

# Use of Heuristics during the clinical decision process in Primary Care physicians in real conditions.

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## Abstract

**Rationale, aims and objectives:** The available evidence on the existence and consequences of the use of heuristics in the clinical decision process is very scarce. The purpose of this study is to measure the use of the Representativeness, Availability and Overconfidence heuristics in real conditions with Primary Care physicians in cases of dyspnea and to study the possible correlation with diagnostic error. **Methods:** A prospective cohort study was carried out in 4 Primary Care centers in which 371 new cases of dyspnea were registered. The use of the three heuristics in the diagnostic process is measured through an operational definition of the same. Subsequently, the statistical correlation with the identified clinical errors is analyzed. **Results:** In 9.97% of the registered cases a diagnostic error was identified. In 49.59% of the cases, the physicians used the representativeness heuristic in the diagnostic decision process. The availability heuristic was used by 82.38% of the doctors and finally, in more than 50% of the cases the doctors showed excess confidence. None of the heuristics showed a statistically significant correlation with diagnostic error. **Conclusion:** The three heuristics have been used as mental shortcuts by Primary Care physicians in the clinical decision process in cases of dyspnea, but their influence on the diagnostic error is not significant. New studies based on the proposed methodology will allow confirming both its importance and its association with diagnostic error.

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## ABSTRACT AND KEYWORDS

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**Methods:** A prospective cohort study was carried out in 4 Primary Care centres in which 371 new cases of dyspnoea were registered. The use of the three heuristics in the diagnostic process is measured through an operational definition of the aforementioned. Subsequently, the statistical correlation with the identified clinical errors is analysed.

**Results:** In 9.97% of the registered cases a diagnostic error was identified. In 49.59% of the cases, the physicians used the representativeness heuristic in the diagnostic decision process. The availability heuristic was used by 82.38% of the doctors and finally, in more than 50% of the cases, the doctors showed excess confidence. None of the heuristics showed a statistically significant correlation with diagnostic error.

**Conclusion :** The three heuristics have been used as mental shortcuts by Primary Care physicians in the clinical decision process in cases of dyspnoea, but their influence on the diagnostic error is not significant. New studies based on the proposed methodology will enable the confirmation of both its importance and its association with diagnostic error.

**KEYWORDS :** heuristics; medical decision making; primary care; diagnostic error; cognitive process; general practice.

## MAIN TEXT

### INTRODUCTION

In contrast to what happens in other health disciplines, the clinical decision-making process in Primary Care (PA) is subject to highly uncertain environments.<sup>1</sup> In the latter, the initial phases of clinical processes predominate, the symptoms and signs are poorly defined, and it is often not possible to identify a specific diagnosis or to assign a code.<sup>2</sup>

For a time, it was assumed that the clinical decision process could be like a decision tree of probabilities that are adjusted until an optimal decision is made. However, the clinical decision is limited by at least three aspects: the available information, the cognitive limitation of the individual mind, and the time available to make the decision.<sup>3</sup> The constant uncertainty, the absence of sufficient information or the poorly defined nature of the dealt problems, and the reduced time of consultation in PA, favours the use of different instruments (not always rational), which can be used both consciously and unconsciously.<sup>4</sup>

Among them, it is worth mentioning the important role played by certain practical rules or heuristics, which are very efficient in saving time and cognitive effort, enabling greater speed in the clinical decision-making process. Judgment under uncertainty is often based on a limited number of heuristics, whether correct or incorrect, where there is no absolute certainty about their effect.<sup>5</sup>

The literature indicates large discrepancies regarding the use of heuristics in decision making, from those who consider it an adequate resource <sup>6,7</sup>, to those who value it as a determinant of large predictable errors or systematic biases. <sup>8</sup>

In the clinical field, making a mistake, either by excess or by default, increases the risk of harmful effects, in addition to the costs involved in making a diagnostic error. This is defined as that which is incorrect, not done at the right time, or simply ignored.<sup>9</sup> More recently, it has been proposed that overdiagnosis (the diagnosis of conditions that really exist but will not produce relevant effects on the subject throughout his or her life) should also be included within the error diagnosis.

The literature has identified more than 100 deferential heuristics.<sup>10</sup> Some of them present potential effects in clinical practice, such as the heuristic of Representativeness, Availability and Overconfidence.

The representativeness heuristic refers to the "degree of correspondence that exists between a sample and a population".<sup>11</sup> The availability heuristic establishes the frequency of an event by the ease with which it is retrieved by the mind.<sup>12</sup> The use of the Overconfidence heuristic involves placing opinion above existing evidence.<sup>8</sup>

In a recent study of 100 cases of diagnostic errors, the error was classified as "no-fault," "system-related," or "cognitive. More recently, a quasi-systematic review of the use of heuristics in physicians shows how representativeness, availability, and overconfidence are some of the most used heuristics in clinical practice.<sup>13</sup> Nevertheless, they find no answer to whether their use produces systematic errors, therefore they advocate evaluating this use in real-time clinical practice.

