

On Medical Uncertainty and Coping Strategies during Resident Education

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Abstract

Medical residents experience distinct levels of uncertainty in clinical practice, whereby they develop diverse coping strategies with the goal of dealing effectively with ordinary and extraordinary situations. Taken from a previous mixed method study, 36 hypothetical uncertainty situations were presented to residents in a survey and the data was examined to analyze the interaction between 8 types of uncertainty, 11 possible strategies to solve the situation. We explore some of the contextual variables that influence the residents to use one strategy or another depending on the type of uncertainty. Latent class (LC) regression models were used for each type of uncertainty to classify 2,414 students into groups according to the strategy used to handle the uncertainty, as well as independent variables that could have affected belonging to a specific group. Statistically significant contextual elements for resident decision-making: years into the residency, hospital level, and area of specialty. In the LC analysis, up to four classes were identified; two of them were consistent for all types of uncertainty, the other two classes varied depending on the type of uncertainty. Recognition of contextual elements on the uncertainty situations that affect resident decision-making may help plan actions to improve medical practice.

Keywords: Latent Class Analysis, Uncertainty, Postgraduate medical education, decision-making

1. Introduction

Medical residents experience distinct levels of uncertainty and stress in clinical practice, whereby they develop diverse coping strategies to deal with ordinary and extraordinary situations. Decision-making is mediated by the type of uncertainty as well as the material and organizational factors present in the clinical environment (Hamui-Sutton, Vives-Varela, Gutiérrez-Barreto, Leenen, & Sánchez-Mendiola, 2015). When the sources of uncertainty in medicine can be identified (Luther & Crandall, 2011) and strategies to deal with it recognized, methods for its appropriate management can be designed and taught. This in turn can increase the quality of medical care and professional development in several aspects.

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In the area of communication and ethics, the management of uncertainty enables clearer, more honest and empathetic interpersonal relationships; in the area of emotions it can contribute to decrease the fear and anxiety of committing errors, as well as to increase tolerance to ambiguity (Han, Schupack, Daggett, Holt, & Strout, 2015). Reflecting and dealing with uncertainty also influence the efficient integration of theoretical and procedural knowledge in day-to-day practice, the healthcare team interactions, and the rational use of resources decreasing the propensity to order excessive diagnostic tests. From this viewpoint, the study of uncertainty refers not only to clinical reasoning, but also to the context where residents develop and thrive (Farnan, Johnson, Meltzer, Humphrey, & Arora, 2008; Hamui-Sutton et al., 2015).

In the field of medicine, the study of uncertainty goes back to the late seventies, when Light described five areas in which students experienced uncertainty related to clinical reasoning (Light, 1979). Twelve years later, Beresford identified three types of uncertainty, based on qualitative studies that analyzed data from physicians in hospital contexts: technical, conceptual, and personal. In another qualitative study with medical residents (Beresford, 1991), Farnan reconsidered Beresford's conceptual dimensions, and proposed an extension to six categories: in technical uncertainty, they included procedural skills and knowledge of medical therapeutic orders; in conceptual uncertainty, they grouped the moments of clinical care transitions (e.g. transfer among clinical services, handoffs after on-call duty, when discharging a patient), diagnostic decision-making, and conflict resolution; and in personal uncertainty, they focused on the goals of care (Farnan et al., 2008). This research study underscores the importance of context and the functionality of resident's hospital and academic hierarchies and offers a framework that describes their trajectory when coping with uncertainty in their actions as well as in their decision-making.

In the nineties, several efforts were made to measure (in) tolerance to uncertainty in medical under- and postgraduate students. A variety of instruments were developed to explore personal attitudes in response to uncertainty, through hypothetical statements and using a Likert-type response format. Authors who developed or applied items to measure attitudes towards intolerance to uncertainty include Gerrity, Geller, DeForge & Sobal, Merrill, and Allison (Allison et al., 1995; DeForge & Sobal, 1989; Geller, Faden, & Levine, 1990; Martha S. Gerrity, White, DeVellis, & Dittus, 1995; M S Gerrity, DeVellis, & Earp, 1990; MERRILL et al., 1994). In the new millennium, interest to explore the phenomenon of uncertainty in medical practice has continued; in particular, Greco & Roger, Carleton, Weissenstein, and Hancock have developed new tools to measure attitudes towards intolerance to uncertainty (Carleton, Norton, & Asmundson, 2007; Greco & Roger, 2001; Hancock, Roberts, Monrouxe, & Mattick, 2014; Weissenstein, Ligges, Brouwer, Marschall, & Friederichs, 2014).

