"With Great Responsibility Comes Great Uncertainty"

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ABSTRACT

BACKGROUND: Uncertainty is inherent in medicine, and trainees are particularly exposed to the adverse effects of uncertainty. Previous work suggested that junior residents seek to leverage the support of supervisors to regulate the uncertainty encountered in clinical placements. However, a broader conceptual framework addressing uncertainty experience, from the sources of uncertainty to residents' responses, is still needed.

OBJECTIVE: To capture the spectrum of uncertainty experiences in medical residents, providing an integrative framework that considers the influence of specialties and training stages on their experience with clinical uncertainty.

DESIGN: We used Hillen's uncertainty tolerance framework to conduct a thematic template analysis of individual and focus group interviews, identifying themes and subthemes reflecting residents' experience of clinical uncertainty.

PARTICIPANTS: Medical residents from diverse medical specialty training programs, across five French medical schools.

APPROACH: Qualitative study driven by an interpretivist research paradigm.

RESULTS: Twenty residents from all years of medical residency and diverse medical specialties were interviewed during three focus groups and five individual interviews. They described managing treatments, making ethical decisions, and communicating uncertainty, as their major sources of uncertainty. We identified residents' delayed response to uncertainty as a key theme, fostering the development of experiential learnings. Prior clinical experience was a key determinant of uncertainty tolerance in medical residents. Entrusting residents with responsibilities in patient management promoted their perception of self-efficacy, although situations of loneliness resulted in stress and anxiety.

CONCLUSION: Residents face significant uncertainty in managing treatments, ethical decisions, and communication due to limited clinical experience and growing responsibilities. Scaffolding their responsibilities and clearly defining their roles can improve their comfort with uncertainty. To that extent, effective supervision and debriefing are crucial for managing emotional impacts and fostering reflection to learn from their uncertain experiences.

KEY WORDS: uncertainty; postgraduates; professional responsibility; decision-making; clinical supervision

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BACKGROUND

Ineffective management of uncertainty in physicians is associated with an increased risk of burnout, misuse of healthcare resources, or medical errors.[1,2] Clinical uncertainty especially affects medical trainees throughout their curriculum.[3–6] Only a few studies have explored the experience of clinical uncertainty in residents, although they should be considered high-priority targets for uncertainty training.[7,8]

Handling independence as an inexperienced practitioner creates unique tensions in residents,[9] leading to a distinct experience of uncertainty as compared to medical students or senior physicians. In two studies exploring uncertainty experience in emergency residents during their night shifts, Ilgen et al. showed that residents' uncertainty stemmed primarily from a lack of confidence regarding their interpretation of clinical data.[9] Residents managed uncertainty-related discomfort by engaging their supervisor, seeking an optimal level of supervision to safely expand their zone of proximal development.[10] As these studies focused on junior residents, they did not explore how the responsibilities undertaken by more advanced trainees, who frequently act independently, impact their experience of uncertainty. Furthermore, other studies showed that clinical experience accumulation and expertise provide additional resources to manage uncertainty, thus shaping physician's overall experience of this

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phenomenon.[11–18] Therefore, there remains a need for exploration of advanced trainees experience of uncertainty.

Previous work conducted in surgical settings highlighted the influence of situational characteristics, including the context and the task to be performed, on uncertainty experience.[19] Exploring how situational characteristics influence the diverse experiences of medical residents as they navigate uncertainty is a critical unmet need, considering their varying levels of expertise and unique working environments. To fill this gap, we conducted a qualitative study to explore the broad spectrum of uncertainty experience in medical residents, at all stages of residency and across different clinical settings.

METHODS

We used an interpretivist research paradigm to conduct and analyze a qualitative study.[20] Focus groups served our research aim, as they were especially adapted to provide an enhanced understanding of professional practice through a collective exploration of the research topic.[21] Group interviews were followed by individual interviews, to provide an in-depth exploration of individual responses and personal perspectives. Three researchers coded the verbatims, through a collaborative and reflective approach to develop a nuanced interpretation of the data, while seeking consensus. Data were sequentially analyzed and interpreted after each interview. All research team members were senior medical teachers, graduated in medical education with experience in qualitative research, and were also practicing as physicians, either as internal medicine specialists (N.B., A.L., P.P.), rheumatologist (F.R.), or intensive care specialists (Y.L.).