A panoramic review assessed the use of these three heuristics in the clinical decision process in Primary Care.<sup>14</sup> With 49 selected studies, little empirical evidence was observed in the study of the use of these heuristics in real clinical conditions, with almost all the studies being simulated or hypothetical in laboratory conditions, mostly with medical students. This scarcity is even greater in PA (where only 6 of the 49 studies were conducted).

All of them were based on questionnaires,<sup>15</sup> or interviews,<sup>16</sup> and in some cases, video viewing,<sup>17</sup> or vignettes referring to the analysis of patient complaints or the study of the clinical registry in residents.<sup>18</sup> Therefore, current empirical evidence is insufficient to determine the use of these heuristic rules in the clinical decision process, and even more so to determine whether the bias derived from them is a relevant factor in Diagnostic error.<sup>19</sup>

A previous article proposed an operational definition of the use of Representativeness and Availability heuristics in the PA clinical decision-making process, which is described below. Nonetheless, at present there are still multiple unknowns regarding the role that heuristic rules and intuition play in clinical decision-making and diagnostic error. The objectives of this study are, on the one hand, to measure the use of Representative, Availability and Overconfidence heuristics in the decision-making process of primary care physicians in cases of dyspnoea, and on the other hand, to study the possible correlation between this type of heuristics and diagnostic error.

## METHODS

**Scope of study :** 4 PA centres were selected in the Province of Granada and 6 centres in Madrid. A total of 371 cases were registered, with 23 participating physicians, 11 women and 12 men. The average age was 49 years and the average PA experience was 22 years.

**Study design:** Applying the methodology proposed in the protocol, a prospective cohort study of new episodes of dyspnoea identified by the attending physician was designed.<sup>20</sup> This methodology was the result of the adaptation of the study protocol to patients with dyspnoea treated in Dutch hospitals by Zwaan et al.<sup>21</sup> It was considered that dyspnoea was a relevant reason for consultation in the PA care process given its prevalence and the possibility of being caused by a wide range of diagnostic possibilities. Cohort follow-up time ranged from the first visit for a new case of dyspnoea, to the moment of the confirmation diagnosis.

For each patient who came in with a new episode of dyspnoea, the doctor filled out two questionnaires using a Tablet with Internet access. The questionnaire accessible through the Wufoo application, (<https://www.wufoo.com/>) was located on the desktop of the electronic device given to the participating doctors to facilitate its completion. It contained all the data on the patient and the diagnostic process.

### Operational definition of heuristics:

For the operational definition of the Representativeness and Availability heuristics, the study protocol published by some of the authors was used, which analyses the cognitive aspects of the diagnostic process of dyspnoea by primary care physicians,<sup>20</sup> and whose definition is described below: (Fig.1)

*Representativeness* : the final diagnosis of the dyspnoea picture coincides with the first diagnostic impression made by the physician when identifying a new episode of dyspnoea, prior to performing the anamnesis, physical examination or request for diagnostic tests ("this patient is representative of..."). It would be part of what has been called "gut feeling",<sup>22</sup> hunch or "first diagnostic impression",<sup>23</sup> identifying the degree of similarity of the sample (the new case) with the population (the set of cases of that specific diagnosis).

A representative heuristic is identified when the first diagnostic impression (FDI) does or does not coincide with the Final or Confirmatory Diagnosis (CD). This definition is consistent with that established by Klayman<sup>24</sup> and allows the heuristic to be quantified in real clinical decision contexts.

*Availability* : inclusion of the final diagnosis of the case of dyspnoea among the list of three possible diagnoses (in order of priority) included in the question of Differential Diagnosis in the case of dyspnoea after anamnesis and physical examination. It would identify the diagnostic options that are most quickly rescued from memory.<sup>25</sup> Therefore, there is an availability heuristic when the final or confirmation diagnosis (CD) is included among the three hypotheses of differential diagnosis (DD).

*Overconfidence*: The doctors were expressly asked what level of confidence (between 0 and 100%) they had in their diagnostic proposal (the "diagnostic judgment" proposed after performing the anamnesis and physical examination on the first visit facing a new case of dyspnoea). The possible presence of overconfidence in the diagnosis was estimated, if the confidence in the diagnosis was greater than 75% (data that represents the average presence of overconfidence in the subjects of the study).

*Diagnostic error*:

The identification of the diagnostic process as correct was made through a peer review by a group of PA physicians with more than 20 years of clinical experience, using as a reference the methodology audit proposed by Zwaan.<sup>21</sup>

In the audit carried out by peers, it was assessed whether the appropriate tests were requested, whether they were interpreted correctly, whether the diagnostic process was correct, and whether the final diagnosis was correct.

### Measurement tools:

A bivariate analysis was carried out to analyse the possible existence of differences in the diagnostic error variables, according to each of the approaches to the selected heuristics through a matrix of correlations of categorical data, together with the statistical Chi-square and Fisher tests, for the study of significance and prevalence.

## RESULTS

*Diagnostic Errors* : After the peer audit, 33 diagnostic errors were identified in the 371 recorded cases (9.97%).

