high affinity, except in the MS group.

Table 2. Normality tests by group

Model	Group	N	Shapiro-Wilk	Sig.
Intuitive	SMB	30	.972	.602
	SMS4	30	.981	.858
	SMS8	30	.957	.257
	MDS	30	.931	.052
	MS	30	.974	.645
	MSP	30	.983	.905
Empirical	SMB	30	.963	.363
	SMS4	30	.969	.522
	SMS8	30	.975	.670
	MDS	30	.979	.808
	MS	30	.961	.338
	MSP	30	.942	.105
Theoretical	SMB	30	.973	.612
	SMS4	30	.957	.258
	SMS8	30	.940	.089
	MDS	30	.939	.085
	MS	30	.955	.236
	MSP	30	.966	.444

Table 2 presents the results of the normality test in the study groups. In order to analyze the observed distribution between the models for each study group, normality in the distribution of the data was determined by the Shapiro-Wilk test. The results confirm the absence of significant differences ($p < 0.05$), so that the distributions of all groups are adjusted to a normal distribution, considering a statistical significance of 5%, in all cases (i.e., all groups have a normal distribution).

Table 3. Comparison between groups according to CRM

Groups		Intuitivemodel	Empirical model	Theoretical model
SMB-SMS4	U test	377.500	434.000	315.500
	P-value	0.541	0.003*	0.002*
SMB-SMS8	U test	350.500	306.000	346.500
	P-value	0.141	0.033*	0.125
SMB-MDS	U test	442.000	426.500	289.500
	P-value	0.906	0.727	0.017*
SMB-MS	U test	387.000	223.500	344.500
	P-value	0.351	0.001*	0.118
SMB-MSP	U test	364.500	391.000	349.000
	P-value	0.206	0.381	0.135
SMS4-SMS8	U test	430.000	318.000	247.500
	P-value	0.767	0.050	0.003*
SMS4-MDS	U test	372.000	443.500	215.500
	P-value	0.248	0.923	0.001*
SMS4-MS	U test	446.500	230.000	231.000
	P-value	0.959	0.001*	0.001*
SMS4-MSP	U test	431.000	403.000	261.500
	P-value	0.779	0.486	0.005*
SMS8-MDS	U test	349.500	339.000	374.000
	P-value	0.137	0.100	0.260
SMS8-MS	U test	426.500	329.500	430.000
	P-value	0.728	0.074	0.767
SMS8-MSP	U test	445.000	374.500	414.000
	P-value	0.941	0.263	0.594
MDS-MS	U test	385.000	254.000	417.500
	P-value	0.336	.004*	0.630
MDS-MSP	U test	367.000	416.500	418.000
	P-value	0.219	.619	0.636
MS-MSP	U test	439.500	289.000	445.000
	P-value	0.877	.017*	0.941

In Table 3, when analyzing the observed differences between the study groups, in relation to the intuitive model and using the Mann-Whitney U test, no statistically significant differences were found in any of the study groups.

In the same table, when observing the results of the Mann-Whitney U test, with a significance level of 0.5 ($p < 0.05$), between the study groups, in relation to the empirical model, we found statistically significant differences when comparing the following groups: SMB and SMS4; SMB and SMS8; SMB and MS; SMS4 and MS; MDS and MS; MS and MSP.

Finally, in the same table, the results show statistically significant differences with respect to the theoretical model, using the Mann-Whitney U test, with a significance level of 0.5 ($p < 0.05$) when comparing the following groups: SMB and SMS4; SMB and MDS; SMS4 and SMS8; SMS4 and MDS; SMS4 and MS; SMS4 and MSP.

Table 4. Correlation between the degrees of education and CRM

	R	P-value	N
Intuitive model	-0.059	0.434	180
Empirical model	-0.161	0.030*	180
Theoretical model	-0.231	0.002*	180

Subsequently, the Spearman statistical test was performed to identify the correlation between the education levels and the CRM. The test was established with a level of significance of 5%, showing association in the empirical and theoretical models. The relationship between variables was a negative correlation ($r = -0.161$, $r = -0.231$ respectively); although it was discrete, they present a statistically significant association in both cases. Therefore, for this population, the higher the medical degree, the lower the affinity for the empirical and theoretical models.

Table 5. Correlation between years of experience and CRM

	R	P-value	N
Intuitive model	-0.006	.932	180
Empirical model	-0.140	.06	180
Theoretical model	-0.220	.003*	180

Spearman's statistical test was used to evaluate the association between the *years of experience* variable and the CRM. All of the models showed a negative correlation, the theoretical model being the only one that presented a statistically significant value (p value < 0.05), which means that, for this population, increasing the years of clinical experience will lower the score for the theoretical model.

Table 10. Correlation between sex and CRM

	R	P-value	N
Intuitive model	.073	.332	180
Empirical model	-.037	.622	180
Theoretical model	-.052	.485	180

A correlation test was applied to check whether sex was linked to any of the CRM categories preferred by the subjects. The results showed that there is no relationship between these variables, assigning the level of significance to 5%.

