‘A whole lot of uncertainty’: A qualitative study exploring clinical medical students' experiences of uncertainty stimuli

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Abstract

Introduction: Uncertainty tolerance (UT) describes how individuals respond to stimuli of uncertainty, with low UT among medical doctors and students linked to negative outcomes such as burnout. UT research in medical education has focused on measuring the construct, with little research seeking to understand how medical students experience uncertainty. Hence, knowledge on how education may shape students’ UT development is lacking. As a first step to understanding students’ UT, we asked ‘How do medical students, in their clinical years, experience uncertainty stimuli?’

Methods: Utilising a social constructionist approach, we undertook a qualitative study with 41 clinical years medical students. Data were collected during the 2020 academic year employing in-semester reflective diary entries (n = 230 entries), and semi-structured interviews at the end of semesters (n = 40 interviews). Data were analysed by framework analysis.

Results: Students described three major themes of uncertainty stimuli: (i) educational uncertainty, (ii) professional uncertainty and (iii) clinical uncertainty. Educational uncertainty was the dominant stimulus described by students and represents unknowns related to what students needed to learn and how to learn within the context of clinical placements. Professional uncertainty encompassed questions about who students are as developing professionals and who they would be as doctors. Clinical uncertainty was the least represented stimulus and concerned aspects of patient care where the body of medical knowledge is unable to provide clear answers.

Conclusions: Our findings indicate that clinical learners experience wide reaching uncertainties and suggest that students' stimuli may differ from those of clinicians with more established knowledge and careers. This work now paves the way forward in developing educational interventions to foster UT, such as modifying uncertainties not integral to learning, and purposefully introducing clinical uncertainties relevant to students' learning stage.
## INTRODUCTION

Uncertainty tolerance (UT) is a construct used to describe how individuals respond to the perception of uncertainty through their cognition, emotions and behaviour and has high relevance to health care practice. Low UT in health care practitioners is linked to negative health care outcomes, including increased health care resource use, and psychological distress and burnout in medical doctor and student populations. Accordingly, there is an impetus to ensure that medical graduates and doctors-in-training develop UT that allows them to appropriately manage uncertainties encountered in clinical practice.

This is evidenced by the inclusion of uncertainty management skills in postgraduate training competency frameworks and nationwide assessment of UT in graduates. Existing UT research in medical education predominantly utilises quantitative, cross-sectional cohort studies; however, such studies are inconsistent both in their UT measurement approach and research findings. When the impact of education on UT is explored, it is typically assessed indirectly by implementing a variety of scales designed to measure UT and analysing associations between measured UT and stage of training. These studies identified that advanced training stages are associated with increased UT, decreased UT and no significant differences in UT. Furthermore, studies have not typically taken methodological approaches aiming to elucidate the reasons underpinning these disparate results. One potential cause of these inconsistent results may relate to UT scale performance in medical students, as the most commonly used UT scales were originally developed and validated for senior physician populations. A recent meta-analysis of UT scale reliability identified significantly lower reliability among medical students when compared to physicians. As such, how medical students experience uncertainty, whether these experiences are represented by existing UT scales, and how education may shape students’ UT development, are largely unknown. To address this gap, we undertook a qualitative study of clinical years medical students’ experiences with uncertainty.

### Current theory on UT

The integrative UT model was developed by Hillen et al. following a conceptual analysis of inventories designed to measure UT and synonymous constructs. The model is contemporary, broad in its conceptualisation of UT and context independent. Given the relative lack of UT research in medical students, we selected this model as our conceptual framework to facilitate a comprehensive exploration of medical students’ experiences with uncertainty. Prior to the integrative model, UT-related nomenclature was diverse. Notably, the term ‘ambiguity’ was treated as synonymous with uncertainty by some researchers and a distinct yet related construct by others. Hillen et al. highlighted the considerable conceptual overlap between uncertainty/ambiguity tolerance and thus include inventories purported to measure both these constructs in their analysis.

The resulting integrative model illustrates that a stimulus is perceived as uncertain, to which the individual then appraises/responds.