Another group of studies have focused on uncertainty during decision-making associated to specific diseases: Pearson explored attitudes towards risk and actions related to triage of chest pain in the emergency room (Pearson et al., 1995); a study by McKibbin associated the perception of risk in primary care physicians with the use of electronic information resources (McKibbin, Fridsma, & Crowley, 2007) and an article by Hamilton studies the sources of uncertainty in the diagnosis and therapy of Fanconi anemia (Hamilton et al., 2013); Han also performed a study about aversion to ambiguity in medical tests and treatments related to cancer screening (Han et al., 2014).

In 2011, Han published a theoretical conceptual paper to define a taxonomic structure of uncertainty in medical care that considers three elements: the source of uncertainty, the issue that generates uncertainty (scientific or practical), and the locus of uncertainty (physician or patient) (Han K. J. Paul, Klein M.P. William, 2011). Regarding the source of uncertainty, they distinguish three types: uncertainty as the probability of making the right decision, probability of "success;" uncertainty as ambiguity that can be translated as lack of reliability, credibility or precision of information; and uncertainty as the complexity related to the difficulty to understand the phenomenon itself because of all the factors involved. Using this model, Han analyzed the changes in tolerance to uncertainty in a cohort of 26 undergraduate students through measurements in the first and fourth year of the program (Han et al., 2015) in a longitudinal study. The instrument measured the three types of uncertainty sources: probability or risk, ambiguity and complexity, each with a different scale. They found that the uncertainty of probability and complexity did not change over time, while the ambiguity did decrease between the first and the fourth year. The relevance of this study relates to the distinction of subtypes that allowed a better understanding of the influence of uncertainty in clinical practice and its changes over time. After reviewing the previous studies, two tendencies to study uncertainty in clinical practice can be identified: one based on qualitative research (Beresford, 1991; Farnan et al., 2008; Hamui-Sutton et al., 2015) that explores the experiences of physicians and residents in their daily activities taking context into account, and

Another that is oriented to the measurement of (in)tolerance to ambiguity through inquiring whether residents have been in a determined uncertainty situation and if so to choose from a selection of responses how they handled it with the objective of describing the personality types that intervene in judgements and actions. The precedent for this paper is Hamui's mixed-methods study (Hamui-Sutton et al., 2015). On one hand, the qualitative phase of this study included 128 residents who reported critical incidents through narrative descriptions about uncommon situations experienced in the two weeks before the study. The critical incidents were analyzed and the 45 most relevant situations were selected, together with 11 coping strategies for the resolution of the incidents. Based on these qualitative results, the existing uncertainty typologies were expanded, leading to a new typology that distinguishes five types of uncertainty: technical, conceptual, communicational, systemic, and ethical. Furthermore, the 45 selected situations were rephrased in general terms and arranged in a standardized questionnaire which presented each situation with the 11 coping strategies. The quantitative phase, on the other hand, was a pilot study in which the latter instrument was applied to 120 (other) medical residents. The analyses showed that, regardless of the type of uncertainty, the most common strategy to solve critical incidents (used in about half of the situations) was consulting with a senior physician. This result underscores the importance of the hierarchical relationships in the hospital. Additionally, the instrument was further refined and a last version was obtained with 36 situations. In this study, we gave the newly obtained instrument to a large group of medical residents, with the following aim: we hoped to find the features that characterized groups of residents when opting for any of the strategies in specific uncertainty situation.

2. METHODS

2.1 Participants

Medical students making their residency in one of the 78 specialties that make up the Unified Program of Medical Specialties at the UNAM Medicine School from March to May 2013 were invited through e-mail to participate in the study. Participation was voluntary and students were informed that their decision would not have any consequence on their professional trajectory. The total residence population was 8,600.3,181 (36.98%) residents answered and registered. However, only 2,414 (76%) participants completed the questionnaire and were included for further analysis in the study (see Table 1).