IV. DISCUSSION

To The response frequency showed that the population had the highest affinity for the theoretical model, followed by the empirical and, lastly, with a clear margin of difference, the intuitive model. The affinity for the theoretical model is higher among the students in the SMB, SMS4 and SMS8 groups. This can be explained by a lesser degree of clinical contact and a reliance on clinical methods extracted from the literature (i.e., algorithmic, punctual and artificial). Given that the students had no other elements than those extracted from the literature, it was important to know the specific objectives of their education, as well as the skills that were focused on during the students' development, in order to compare them with the other physicians in the research population.

The proficiency profile of the Mexican general practitioner establishes seven generic competencies to be developed in the medical student; of these seven, only some are specifically related to the efficiency of CR, such as the complex thinking and systemic competency, where it is sought the inclusion of multi-causality and

dynamic systems, establishing that the physician must be prepared to face the uncertainty of non-linear problems. The profile also considers the capacity of the “clinical method and medical decision-making”, in which it seeks to strengthen the ability to use decision analysis in times of uncertainty, as well as the use of systematic methods to identify particular diseases based on the best available evidence, limitations of knowledge and resources, analysis and calculation of individual risks^[22]. Therefore, these competencies (dealing with the role of knowledge in medical training) follow the theoretical model, demonstrating that the educational system favours this model.

In addition, the study by Pam Hruska, et al. shows that there is greater intensity in certain areas of the brain when engaged in CR, and these areas can differ between medical students and specialists. Specifically, there is greater prefrontal activity in novices when performing CR, in comparison to experts who have more activity in the inferior temporal gyro^[23]. This demonstrates that students differ from experts by not using (at the same level) the brain structures that deal with experience during CR. Their ways of thinking remain attached to the theoretical model, and the results show that the theoretical model is preferred by the health professional.

Interestingly, from the MDS group who highly favor the empirical model, the levels of affinity decrease by a factor of at least 10 percent starting with the clinical experience that is not present in the students. In this academic stage, the construction of patterns begins to form more easily, reinforced by the continuous clinical experience to which they are exposed, even arriving at decisions automatically (without reflection) as an unconscious operation^[24]. On the other hand, the qualified physicians and specialists have very different opinions about the empirical model, perhaps due to the years of experience variable of the MS group, with respect to the MSP.

As for the intuitive model, no group had a high affinity level for it, but it is striking that the SMB group had the same score as the MSP group, these being the groups with the highest scores. The SMS8 had the lowest score by not having any participant who favored the intuitive model. The low level of affinity for this model is explained by the fact that education is oriented to the theoretical model; being contradictory to this, it is understandable that any preference for the intuitive model is low.

In addition to being the only model that did not present statistically significant differences between the groups, so the differences between them were attributed to chance. An argument supporting clinical knowledge based on intuition may be risky and questioned in practice, especially since it differs from the scientific model that supports evidence-based medicine. Several authors do recognize intuition as a source of knowledge, with a very characteristic and undeniable importance^[25], which can be defined as “tacit knowledge”^[26]. Also, the perfect expression and greatest scales of clinical expertise, based on the Dreyfus model, namely that of expert and master, relies on intuition as its essential characteristic^[27]. Mario Bunge recognizes its importance, despite criticism, defining it as a hurried conjecture that, on some occasions, allows a novel way of solving a problem^[18].

The association test verified whether variables, such as education, years of experience or sex, altered the affinity to one of the models of CR. The results showed that levels of education are related to the empirical and theoretical models with a negative association (i.e., a higher degree results in less affinity to these models). The results for the correlation between experience and the CRM also present a negative association to the theoretical model, the only one with statistical significance (i.e., the more years of experience results in a lower affinity to the theoretical model). This falls in line with the previous result, however, it seems to contradict common sense, in that a longer career in medicine would provide greater value to the experience variable. A possible explanation for this contradiction is the flexibility that experts exercise to arrive at a diagnosis. The most experienced physicians are those who are more open to change, are more apt to bend the systematic methods and are more likely to use creativity, all which could arrive at conclusions that are contrary to what one would think. They are often in search of innovation, because it overcomes the limitations of clinical positivism^[28].

V. CONCLUSION

The model most accepted by physicians and students is the theoretical one, because it shares the epistemological characteristics with the predominant standard that medicine is based on scientific evidence. The empirical model tends to have a high affinity, although considerably less than the theoretical model. There is a negative association between education levels and the empirical and theoretical CRM: the higher the degree, the less affinity for the models. Likewise, there is a negative association between the empirical and theoretical CRM and the years of experience: the more years of experience the health professional has, the less affinity for the models. On the other hand, the intuitive model is favored much less and poses a problem for clinical knowledge because it is contradictory to current medical principles; however, it should not be forgotten or excluded, as it will continue to be an alternative method to guide diagnoses.