Conceptual Framework

In order to describe the various dimensions of uncertainty in residents, we employed Hillen's uncertainty tolerance conceptual framework.[22] In this model derived from a conceptual analysis of existing measures of uncertainty in healthcare professionals, uncertainty tolerance is viewed as an overarching concept, encompassing the perception of uncertainty sources, individual responses, and moderating factors. Uncertainty sources include ambiguity (*i.e.*, the lack of reliability, credibility, or adequacy of information), complexity (*i.e.*, characteristics of information that limit understanding), or probability (*i.e.*, randomness or indeterminacy of future outcomes). Uncertainty responses include three core domains: emotional, cognitive, and behavioral responses, the latter involving the strategies that are implemented to manage uncertainty. Moderators correspond to the various individual or situational characteristics, influencing uncertainty perception or response to uncertainty. This model fits our research objective by distinguishing the specific influence of the different domains of uncertainty tolerance on residents' overall experience.

Setting

In France, after 6 years of medical school, graduates undergo a 3- to 5-year residency training program, culminating in their certification as medical specialists. Residents are initially considered junior doctors, transitioning to senior residents in their final training years. During all residency, trainees are officially qualified to prescribe medications and are tasked with acquiring practical experience on the field, gradually acquiring more responsibilities in patient care with increasing autonomy.

Population and Sampling

Residents from five French academic hospitals (Rennes, Nantes, Angers, Reims, and Strasbourg University Hospital) were recruited by email. Residents' mailing lists were provided by their local academic coordinator. Enrollment decisions were based on an a priori purposive sampling framework ensuring diversity in terms of years of training, academic hospital affiliation, and medical discipline to embrace residents' uncertainty experience, through data enrichment. Recruitment and data collection continued until thematic sufficiency was achieved. Participants did not receive any compensation. This study received Approval from Rennes University Hospital Ethics Committee.

Data Collection

We conducted virtual focus groups and individual semi-structured interviews, between January 2022 and December 2023. Focus groups included residents from diverse participating institutions and with various professional experiences, aiming to enrich the data by capturing the influence of their diverse backgrounds as they shared their stories. After completing the focus groups, we enrolled additional participants to conduct individual interviews. This step (i) ensured that data sufficiency was reached, addressing the potential limitations of participants collectively sharing their stories, and (ii) provided an in-depth analysis of new themes identified during the focus groups.

Focus groups and individual interviews were facilitated by one investigator (A.L/N.B.) with two co-facilitators (N.B., Y.L., F.R.). Participants were asked to recall a situation of clinical uncertainty they personally experienced during their residency. Using a structured interview guide, participants

Table 1 Participant Characteristics

Gender	*n*=20
Female	9
Male	11
Study year/post graduate year	
6/1	4
7–9/2–4	11
10/5	5
Average age (years)	27.3
Medical specialty	
Internal medicine	5
Others	15

were asked open-ended questions to make them reflect on the source of their uncertainty, their reactions, and the decisions they made to manage the situation. The guide was developed jointly by the research team, tested in a pilot focus group session with trainees and adjusted accordingly.

We conducted online focus groups because of pandemic restrictions and due to the multicenter design of the study.[23] Interviews were recorded online using Google Meet® software with privacy and security standards designed to ensure the confidentiality of protected health information. Individual interviews were conducted face-to-face and audio-recorded. Recordings were transcribed verbatim, anonymized, and checked for accuracy. Focus group guide and participants' quotations were translated into English for illustrating purposes.