Table 1. Demographics information of the participants

| | n | % | Mean | SD |
|--|------|------|------|------|
| <i>Gender</i> | | | | |
| Men | 1192 | 49 | | |
| Women | 1222 | 51 | | |
| <i>Age (years)</i> | | | 29.5 | 3.7 |
| Less than 28 | 727 | 30 | | |
| 28 - 30 | 1044 | 43 | | |
| More than 30 | 643 | 27 | | |
| <i>Marital Status</i> | | | | |
| Single | 1686 | 70 | | |
| With couple | 728 | 30 | | |
| <i>Average of the degree (expressed on a scale of 1 to 10)</i> | | | 8.6 | 0.5 |
| Less than 8.4 | 701 | 29 | | |
| 8.4 - 8.9 | 1047 | 43 | | |
| 9 or more | 666 | 28 | | |
| <i>Score of the EN-ARM†</i> | | | 62.3 | 17.8 |
| Less than 63.4% | 822 | 34 | | |
| 63.4% - 71.2% | 1045 | 43 | | |
| More than 71.2% | 547 | 23 | | |
| <i>Type of resident</i> | | | | |
| Specialty | 1719 | 71 | | |
| Subspecialty | 695 | 29 | | |
| <i>Years in the residency (years)</i> | | | | |
| 1 | 350 | 14.5 | | |
| 2 | 540 | 22.4 | | |
| 3 | 524 | 21.7 | | |
| Between 4 and 5 | 305 | 12.6 | | |
| 6 or more | 695 | 28.8 | | |
| <i>Hospital Level</i> | | | | |
| Primary care | 258 | 11 | | |
| Second level | 512 | 21 | | |
| Third level | 1644 | 68 | | |
| <i>Type of specialty</i> | | | | |
| 1 | 653 | 27 | | |
| 2 | 1426 | 59 | | |
| 3 y 4 | 335 | 14 | | |

2.2 Instrument

All participants answered a questionnaire containing 36 critical events and an introductory part with eight questions on demographic and other academic background information (sex, age, civil status, average score on pre-graduate exams, score obtained on the selection exam for medical residents [Examen Nacional de Aspirantes a Residencias Médicas, ENARM], health institution, medical specialty, and number of years in residency). Each critical event was presented with a list of 12 response categories: Apart from the option of not having been in the situation, the list contained 11 coping strategies (see Table 2, first column). The critical events and the response options were obtained from the study by Hamui (Hamui-Sutton et al., 2015).

Table 2: Answers according to type of uncertainty (expressed in percentages)

| Responses | Typology of uncertainty n = 2,414 | | | | | | | | Total |
|---|--------------------------------------|-----------------|-----------|---------|------------------------------|--------------------|-----------------------------|------------------------|-------|
| | Conceptual | Communicational | Technical | Ethical | Systemic: Violation of rules | Systemic: Security | Systemic: Lack of resources | Systemic: Coordination | |
| I have not been in that situation | 46 | 27 | 33 | 50 | 44 | 35 | 19 | 37 | 38 |
| I have been in that situation | 54 | 73 | 67 | 50 | 56 | 65 | 81 | 63 | 62 |
| Strategies | | | | | | | | | |
| I consulted with senior physicians | 62.6 | 62.6 | 59.5 | 48.7 | 43.4 | 43.7 | 35.4 | 53.0 | 51.8 |
| I consulted with peers or colleagues with a lower academic degree | 3.2 | 3.6 | 4.9 | 8.5 | 1.6 | 3.3 | 4.8 | 7.5 | 5.3 |
| I consulted with non-medical personnel | 1.5 | 0.4 | 1.2 | 0.9 | 17.4 | 1.2 | 7.0 | 3.2 | 2.8 |
| I consulted with a medical committee | 4.1 | 1.9 | 1.4 | 6.3 | 14.3 | 5.9 | 2.8 | 8.4 | 5.0 |
| I consulted with the patient or family | 0.2 | 1.3 | 0.3 | 1.5 | 2.3 | 5.6 | 2.8 | 1.4 | 1.8 |
| I consulted informational sources (books, internet, etc.) | 15.7 | 7.5 | 7.5 | 4.7 | 0.3 | 5.7 | 10.1 | 4.5 | 6.8 |
| I followed the clinical guidelines | 7.3 | 6.5 | 12.3 | 10.3 | 4.5 | 17.8 | 17.0 | 9.8 | 11.2 |
| I made my decision without consulting anyone | 2.0 | 13.4 | 9.0 | 12.8 | 8.6 | 7.9 | 12.9 | 7.6 | 9.9 |
| I delegated the process of the incident | 2.1 | 1.9 | 2.7 | 2.2 | 3.0 | 5.4 | 2.1 | 1.5 | 2.5 |
| I requested laboratory and imaging studies | 0.4 | 0.2 | 0.4 | 0.3 | 0.2 | 0.3 | 0.2 | 0.5 | 0.3 |
| I followed a different strategy | 0.8 | 0.7 | 0.8 | 3.8 | 4.4 | 3.2 | 5.1 | 2.6 | 2.6 |