The stimulus is defined by informational properties of probability (randomness or indeterminacy of future outcomes), ambiguity (lack of reliability, credibility or information adequacy) or complexity (features of information that limit understanding). Thus, within this contemporary UT model, ambiguity is considered a subordinate aspect of the UT construct. Definitions draw primarily from Han et al.’s earlier work, wherein the focus is on clinical uncertainty (i.e. probability, ambiguity or complexity within the patient care context). Following perception of uncertainty, an individual’s appraisals/responses are subdivided into cognitive, emotional and behavioural domains, with each spanning a continuum from negative (e.g. threat, worry and avoidance) to positive (e.g. confidence, curiosity and action). The model also introduces moderators or factors influencing the perception of, and/or responses to, uncertainty. Despite the inclusion of moderators, Hillen et al. state that the model can be applied to research that conceptualises UT as either a static personality trait or a dynamic state influenced by context and experience. Whether UT is a trait or a state is the subject of debate among researchers, with both conceptualisations represented in prior research on UT and medical education.

### Prior qualitative research on UT and medical education

Prior studies implementing UT scales among medical students are inconsistent in their conclusions regarding whether UT is a static trait or dynamic state. By contrast, the few qualitative studies exploring medical students’ UT are generally supportive of UT as a dynamic state and provide some preliminary insights about how medical students experience uncertainty.

An earlier qualitative study into medical students’ experiences of uncertainty is from the medical sociologist Fox, who undertook an ethnographic study in the 1950s. Fox described three sources of uncertainty that doctors and medical students face: (i) ‘incomplete or imperfect mastery of available knowledge’, (ii) ‘limitations in current medical knowledge’ and (iii) ‘difficulty in distinguishing between personal ignorance or ineptitude and the present limitations of medical knowledge’. Medical student participants were followed across their course duration, wherein Fox described a shift in attitudes towards uncertainty with time, with medical students in their later years ‘coming to terms’ with uncertainty as a feature of medical practice. Due to the considerable expansion of medical knowledge since the 1950s, it is, however, unclear whether participants conceptualised uncertainty in a manner transferable to contemporary medical students.

In more recent times, Knight and Mattick interviewed second-year preclinical medical students about their personal epistemology. The results identified several themes pertaining to students’ perceptions of uncertainty in relation to medical knowledge and clinical practice. Some students expressed beliefs that scientific approaches will ultimately overcome clinical uncertainty, suggestive of viewing medical knowledge in certain, ‘black and white’ terms. By contrast, other students acknowledged implicit medical ambiguities, whereby knowledge is contextual and changes in accordance with a particular patient. When exploring students’ epistemological development over
time, Knight and Mattick\textsuperscript{21} described that some students changed in their understanding about medical knowledge, shifting away from earlier certain views, towards appreciating uncertainty in medicine.

Our own prior longitudinal qualitative research exploring preclinical medical students’ experiences of uncertainty within the context of anatomy education also identified a change in students’ perceptions of uncertainty.\textsuperscript{22} Although the dominant perceptions of anatomy early in the study were in terms of absolutes (similar to the ‘black and white’ or ‘exact science’ of Knight and Mattick\textsuperscript{21}), over time, and through the influence of educators who acknowledged uncertainties, this shifted to students accepting uncertainties.\textsuperscript{22} Uncertainty stimuli described by students included anatomically focussed uncertainties (e.g. complexity of donor dissection and possibility of anatomical variations), as well as stimuli that may be transferable to learning as a medical student more generally (e.g. uncertain breadth of content and no single best study approach).\textsuperscript{22} Additionally, the socio-cultural threshold of dissection theme (i.e. uncertainty about engaging in the act of dissection, which is normalised within medical education, yet otherwise culturally forbidden) suggests that some uncertainty stimuli for medical students extend from knowledge acquisition and clinical uncertainties, to encompass the students’ socialisation as developing professionals.\textsuperscript{22} Thus uncertainty stimuli, in only one preclinical course, appeared much broader and more nuanced than previously described.