Analysis

Transcripts were analyzed using template analysis, a stepwise type of thematic analysis.[24] Template analysis is based on successive versions of an evolving coding template consisting of hierarchically structured themes, which are continuously modified as the analysis progresses. This method fit our objectives, as it allowed the emergence of new themes from the data, while building on Hillen's theoretical foundation.[25]

As a first step, the research team developed a preliminary template based on Hillen's theoretical framework. Five codes were selected a priori from Hillen's themes: (a) sources, (b) moderators, and (c) cognitive, (d) emotional, and (e) behavioral responses. Each transcript was sequentially analyzed following each interview, by two independent coders (A.L., N.B.).

Discussion rounds were held after the analysis of each transcript, to revise and enrich the analysis template. New themes could be created by merging and refining codes, to accurately reflect the whole content of the transcripts. The final template was reviewed and discussed within the whole research team, and NB checked-back the entire dataset to ensure that the final template adequately reflected the entire verbatim content.

RESULTS

We interviewed 20 residents, 15 in the three focus groups, each comprising four to six participants, and 5 during additional individual interviews, each lasting 60 to 90 min. Demographics of the participants are shown in Table 1. Residents' specialties included Internal Medicine (*n*=5), Pediatrics (*n*=3), Intensive Care Medicine (*n*=2), and Emergency Medicine, Nephrology, Geriatric Medicine, Dermatology, Gastroenterology, Oncology, Rheumatology, Cardiology, Medical Gynecology, and Psychiatry (*n*=1 each).

We identified three major themes of uncertainty derived from Hillen's framework. These themes describe how residents' encounters with clinical uncertainty led to diverse individual responses and how various situational and individual factors influenced their perceptions and responses to uncertainty. We also identified new subthemes, highlighting the specificities of residents' experience of clinical uncertainty. Definitions of themes and subthemes are provided in the Appendix. The interrelations between themes and subthemes are presented in a conceptual map (Fig. 1).

Uncertain Situations: The Conflict Between a Technical, Scientific, and Humanistic View of Medicine

Residents identified the ambiguity resulting from the conflict between science ("what is technically possible?") and humanism ("what would be best for this patient?") as a major source of uncertainty. They described these personal dilemmas as being rooted in moral and ethical concerns, encompassing decisions about the level of active care and end-of-life situations.

> I spent the first three months of my residency with a lot of COVID-19 infections and many elderly people, and we knew they would not be admitted in ICU (…) And one time, (…) I ended up with a mentor, who was reluctant to "let patients go" when they were at their very end, to withdraw oxygen support (…) then I ended up all alone, a Friday evening at 6.30pm discussing with the nursing team, not knowing what to do…

Residents also described how they embraced a humanist approach, seeking the best way to disclose their own uncertainties while considering the specific cultures, beliefs, and concerns of their patients and their families. These situations were therefore filled with a complexity resulting in an uncertainty many residents viewed as "irreducible."

> There was (…) doubt in the way of saying things about uncertainty itself, especially when we don't exactly know who we are talking to: "Do these parents have good comprehension skills?" I mean… should we use medical terms? or use lay terms? What we would like to know, actually, is: "which message got through in the end"?