Shows the percentage of residents who elected specific strategies according to the typologies of uncertainty used in this study

2.3 Procedure

The questionnaire was given online using the LimeSurvey open source PHP web application software (at <http://www.limesurvey.org>). Instructions to access the application with a link to the questionnaire, were sent by email to all residents. Successful participation implied the completion of the following three steps: (a) After accessing the link, participants were informed about the study and its objectives, and were subsequently asked to consent to take part in the study; (b) On the second screen the residents had to respond to eight questions on general demographic and other background information; (c) On the last screen the residents had to answer the 36 critical events, which implied selecting a single option from the 12 response categories presented. The 36 uncertainty situations were ordered randomly.

2.4 Analysis

The objective was to analyze how the type of uncertainty and the contextual variables relate to the probability of the resident using one of the strategies and being part of a group with specific characteristics. We used latent class regression models for each type of uncertainty to classify residents into classes or groups according to the strategy used to handle the uncertainty, and covariates that could affect their belonging to a specific group.

For the data analysis, we used eight types of uncertainty which can be found in Table 3; these include technical, conceptual, communicational, ethical and systemic uncertainties, the latter is further divided into violation of norms, security, lack of resources and coordination.

Table 3. Results of latent class regression analysis for each uncertainty (n = 2,414)

| Typology of uncertainty | Number of classes | Size of class | | | | Covariates | ln L | BIC | Number of parameters estimated | Classification Error |
|-------------------------|-------------------|---------------|---------|---------|---------|-------------------|---------|---------|--------------------------------|----------------------|
| | | Class 1 | Class 2 | Class 3 | Class 4 | | | | | |
| Conceptual | 2 | 0.47 | 0.53 | | | Block, Hosp Level | 8922.9 | 18196.4 | 45 | 0.029 |
| Communicational | 4 | 0.34 | 0.41 | 0.13 | 0.12 | Block | 12849.6 | 26618.4 | 118 | 0.017 |
| Technical | 3 | 0.26 | 0.43 | 0.31 | | Block, Hosp Level | 18678.5 | 38385.2 | 132 | 0.021 |
| Ethical | 4 | 0.46 | 0.12 | 0.09 | 0.33 | Block | 27687.3 | 57384.1 | 258 | 0.015 |
| Systemic: VR | 4 | 0.40 | 0.39 | 0.05 | 0.16 | -- | 6751.2 | 13961.9 | 59 | 0.068 |
| Systemic: S | 3 | 0.36 | 0.25 | 0.39 | | Block, Years | 15126.1 | 30953.1 | 90 | 0.032 |
| Systemic: LR | 3 | 0.15 | 0.27 | 0.58 | | Block, Years | 12251.4 | 25040.3 | 69 | 0.041 |
| Systemic: C | 4 | 0.41 | 0.22 | 0.29 | 0.08 | Block, Years | 17224.4 | 35609.4 | 149 | 0.020 |

*VR: Violation of rules, S: Security, LR: Lack of resources and C: Coordination. This table shows the number of latent class by typology of uncertainty in the statistical analysis