When considering clinical years medical students, contemporary descriptions of students’ experiences of uncertainty are limited. With student participants in their first year of clinical placements, Nevalainen et al.\textsuperscript{23} explored students’ experiences of uncertainty using data collected from reflective learning diaries. Student experiences with uncertainty were described in six ‘domains’, which appear to primarily pertain to negative responses to uncertainty (e.g. fear of making mistakes, insecurity of professional skills and coping with responsibility). One domain, ‘confusion with the inexactness of medicine’, appears to discuss ambiguity as a stimulus of uncertainty in clinical medicine; however, uncertainty stimuli beyond clinical uncertainty are not described.\textsuperscript{23} Importantly, Nevalainen et al.\textsuperscript{23} described students developed UT over time, moving from negative responses to ‘tolerating oneself as incomplete and accepting oneself as good enough a doctor-to-be’.

Thus, contemporary, qualitative studies into medical students’ experiences of uncertainty are supportive of UT as a dynamic state changing over time. However, these studies are largely limited to preclinical settings and/or do not specifically explore the breadth or depth of uncertainty stimuli within this population. Improving our understanding of students’ experiences with uncertainty in the clinical education context may provide insights into the construct to inform the role of UT scales implemented among this population and allow for the development of educational interventions that build students’ UT before they begin practice. Conceptualising UT as a state, the present study aims to address a gap in the current literature by exploring how medical students experience uncertainty during their clinical years, focussing on the aspects of students’ experience that stimulate uncertainty.

2 | METHODS

2.1 | Study design

The present study, pertaining to uncertainty stimuli, is part of a larger study with clinical years medical students at an Australian medical school. Drawing on existing research suggesting that UT is, at least in part, modifiable and socially determined,\textsuperscript{3,22} we took a social constructionist view to understand participants’ experiences of uncertainty.\textsuperscript{24} Aligning with this worldview, we used longitudinal qualitative research methodology.\textsuperscript{25} Following institutional ethics approval, data were collected during the 2020 academic year, with each student asked to complete a minimum of six reflective diary entries during semester and a semi-structured interview following the conclusion of each semester.

2.2 | Context

The medicine course at the study institution incorporates direct and graduate-entry streams (i.e. following completion of secondary schooling or a prior degree respectively), both resulting in graduation with a Bachelor of Medical Science and Doctor of Medicine (MD). The two streams undertake a separate preclinical phase, but from the first clinical year are integrated with students undertaking clinical placements together for the remainder of the course.

Our study involved students from two different year levels and both student entry streams: Year 3B and Year 5D. Year 3B is the first clinical year of the course, with students rotating through a range of hospital-based medical and surgical specialities. Year 5D is the final year of the course, with students required to complete six clinical rotations in specific areas (i.e. aged care, emergency medicine, medicine, surgery and an additional specialty area), as well as a scholarly intensive project (typically participation in clinical research).

2.2.1 | Pandemic impacts on medical student placements and assessment

The arrival of the COVID-19 pandemic in Australia early in 2020 impacted clinical placements at the study institution. The pandemic represents a globally shared example of health care-related uncertainty.\textsuperscript{26} Although our study, predictably, was not designed for this pandemic, we considered the pandemic context as a potentially rich environment for exploring students’ experiences of uncertainty. Specific impacts on student participants are detailed to provide relevant study context.

Student placements commenced as usual in early 2020, with pandemic-related restrictions on student placements enacted from the beginning of diary entry Period 2. Year 5D students were largely able to attend placements throughout 2020, albeit with some limitations (e.g. restrictions on students moving between clinical sites and on patient interactions in cases of confirmed or suspected
COVID-19). For Year 3B, the majority of the curriculum was delivered online via Zoom (version 5, Zoom Video Communications, San Jose, CA, USA), and international and interstate students were provided with the option to return home. Due to travel restrictions, some of these students were not able to return to recommence placements in 2020 despite placement opportunities and patient interactions resuming for local students during Semester 2.

2.3 Sampling and recruitment

We purposively sampled students enrolled in Years 3B and 5D of the medical course in 2020. These year levels were chosen to capture learning transitions experienced or anticipated by these student groups. In Year 3B, students transition from a university setting to clinical placements, and in Year 5D, students are building towards the transition from medical student to intern doctor. Transitions were previously identified as a stimulus for uncertainty; thus, we anticipated that these transitional contexts may be ripe for exploring experiences of uncertainty.