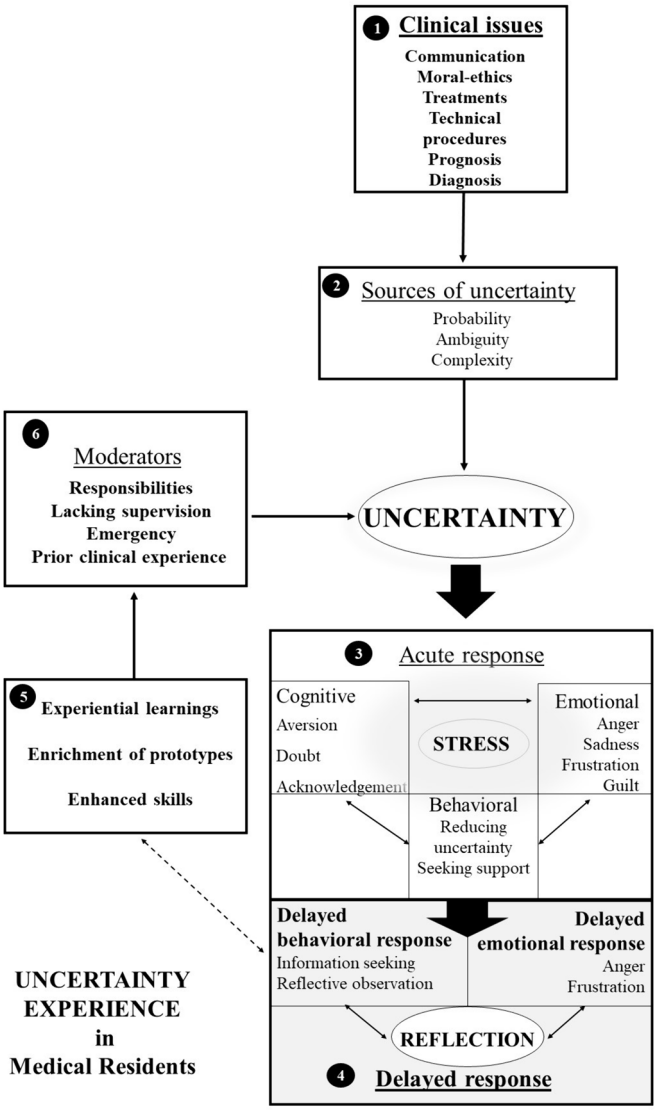

Figure 1 Integrative framework of clinical uncertainty experience in residents. In this model, uncertainty arises from a source of uncertainty that occurs when facing a medical issue. The subsequent individual responses to uncertainty are captured into three domains, which are cognitive, emotional, and behavioral responses. The delayed response was mainly related to reflection, fostering experiential learnings, thus ameliorating subsequent experience of uncertainty. Learnings from reflection varied among participants and situations; the dashed arrow indicates the links between reflection and learning, underscoring the need to explore individual and situational characteristics that facilitate experiential learning. Our framework, designed iteratively, depicts bidirectional connections among core elements, demonstrating how past experiences influence future situations.

Approaching Medicine from a technical perspective also induced uncertainty as some residents reported procedural issues that challenged the limits of their skills, demanding quick adaptation to the situation within a constrained timeframe.

> Very recently, I had a patient with advanced esophageal cancer. I needed to insert a gastric tube for nutritional support, but I couldn't manage it; I couldn't see anything (...) his stomach was full of residues. I was afraid he might inhale (…). Maybe I should have opted for a radiologically inserted gastrostomy, but it's the same – it requires a guide (…) We always think that someone more experienced would handle the situation better.

Accordingly, technical procedures challenged residents as they continually reassessed their chances of success and anticipated potential patient outcomes throughout the procedure, making probability a significant source of uncertainty.

The Multifaceted Reactions to Uncertainty: Cognitive, Emotional, and Behavioral Responses

Cognitive Responses. Some residents reported positive-valence responses arousing from a cognitive appraisal of uncertainty as beneficial for decision-making:

> It's not necessarily a bad thing to doubt your diagnosis and treatment; on the contrary, it helps you to avoid persisting in mistakes or going down the wrong path…

Yet, accepting uncertainty was rarely reported, as residents largely described doubts or aversion as the prominent cognitive response to uncertainty:

> For me, it is very unpleasant to be in uncertain situations. I try to avoid them as much as possible.

Emotional Responses. Emotional responses were depicted as a continuum aligned with the valence of cognitive appraisal. Hence, residents largely reported reactions such as panic**,** sadness, guilt, or anger, inducing a state of discomfort closely linked to anxiety or stress. Several residents even reported a feeling of incompetence, arising from their self-perception of ignorance:

> It was also frustration that came to me, thinking: "I feel incompetent, I don't feel up to the task..." and it made me angry at myself, telling myself "I should know this, it should be obvious to me..."