Some variables were excluded (gender, marital status, average of the degree, type of resident), because the significance rate was low. The variables used in the analysis were: (1) Age, we divided into 3-year age categories to simplify the descriptive presentation and facilitate the data interpretation, (2) Score on ENARM, it is the mark obtained on a scale from 0 to 100, (3) Years in the residency, which refers to the years the resident has studied in one or several medical specialties, we grouped the years of residency 4 and 5 because the number of residents was very low and there was no significant difference for this model (4) Hospital level, we divided the type of hospitals in three levels according to the human resources and infrastructure in each one, and, finally (5) Type of specialty,

the Mexican Health System categorize specialties in 4 groups: block 1: surgical, block 2: medical, block 3: community medicine and block 4: imaging (Sector et al., 2015). The poLCA (Polytomous variable latent class analysis) library was used to run the models in the R statistics program. The basic latent class model is a finite mixture model in which the component distributions are assumed to be multi-way cross-classification tables with all variables being mutually independent. The latent class regression model further enables to estimate the effects of covariates on predicting latent class membership. poLCA uses expectation-maximization and Newton-Raphson algorithms to find maximum likelihood estimates of the model parameters. A characteristic of this method is that the allocation of an individual to a specific class is estimated through the probability of belonging to it given the individual's answer pattern.

According to Bartholomew (David J., Martin, & Irini, 2011) three assumptions are made: 1) each participant belongs to only one of the latent classes found, 2) the probability of giving a specific answer to a question is the same for all the individuals in the same class, but different from the individuals in another class and 3) given the belonging of an individual to a latent class, his answers to each of the questions are conditionally independent (local independence).

To evaluate the models' goodness of fit the Bayesian information criterion (BIC) was used. In it, the BIC's smallest value indicates that that particular fit of the model is the best of all the models that were tried (Gill, 2002). Another important indicator to consider is the classification error, where a smaller value is always preferred.

We started off with the simplest model of only one class and classes were subsequently added one by one until we reached ten. Covariates were included once the most suitable number of latent classes was determined and the fit and significance of each model were verified. Then, we verified once more through BIC what models together with which covariates generated the smallest statistical value and only five of the nine possible variables and four of the models have statistical significance. Ethical approval for this study, under the project named “Strategies of the resident physician to situations of uncertainty during critical incidents” (DGAPA-PAPIIT IN201514), was obtained from the Research and Ethical Board of UNAM Faculty of Medicine.

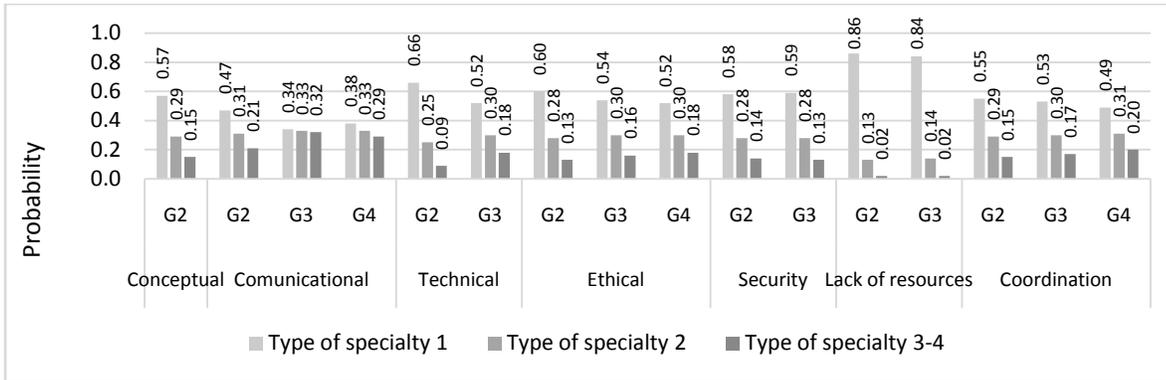
3. Results

The latent class analyses allowed the identification of two groups in all the types of uncertainties: the first included residents who have a high probability of answering “I have never been in that situation” and the second residents who have a high probability of handling the uncertainty by “consulting with doctors of higher hierarchy”. A third and even a fourth group were observed in seven of the eight uncertainties and the strategies these groups used varied depending on the type of uncertainty. In technical uncertainty, the third group opted for sticking to clinical guidelines, consulting information sources and handling the situation without consulting anybody. In security uncertainty, this group had a greater probability of sticking to clinical guidelines and other strategies. In lack of resources they had a higher probability of opting for using other strategies and sticking to clinical guidelines, while in the communicational uncertainty they had a higher probability of choosing to consult information sources and stick to clinical guidelines; in this type of uncertainty the fourth group opted for handling the uncertainty without consulting. In ethical uncertainty, the third group had a higher probability of choosing to consult medical committees and stick to clinical guidelines while the fourth group highest probability was to go for handling without consulting and other strategies. Furthermore, in the norm violation uncertainty the third group had a higher probability of consulting a medical committee while the fourth preferred other strategies. Regarding the coordination uncertainty, the third group had a higher probability of handling it with other strategies, sticking to clinical guidelines and handling it without consulting while the fourth group would most probably consult with a medical committee. There are a few points worth taking into consideration: 1) “Consulting medical committees” is a strategy that had a higher probability of being used for the norm violation, coordination and ethical uncertainties. 2)