We recruited 23 students in Year 3B and 18 students in Year 5D and were able to maintain excellent levels of participation across duration of the study, with 35 out of 41 (85.4%) students completing all stages. On study enrolment, participants completed a brief demographic survey (Table 1). Aligned with the study institution’s student demographics, the majority of study participants identified as women and were direct entry, domestic students. Students’ ancestry was predominantly East Asian, European and South Asian, with a slight

| Table 1 Participants’ self-reported demographics | Year 3B | Year 5D | Total |
|-----------------------------------------------|--------|--------|-------|
| Participant number                            | 23     | 18     | 41    |
| Mean age (years) at commencement of medical school | 18.6   | 19.7   | 19.1  |
| Gender                                        |        |        |       |
| Woman                                         | 18     | 10     | 28    |
| Man                                           | 5      | 8      | 13    |
| Entry pathway                                 |        |        |       |
| Direct                                        | 21     | 14     | 35    |
| Graduate                                      | 2      | 4      | 6     |
| Enrolment type                                |        |        |       |
| Domestic                                      | 18     | 16     | 34    |
| International                                 | 5      | 2      | 7     |
| Ancestry                                      |        |        |       |
| East Asian                                    | 10     | 7      | 17    |
| European                                      | 7      | 3      | 10    |
| South Asian                                   | 3      | 6      | 9     |
| Oceanian                                      | 1      | 1      | 2     |
| Americas                                      | 1      | 0      | 1     |
| North African and Middle Eastern              | 0      | 1      | 1     |
| Not stated                                    | 1      | 0      | 1     |
| Religiosity                                   |        |        |       |
| Non-religious                                 | 15     | 9      | 24    |
| Religious                                     | 8      | 9      | 17    |
| Career aspirations                            |        |        |       |
| Unsure                                        | 13     | 4      | 17    |
| General practice                              | 3      | 6      | 9     |
| Adult physician                               | 1      | 3      | 4     |
| Surgery                                       | 1      | 2      | 3     |
| Obstetrics and gynaecology                    | 1      | 1      | 2     |
| Psychiatry                                    | 2      | 0      | 2     |
| Other (not specified)                         | 2      | 0      | 2     |
| Emergency medicine                            | 0      | 1      | 1     |
| Pathology                                     | 0      | 1      | 1     |
majority of students identifying as non-religious. The majority of students were unsure about their plans for specialisation.

We considered the cohort as a whole as providing sufficient information power for the study because (i) our study aims were relatively narrow (i.e. exploring a single construct), (ii) our sample was specific to our research question (i.e. medical students in clinical years), (iii) we had rich dialogue between the researcher and participants and (iv) our analysis was theory-informed.

2.4 | Data collection

Data were collected via reflective diaries and end-of-semester interviews. In order to help facilitate students’ comfort with expressing their experiences across the study, data were collected by G.C.S. only, who made herself known to participants as a medical education PhD candidate. G.C.S. anonymised all data prior to analysis by M.S. and M.D.L., especially as M.D.L. was known to some participants as an anatomy educator. However, none of the authors had any involvement in either teaching or assessment of participants during, or following, the study period.

2.4.1 | Reflective diary entries

Diary entries were chosen for data collection due to their demonstrated success in enabling students to discuss difficult experiences that they may be uncomfortable disclosing in peer-group settings. Students were asked to complete six reflective diary entries during the 2020 academic year, with these submitted approximately every 6 weeks during semesters. Aligning with recommendations for reflection in medical education, students were provided with several options for their diary medium: typed, handwritten or audio recorded. In total, students submitted 230 diary entries, containing 178,308 words.

For Diary 1, students were prompted to describe scenarios from their current clinical rotation in which they felt certain and uncertain (Box 1). Discussion of certainty was solicited to gather further context for students’ experiences. Although our instructions to students referred to the diary entries as reflective diary entries, initial analysis (see below) of Diary 1 data highlighted that without explicit prompts on how to reflect, some students focussed on describing their scenarios without reflection. We initially addressed this by sending follow-up questions to the relevant students. Following on, with Diary 2 instructions, students were provided with a brief framework for reflection (Box 1). The Diary 2 time-point corresponded with the advent of COVID-19-related restrictions on some clinical placements. To address circumstances where attendance on placements were restricted, the Diary 2 prompt was adjusted to allow students to describe and reflect on scenarios from their experience as a medical student more generally. Initial analysis of Diary 2 data identified factors outside of students’ placement experience that appeared to be impacting their experiences of uncertainty on placement and in learning more generally. Therefore, due to the breadth of data obtained and ongoing uncertain impacts of the pandemic, the modified prompt was maintained for the duration of the study.