Although most emotional reactions were described as negative in valence, some participants identified uncertain situations as an opportunity to develop their skills:

> We're always satisfied when everything's straightforward... but when it comes to the doubts I've had, in the end I've learned a lot... so situations of uncertainty aren't necessarily a bad thing.

Behavioral Responses. All residents were primarily seeking to reduce their uncertainty, by collecting additional data including new diagnostic tests, literature search, or solicitation of their supervisors. They also described how they largely rely on pattern recognition for making decisions, attempting to link the situation to similar past experiences:

> In fact, we also manage uncertainty using analogy: we have seen someone acting like this in such a situation, and we realize that this reaction is the most appropriate one, and try to reproduce it.

In some situation, residents reported an "irreducible uncertainty."[11] In these situations, a few residents described a shift in their management strategies, adapting to situations by adjusting their expectations and priorities:

> From the moment we accept that there will be uncertainty (…) we feel more comfortable in decision-making (…) In most cases, there is not only one choice being all good and another one being all wrong; it is all about being ready to take the decision we believe to be the best at that time, in this situation.

Delayed Response to Uncertainty. Residents described developing their skills after the action, while reflecting on their uncertain experience. Such a delayed response was reported by almost all participants and was thus identified as a key new theme of their uncertainty experience. This delayed response encompassed both emotional and behavioral reactions, which aroused or extended beyond the initial clinical situation:

> I was mad at myself... The next days, I dissected the case again and again, to find out what I could have done, what I had missed… in retrospect, I realized that "this is how it is, I did what needed to be done, there were things that I couldn't know at that time (…)". For me, doing this was very tranquilizing.

Looking back on uncertain situations also enabled residents to mitigate their aversive delayed emotions:

"Regarding ethical discussions, I realized that things were not as clearly defined as they seemed after all. So, now when I have a patient with a similar profile, I anticipate and discuss it with my supervisor before he leaves, and I ask him "if the situation were to change, how far should we go?"" Accordingly, delayed responses were closely linked to residents reflecting on their actions to develop experiential learnings, including forward planning skills.

Moderators of Uncertainty Experience: How Situational and Individual Characteristics Influenced Residents' Experience with Uncertainty

According to Hillen, moderators of uncertainty tolerance referred to factors influencing either the perception, or the responses, to uncertainty.[22] We identified two strong moderators of residents' experience with clinical uncertainty, which were the responsibilities they assumed in their situation and their past clinical experience.

Responsibilities and Supervisory Guidance. Residents reported how assuming responsibilities affected their perception of uncertainty, as exemplified by this participant: "In a lot of situations we are the decision-makers, and we are at the forefront of responsibility."

Some residents reported situations in which their supervisors deliberately entrusted them to manage a patient:

> I was a bit anxious... and then, (…) I managed to find the proper dosage of anesthetics, and then once everything was under control, I called my supervisor and told him "it's ok"(…) in the end, I didn't get back home thinking "I was so bad!"

Residents noted that lack of support, especially during night shifts and emergencies, worsened their experience of uncertainty. Supervisors being "on call" but not on site led to feelings of loneliness and pressure to make immediate

decisions without immediate guidance. In these situations, residents illustrated how time pressure increased their perception of responsibility, leading to additional stress:

> Past a certain hour, when our supervisor is not necessarily available, we have to make decisions as residents that are clearly beyond our limits (…) sometimes it has major consequences, and it is when uncertainty is the most difficult to live with.

Discussing their responsibilities, residents described difficulties in identifying their roles and boundaries, affecting both themselves and the nursing team:

> I was on call, and after 72 hours we normally start rewarming the child. And the nurse said to me "the parents want to see you"(…) and it was my first uncertainty: "should I go to see the parents? Isn't it up to the attending to talk to the parents?"

Clinical Experience. Prior experience was a major moderator of uncertainty experience, as residents widely used pattern recognition to manage uncertainty and make decisions.[26,27] The first weeks of residency were therefore constantly filled with uncertainty:

> Well, uncertainty was a little bit every day, every day of my first three weeks, I think. Well…I couldn't do anything… everything was a discovery, and I couldn't do anything without my supervisors.