“Consulting information sources” was used with more frequency in the communicational, conceptual and technical uncertainties 3) “Sticking to clinical guidelines” was reported in the security, ethical, communicational and lack of resources uncertainties, 4) “Handling without consulting” was used with a higher probability in communicational and ethical and 5) “Other strategies” in the uncertainties of norm violation, security and lack of resources. Regarding covariates studied, specialty block, hospital level and number of years in the residency were the statistically significant variables to describe the groups/ classes. Specialty block had statistical significance in all types of uncertainty except for norm violation.

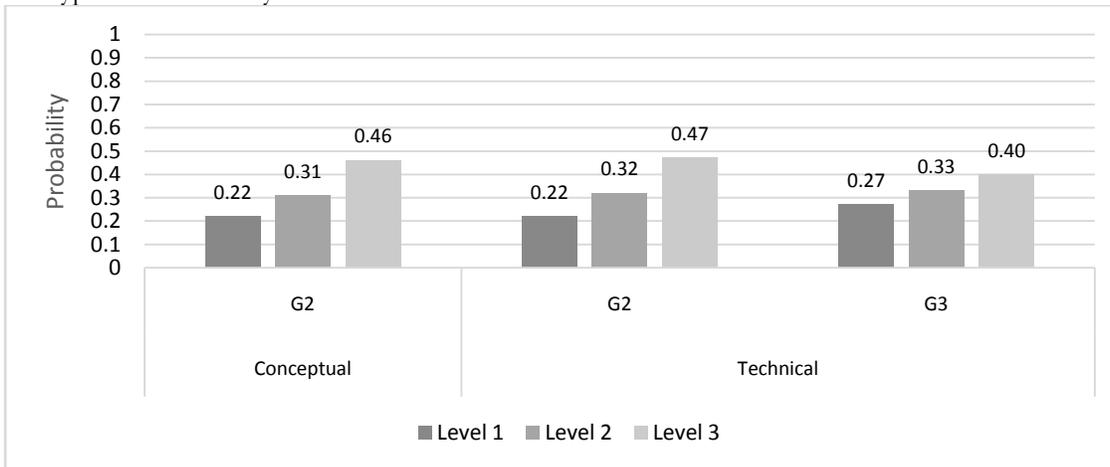
Results showed that residents in the second, third or fourth group have at least twice the probability of belonging to block 1 or 2 compared to blocks 3 and 4; the latter have a higher probability of belonging to the first group (have never been in that situation) (Graph1). Only in the communicational uncertainty residents have the same probability of belonging to any of the blocks, regardless of the used strategy. The systemic uncertainty “lack of resources” stands out since the probability of belonging to block 1 is 0.86 in the second group and 0.84 in the third group, whereas it is only 0.02 for block 4. (Graph1).

Graphic 1: Probability of belonging to each of the specialty blocks given that it belongs to G2, G3 or G4 with respect to G1 in seven types of uncertainty



Covariate “Hospital level” had statistical significance in the conceptual and technical uncertainties. It was observed that the probability of belonging to the second or third groups for residents in third level hospitals was twice as much as that of the residents in first level hospitals who had a greater probability of belonging to the first group “have never been in that situation”(Graph2).

Graphic 2: Probability of belonging to each of the hospital levels since it belongs to G2 or G3 with respect to G1 in two types of uncertainty



Covariate “number of years in residency” was statistically significant in the systemic uncertainties: security, lack of resources and coordination.

We found that having 6 or more years in the residency increased the probability of belonging to the second, third and fourth groups two-fold compared to first year residents who had a higher probability of being in the first group “have never been in that situation”. Regarding model evaluation, the ones for violation of norms, conceptual, lack of resources and communicational had the lowest BIC in that order. Therefore, these are the models with the best evaluation of the eight uncertainties; on the other hand, the model for ethical had the highest BIC and was, therefore, the lowest in evaluation considering it was the model with the most estimated parameters. It is also important to note that all the models showed classification errors <0.05, except the uncertainty *violation of norms* whose value was a bit above this (Table 3).