*Use of heuristics*: First, with respect to representativeness, the first diagnostic impression (FDI) coincides with the confirmation diagnosis (CD) in 183 of the cases (49.59%); in the other half of the cases there is no such agreement. This result means that in almost half of the cases the doctors use the representativeness heuristic in the diagnostic decision process.

In the case of availability, the final or confirmation diagnosis coincides with one of the differential diagnoses in 304 of the registered cases, which represents 82.38%. In most cases, the physician determined as a final diagnosis one of the three that appeared most quickly in his mind (DD), being this concordance a sample of the use of the availability heuristic.

Finally, in the overconfidence, in 54 of the cases (14.52%) the doctors felt with a confidence in their diagnostic judgment below 50%. In 103 cases (27.69%) the confidence was between 50 and 70%. Finally, in 214 cases (57.80%) the doctors showed an above-average confidence in their diagnostic judgment (more than 75.17%). This result shows that in more than half of the cases the doctors showed above-average confidence. (Fig.2)

### *Correlation of heuristics with diagnostic error:*

**Representativeness:** of the 33 errors detected, 17 of them showed a concordance between the FDI and the CD. In a little more than half of the diagnostic errors (51.5%) a possible use of the Representativeness heuristic could be identified. However, the statistics calculated do not show a statistically significant correlation between both variables

**Availability:** in 25 of the 33 diagnostic errors there is a concordance between the confirmation diagnosis and one of the differential diagnoses (DD). This represents 75.8%. However, statistical tests show no statistically significant correlation between this agreement and diagnostic error, even though, with an odds ratio of 1.73, the prevalence indicates a high probability of diagnostic error when DD=CD,

**Overconfidence:** In 22 of the 33 diagnostic errors they (66.7%) showed above-average confidence in the diagnosis. In terms of prevalence, with an Odds Ratio of 1.44 we obtain that the frequency of making diagnostic errors by our doctors is 44% more frequent when they show an excess of confidence. However, as in the case of the previous heuristics, the correlation is not statistically significant.

## **DISCUSSION**

Demonstrating the use of a given heuristic in actual clinical practice is complex, among other reasons because of the absence of a standard operating definition accepted by the literature.

This research represents a step forward in the study of the clinical decision-making process and the use of heuristics in primary care, under real conditions outside the laboratory. The results advance on previous research in several relevant aspects. First, operational definitions of representativeness, availability and overconfidence bias are proposed that can be used in further research on the clinical decision process to confirm or disprove our results. Secondly, the use of heuristic processes is probably more frequent in the diagnosis of primary care physicians. In almost half of the treated cases, the final confirmation diagnosis coincided with the first diagnostic impression (PID), before any clinical intervention was performed, in other words, what was already detected by the patient's eyes, without any intervention ("gut feeling"). Likewise, in more than 80% of the cases, the final diagnosis coincided with one of the three initial diagnostic hypotheses. Finally, in more than 50% of the cases, the doctors presented above-average levels of confidence in their diagnostic judgment.

The results suggest a wide use of heuristics, that is, the use of procedures that could be considered intuitive or, in terms of Stanovich and West,<sup>26</sup> mediated by system 1.

The third contribution of this research is the lack of correlation between the use of heuristics and clinical error, which questions the classic approach of authors such as Kahneman<sup>25</sup> and Croskerry<sup>10</sup> that the systematic use of heuristics or mental shortcuts involves a high risk of error. In proportional terms, many of the diagnostic errors were committed when the physician could have used one of the heuristics analysed, yet in other cases this was not so. This issue has already been defended by authors such as Gigerenzer and Graissmaier,<sup>27</sup> who maintain that heuristics can be a useful and relatively effective way of solving this problem. Some authors even add that heuristics can provide a richer and broader knowledge base for making intuitive judgments and decisions.<sup>28</sup>

In any case, given the absence of previous studies in real conditions and the difficulty of defining and studying an activity that affects the "black box" of human behaviour, this study proposes and contrasts the use of three heuristics in the clinical decision process of primary care physicians and their possible correlation with diagnostic error.

The study has several limitations. First, the limited size of the sample does not allow a generalization of the results obtained. However, the methodology developed that includes the heuristic measurement systems can be reproduced in subsequent studies with larger populations. In second place, the lack of previous studies in real clinical conditions makes it difficult to compare results, but equally this approach supposes clear

methodological advantages over the limited existing literature based on surveys or laboratory experiments that hardly capture the complexity of the real context of clinical decision.

This research initiates a novel methodological approach to the study of the use of heuristics in the clinical decision process in primary care and its relationship with diagnostic error. The results clearly confirm the use by physicians of heuristics of representativeness, availability, and overconfidence, but these mental and intuitive shortcuts to establish a diagnosis do not seem to lead to an increase in diagnostic errors. Further research should confirm or not these results given their relevance for physicians and patients.

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3. **Data Availability Statement:** The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.
4. **Conflict of Interest:** The authors declare that no conflict of interest exists.
5. **Tables**
6. **Figures**

Figure 1. Diagnostic process diagram

Figure 2. Presence of the use of heuristics