Conversely, some participants described how their experience of uncertainty shifted, as they gained experience:

> As time went by, I proved to myself that I could handle these situations. I've gradually come to understand that there isn't necessarily just one single answer to a problem, that someone else might have done things differently from me, but that doesn't mean I made the wrong decision.

DISCUSSION

Hillen's framework adequately captured residents' experience of uncertainty when considering sources, responses, and moderators of uncertainty. Our key findings underscore the diverse sources of uncertainty that residents encounter in their clinical practice and illustrate how their clinical experience and their responsibilities shape uncertainty experience. In our study, reflection emerges as a crucial theme, aiding residents in transforming uncertain situations into valuable experiential learning, thereby influencing their overall experience with uncertainty.

Our study extends the findings to the population of medical residents of a previous work which identified managing treatments, ethical dilemmas, and procedural skills, as major sources of clinical uncertainty in pregraduates.[28] As residents gain experience, they are progressively entrusted with communicating with patients and relatives, including disclosing their own uncertainty. As participants report that communicating their own uncertainties is one of the most frequent and irreducible sources of uncertainty, it underscores the need for specialized training in sharing information, including uncertainties, with patients and their families.[29,30] Implementing communication-focused trainings such as simulation-based trainings including role-play, in the pregraduate curriculum, and promoting trainees' exposure to communicational tasks in their clinical environments, could serve this objective.[31,32] Moreover, equipping residents with collaborative communication methods such as the "ask, tell, ask" plan could help them alleviate discomfort arising from uncertainty by assessing their patients' knowledge and understanding of the situation.[33]

In line with previous work, discomfort experienced in uncertain situations leads residents to primarily reduce their uncertainty.[34] Conversely, residents described how they struggled when "mastering knowledge"[35] did not allow them to reduce uncertainty. Yet in these situations, participants rarely discussed strategies aiming at mitigating their aversive psychological responses to irreducible uncertainty.[36] The limited coping strategies expressed by residents highlight their inadequate resources to manage uncertainty, fostering anxiety and stress. As a result, uncertainty situations confronted residents to the boundaries of their knowledge and skills, encouraging them to develop learning from their clinical experience.[37] Learning from experience was closely linked to reflection according to Nguyen's definition, as residents sought to adopt a critical iterative and exploratory analysis of their actions to improve their response.[38] While reflecting upon their actions, residents also reported learning from cross-checking their decisions against what their supervisor would have done in similar situations, or against existing data from the literature or guidelines. Ilgen et al. found that real-time cross-checking promoted trainees' comfort with uncertainty.[9] Our findings highlight that reflecting and cross-checking after the action is also crucial for residents to learn from their experience, increasing their self-confidence to manage future situations of uncertainty.

To reduce their uncertainty, residents primarily rely on their clinical experience, which serves as a crucial moderator of their uncertainty experience. They describe using recognition-primed model for decision-making, similar to more experienced practitioners, aiming to make quick and effective decisions based on experience according to the theory-based cues.[39–41] Prior experience thus provides residents with comfort when confronted with uncertainty, shifting their responses from avoidance or stress to acknowledgment of uncertainty. Such approach is in accordance with the naturalistic decision-making theory, in which clinicians rely on their accrued experience to engage into forward planning through mental

simulation, enabling them to anticipate the potential various outcomes.[42] Anderson et al. have proposed mental simulation as the critical mechanistic link between uncertainty and emotional response.[43] Thus, naturalistic decision-making is a relevant approach to elicit the way past clinical experience influences the various domains of response to uncertainty.