4. Discussion

With the latent class analysis, we identified the features that characterize resident’s groups regarding to the strategies they used while coping with uncertainty situations. The latent class analysis allowed distinguishing groups in each type and sub-type of uncertainty to measure the probability of a resident that shows a determined answer pattern using a specific strategy when a situation that includes a type of uncertainty arises. As Hamuiet *al* did, we found that the strategies residents used to handle extraordinary situations in their practice was mediated by the type of uncertainty they faced. A first conclusion is that in all types of uncertainty the first group was made up by those who had never been in the described situation, while the second group was made up by those who decided to consult with

higher hierarchy doctors to handle the uncertainty. This finding coincides with Farnan's *et al* who reported residents prioritized hierarchy to look for advice when faced with clinical problems. Likewise, Hamui *et al* (Hamui-Sutton et al., 2014) relate that in clinical organizational culture one of the consensus among residents is the acknowledgement of hierarchies, both in care work and academic tasks.

In the third group, the strategy depended on the type of uncertainty; in the technical and systemic sub-type "security", "lack of resources" and "coordination", the most used strategy was sticking to clinical guidelines or consulting information sources; this highlights the importance of procedure manuals, access to knowledge resources and consensus in hospital environments.

Regarding the ethical and systemic (sub-type "violation of norms") uncertainties the third group consulted with medical committees as their first choice, while the fourth group did this in the systemic, sub-type "coordination" uncertainty. This shows the relevance of institutional instances before unexpected situations. According to the normative hospital manuals for the medical residencies, reporting an event out of the ordinary should be through the medical tutors and in extraordinary events with higher hierarchy instances (Cardiología, 2013; Social, 2011). The strategy of solving without consulting appeared in the third group in the technical and systemic, sub-type "coordination" uncertainties and in the fourth group it was the first choice in the communicational and ethical uncertainties. Too much self-confidence or haste when solving situations in interaction contexts can make the resident act without seeking support, which is understandable to a certain point, in the ethical and communicational uncertainties. Nevertheless, in both the technical and coordination uncertainties the implications of acting on their own can affect the quality of medical care and the functioning of the unit's system; therefore, it is important to reinforce supervision in those cases (Walsh, 2014). (Hore, Lancashire, & Fassett, 2009). Accreditation norms and practice tend to have a more defined role in supervising residents (Martin & Farnan, 2013).

The option of following other strategies (consulting non-medical personnel -nurses, administrative, etc.-, consulting with the patient or relatives, delegating the process and asking for lab studies) was visible in group 3 for the security, lack of resources and coordination uncertainties; and in group 4 in the violation of norms and ethical uncertainties. The multiplicity of alternatives in the residents' decisions and actions in the systemic uncertainties bring them to rehearse other strategies, like the ones mentioned before. In the National Commission of Human Rights report, based on received complaints (México, 2009), some systemic problems were detected within health institutions such as lack of human resources, lack of training, insufficient supplies and very little supervision of residents by the health personnel. These factors had an impact on the residents' practice who improvised strategies when they faced uncertainties derived from these scarcities, thus the importance of administrative management and coordination to deal with the structural and operation problems of medical units. We wanted to know whether individual characteristics (gender and marital status) of the residents influenced the handling of uncertainties. Both in this and Gerrity MS, White KP, DeVellis RF and Dittus RS's study no differences were reported (Martha S. Gerrity et al., 1995).

In contrast, the characteristics of the context where the resident performs (covariates) did matter (years in the residency, hospital level, specialty block) since they were statistically significant according to the type and sub-type of uncertainty (Table 3). Regarding years in the residency, differences between groups were statistically significant in the systemic uncertainty sub-types security, lack of resources and coordination. This showed that the more clinical experience the resident has had the less uncertainty he faced in the hospital system. First year specialty students had less probability of facing uncertainty situations compared to students with 4 or more years. The latter had twice the probability of experiencing systemic uncertainty sub-types security, lack of resources and coordination. A probable explanation is that, as they gain more experience they acquire greater responsibility in the decisions²² that is, a higher hierarchy commits them to supervising doctors of lower hierarchies.