REFERENCES

- [1]. Villarroel Salinas JC., Ribeiro Dos Santos Q., Bernal Hinojosa N., Razonamiento Clínico: Su Déficit Actual y la importancia del aprendizaje de un Método durante la formación de la Competencia Clínica del Futuro Médico, *Revista Científica Ciencia Médica*. 17, 2014, 29-36.
- [2]. Viesca Treviño C., Ponce de León M., Sánchez Mendiola M., (2005), *Razonamiento clínico*, Lecture, UNAM, DF..
- [3]. Verneaux R., Medrano L., *Epistemología general o Crítica del conocimiento* (Barcelona: Herder, 2005).
- [4]. Garduño J., Viniegra Velázquez, L., Tendencias filosóficas sobre el quehacer científico en los egresados de los programas de maestría y doctorado de la Facultad de Medicina de la UNAM. *Ciencia*, 40(2), 1989,119-130.
- [5]. Eva KW., What every teacher needs to know about clinical reasoning, *Medical Education*,39(1), 2005, 98-106.
- [6]. Croskerry P, Clinical cognition and diagnostic error: applications of a dual process model of reasoning. *Advances in Health Sciences Education*,14(S1),2009, 27-35.
- [7]. Bolton J., Varieties of clinical reasoning. *Journal of Evaluation in Clinical Practice*, 21(3), 2015, 486-489.
- [8]. Victor-Chmil J., Critical thinking versus clinical reasoning versus clinical judgment: differential diagnosis. *Nurse educator*,38(1), 2013, 34-6.
- [9]. Seidel B., Campbell S., Bell E., Evidence in clinical reasoning: a computational linguistics analysis of 789,712 medical case summaries 1983-2012, *BMC Medical Informatics and Decision Making*, 15(1),2015, 19.
- [10]. Doval HC., ¿Qué es la destreza médica? Cómo entendemos, ejercemos y enseñamos el razonamiento clínico, *Revista argentina de cardiología*,79, 2011, 92-102.
- [11]. Taro S., and Yasuharu T., Real-world medical diagnosis: Intuitive process revisited (review), *International Journal of Medicine and Medical Sciences*, 4(9), 2012, 177-179.
- [12]. Pelaccia T., Tardif J., Tribby E., Charlin B., An analysis of clinical reasoning through a recent and comprehensive approach: the dual-process theory, *Medical education online*,16(1), 2011, 5890.
- [13]. Norman G., Brooks L., The Non-Analytical Basis of Clinical Reasoning, *Adv Health Sci Educ Theory Pract*,2(2),1997, 173-84.
- [14]. Dhaliwal G., Developing teachers of clinical reasoning, *The Clinical Teacher*,10(5), 2013, 313-7.
- [15]. Woolley A., Kostopoulou O., Clinical Intuition in Family Medicine: More Than First Impressions, *The Annals of Family Medicine*,11(1), 2013, 60-6.
- [16]. Bunge M., *Intuición y razón* (Buenos Aires, Debolsillo, 2005).
- [17]. Martínez Riu A., Cortés Morató J., *Diccionario de filosofía en CD-Rom* (Barcelona, Herder, 1996).
- [18]. Schwab AP., The Limits of Intuition in Medicine: A Review of Hillel Braude's Intuition in Medicine: A Philosophical Defense of Clinical Reasoning, *The American Journal of Bioethics*,14(6), 2014, 54-5.
- [19]. Gormaz Barbavid C., Brailovsky C., Desarrollo del Razonamiento Clínico en Medicina, *Revista de Docencia Universitaria*, 2012,177-199.
- [20]. Martínez Méndez C., García Rillo A., García Alvarado J., Vargas Muñoz J., Construcción de cuestionario sobre los modelos de razonamiento clínico, *Academia Journals* 2017,12, 2017, 1841-45.
- [21]. Abreu L., Cid A., Herrera G., Lara J., Laviada R., Rodríguez C., et al. Perfil por competencias del médico general mexicano(México, AMFEM, 2008).
- [22]. Hruska P., Krigolson O., Coderre S., McLaughlin K., Cortese F., Doig C., et al. Working memory, reasoning, and expertise in medicine—insights into their relationship using functional neuroimaging, *Advances in Health Sciences Education*,21(5), 2015, 935-952.
- [23]. Peña A., Paco O., Peralta C., Epistemological Beliefs and Knowledge among Physicians: A Questionnaire Survey, *Medical Education Online*, 7(1), 2002, 4534.
- [24]. Kahneman D., Klein G., Conditions for intuitive expertise: A failure to disagree, *American Psychologist*,64(6), 2009, 515-526.
- [25]. Braude H., Clinical intuition versus statistics: different modes of tacit knowledge in clinical epidemiology and evidence-based medicine, *Theoretical Medicine and Bioethics*,30(3),2009,181-198.
- [26]. Carraccio C., Benson B., Nixon L., Derstine P. From the Educational Bench to the Clinical Bedside: Translating the Dreyfus Developmental Model to the Learning of Clinical Skills, *Academic Medicine*,83(8), 2008,761-767.
- [27]. Novoa Jurado A., Molina Durán F., Luna Maldonado A, Reconstrucción del pensamiento médico: fundamentos del pragmatismo clínico, *Medicina Clínica*,123(9), 2004,345-347.

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