As they gain experience, residents endorse increasing responsibilities, which were identified as a key moderator of their experience with uncertainty. This was best encapsulated by a participant: "In any case, without responsibility there is no uncertainty!" Entrusting residents with an appropriate level of responsibilities while defining the appropriate degree of guidance offers residents strong opportunities to build on their skills, while increasing their perception of self-efficacy and finally developing additional resources to cope with uncertainty. Entrustment was thus found as a central moderator of uncertainty, enabling residents to safely extend their proximal zone of development while navigating uncertain situations, in accordance with the "supported independence" as previously described.[10] Conversely, lacking support from supervisors was found detrimental to residents' ability to manage uncertainty.[10] In our work, insufficient support induced a feeling of loneliness, closely related to stress, i.e., a cognitive (aversion) and emotional (fear, uneasiness) response that could explain the "state of discomfort" reported in previous studies.[44–46] Night shifts were therefore a critical point of discussion, as they required residents to manage severely ill patients with minimal support, leading to an intensified sense of responsibility. Residents also mentioned situations of "ambiguous responsibility," where they were unsure of how much independence and autonomy their supervisors, or the nursing team, expected from them. Previous studies highlighted how role ambiguity resulted in negative cognitive responses to uncertainty among healthcare providers, thereby increasing the risk of ineffective response to the uncertainty they face.[47] Importantly, as trainees often struggle to recognize their own limitations,[8,48,49] unclear boundaries regarding autonomy may promote decision-making that exceeds their competence. Such situations can compromise patient safety with impact on residents' well-being, making physicians the "second victims in medical errors."[50] Teaching strategies guided by the entrustable professional activities framework could help clarify residents' evolving roles and enhance their uncertainty management through structured learning with supervisors.[51] This empowerment would enable residents to safely expand their autonomy while navigating complex clinical situations, thereby improving their experience with uncertainty.[52]

Limitations

Our objective through focus group interviews was to enhance the study data by leveraging group dynamics and gaining additional insights from participant interactions. However, focus group interviews can present limitations when discussing stigmatizing topics in front of other participants. These limitations are influenced by various biases, notably social desirability bias, where participants may feel pressured to conform to interviewer expectations, and fear of judgment. To address these issues, we created a supportive, non-judgmental environment using skilled facilitation to elicit diverse perspectives. We balanced group samples by residents' experience levels. To mitigate desirability bias, none of the investigators was engaged in teaching or assessing participants during the study period. Group interviews fostered lively discussions among participants, yielding rich insights into clinical uncertainty as residents openly shared personal situations or emotions. Individual interviews with additional participants were conducted to provide an in-depth exploration of the key themes identified in the focus groups, thus enriching the study data.

Our results are based on data from both focus groups and individual interviews. Despite concerns about interview settings affecting responses, sequential verbatim analysis showed that main themes remained consistent, with individual interviews adding only subthemes. Thus, variations in settings did not compromise our study's interpretation. We did not explore correlations between medical specialty and uncertainty due to sample size limitations and different study objectives. However, the variety of situations in residents' specialties likely affects their experience of uncertainty. Further research is needed to explore how situational characteristics influence uncertainty, enhancing trainees' perception by identifying contributing factors in clinical settings.

CONCLUSION

Managing treatments, making ethical decisions, and communicating uncertainty are the major sources of uncertainty in residents. Residents' experience with uncertainty is shaped by their limited clinical experience and the growing responsibilities they assume during their training. Scaffolding their responsibilities and clearly defining their roles are crucial to improve their comfort with uncertainty. Residents' experience with uncertainty extends beyond immediate actions to include delayed emotional reactions and reflective practices. Therefore, effective supervision and debriefing are crucial, as they help manage the emotional consequences of uncertainty and foster learning from these situations. Future ethnographic research in workplace settings is needed to further explore how situational characteristics shape residents' perceptions and navigation of clinical uncertainty.

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Author Contribution: *All authors designed the study protocol and recruited participants. NB, AL, FR, and YL collected data. All authors participated in data analysis and interpretation. NB, AL, FR, and YL drafted the papers, and all authors critically proofread the successive versions of the manuscript. All authors approved this final version of the manuscript to be published and agree to be accountable for this work. All authors accessed and approved the final content of the manuscript.*

Declarations:

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