The normative manual of most health institutions specifies that lower hierarchy doctor must inform higher rank physicians of their actions^{24,25}; this coincides with the strategies used where the first option to solve an uncertainty is consulting with a higher hierarchy doctor. Furthermore, the more exposition to clinical situations the higher the probability of experiencing uncertainty events. Covariate "hospital level" was statistically significant among groups in the technical and conceptual uncertainties. Besides, directly proportional relation was found between hospital level and the probability of being in group 2 in the conceptual and technical uncertainties, as well as in group 3 in the technical uncertainty (Graph2). In a third level hospital residents have a greater possibility of facing situations of uncertainty that require applying specialized knowledge and skills, this might be due to the complexity of the

clinical cases that are solved in this level (Moreno et al., 2013), hence the value of continuous supervised learning that reinforces knowledge and procedures in clinical practice.

Covariate specialty block had the greatest influence on the statistical difference between the groups, since it shows up in all the types of uncertainty except for the systemic uncertainty sub-type “violation of norms”. We found that in the surgical (block 1) and medical (block 2) areas the probability of experiencing situations of uncertainty was twice as large as in the community medicine and imaging specialties (blocks 3-4). The probability of using consulting with higher hierarchy doctors (group 2) as a strategy was very high in block 1 in seven out of the eight types of uncertainty (Graph 1), followed by block 2; it was lower in blocks 3-4. In the first two blocks, clinical practice implies solving situations that carry life-threatening and functional risks for the patients. In particular, in 2013 there was a study that described that surgical area residents (block 1) were more tolerant to uncertainty due to the inherent difficulty of surgery (Contessa, Suarez, Kyriakides, & Nadzam, 2013), among other factors.

It was also observed that when the uncertainty “lack of resources” showed up, the probability of belonging to the surgical and medical areas was twice as high as that of the other areas. The lack of a material or human resource in medical practice can trigger risks in the patients’ safety (López, 2015). In the situations of “lack of resources” the second strategy used was sticking to the clinical guides, possibly to avoid legal problems due to shortcomings in the system and not to the doctor’s performance. It is remarkable that we found the same probability of presenting communicational uncertainty in all the groups regardless of the block they belonged to. Communication with the stakeholders in medical work (patients, relatives, health team, peers, etc.) is present at all times in clinical practice and makes up a fundamental background to perform adequate medical care (Brashers, 2001).

In this article, we not only considered the strategies used by residents according to the type of uncertainty they faced in extraordinary situations during their clinical practice, but we also made a latent class study incorporating covariates that could influence the probability of a resident belonging to a specific group. The covariate that showed statistically significant differences between the groups more frequently was specialty block (in 7 out of 8 types of uncertainty), followed by years in the residency (in 3 of the 8 types) and hospital level (in 2 of the 8 types). Some of the recommendations that can be derived from this study are: to diminish the situations of systemic uncertainty, the existence and use of clinical guides and procedure protocols allows a better coordination and adherence to norms; also, avoiding the lack of human and material resources decreases residents’ improvisation in uncertainty situations; therefore, the efficient management of the medical unit is a key issue. Regarding ethical and violation of norms, the presence of medical committees is relevant as they represent deliberation spaces that allow reflection and a collegiate answer before specific circumstances. In the third level of hospital attention there were significant differences between groups. In the third and fourth group, the technical and conceptual uncertainties emerged which refer to knowledge and its application. Before the complexity of the cases in that level, continuous study and close supervision become more relevant in these clinical arenas. The strategies “handle without consulting” and “other” were used in groups 3 and 4 in the technical, systemic, ethical and communicational uncertainties. When the resident acts on his own in the first two, there can be risks in the patient’s care so these situations should be detected.

Regarding the other two, it is commonplace that day to day decisions are taken based on medical professionalism, nevertheless, in serious cases, the existence of open communication channels and consultation instances are key. Finally, the situations of communicational uncertainty were present regardless of the block; this indicates it is an aspect that underlies in clinical experience and should not be ignored. Communication is not only common sense, it can be learned and improved with practice. The more fluent and efficient it is, the less communicational uncertainties will happen. This study broadened the analysis, by including contextual elements or covariates that also influenced residents’ decision-making behalf uncertain situations, some of the significant covariates were years in the residency, hospital level and block/area of specialty. This constitutes a contribution to the topic.

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5. References

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