| BOX 1 | Instructions for reflective diary entries |
|---|---|
| **Prompts** | |
| **Diary 1** | 1. Describe a scenario from your current clinical rotation in which you felt certain. AND 2. Describe a scenario from your current clinical rotation in which you felt uncertain or experienced as ambiguous. |
| **Diaries 2–6** | 1. Describe and reflect on a scenario from your experience as a medical student in which you felt certain. AND 2. Describe and reflect on a scenario from your experience as a medical student in which you felt uncertain or experienced as ambiguous. |

| **Framework for reflection** | |
|---|---|
| There are many definitions of reflection in relation to medical education; however, key elements include consciously examining the behaviour, ideas and feelings generated by a learning experience with the purpose of increasing the usefulness of the experience to you, the learner. Reflection is personal and thus there is no one way to reflect. However, a framework that may be helpful for you to engage in reflection is the ‘What? So what? Now what?’ framework as follows: |
| **What?** | Focuses on thoughts at the time of an experience. For example, ‘What was I thinking during the scenario? Or when I took the actions or made the decision that I did’ |
| **So what?** | Considers the significance of what happened, as well as the values and feelings prompted by the experience. For example, ‘How did I feel at the time of and after the experience, why was it important?’ |
| **Now what?** | Looks at the processes and opportunities that can help learning from the experience and identifying future actions. For example, ‘What can I learn from this scenario or do differently next time?’ |

Please consider this framework as a guide only, and ultimately the content of your diary is still up to you.

2.4.2 | Semi-structured individual and group interviews

Semi-structured individual and group interviews were conducted following the conclusion of each Semesters 1 and 2 to further explore themes identified in student diaries and more comprehensively understand their experiences. All interviews were held via Zoom to accommodate pandemic-related restrictions. To provide a degree of flexibility and supporting the methodological approach, students had the option of participating in an individual or group (2–4 participants) interview. Group interviews served to support the sharing of diverse experiences and an interactive exchange of ideas among participants, whereas individual interviews facilitated in-depth responses and personal perspectives. Group size was purposefully
capped at four participants due to the Zoom format, as in our experience, engagement of participants was difficult to maintain with larger groups. In total, 40 interviews were conducted (10 individual and 10 group interviews per time-point), ranging from 32 minutes to 1 hour and 27 minutes (mean 1 hour 3 minutes), totalling over 42 hours of audio data or 414 708 words.

All interviews were facilitated by G.C.S., who had prior experience facilitating qualitative interviews with medical students, including discussions about experiences with uncertainty. Notably, G.C.S. is a graduate of the study institution and practising doctor, attributes that likely enhanced the quality of dialogue between participants and researcher.

The same semi-structured protocol was used for both individual and group interviews. Interview questions were developed iteratively following coding of the preceding diary entries to facilitate data depth (see Appendix S1), with exemplar diary quotations selected to prompt further discussion where necessary. All interviews were audio and video recorded, with the audio recordings transcribed verbatim for analysis.

2.5 | Data analysis

All data were analysed using five-step framework analysis. Step 1 of framework analysis (familiarisation) involved data immersion, with all diary entries and interviews reviewed by the first author (G.C.S.). A subset of diaries, approximately three per time-point, was also reviewed by the other authors to facilitate team-based coding. Initial coding impressions were noted and discussed at regular team meetings. Due to the longitudinal nature of the study, we commenced familiarisation with the first round of diary entries and revisited this step regularly throughout data collection. Step 2 (identifying a thematic framework) involved the development of a codebook with themes, their definitions and illustrative quotations. The codebook was refined following each round of data collection and analysis with the research team. Step 3 (indexing) involved G.C.S. coding the entirety of the dataset, with NVivo (version 12; QSR International, Melbourne, Australia). During this stage, coding discrepancies were noted and discussed across the entire team until coding consensus was reached. In Step 4 (charting), coded data were reviewed by G.C.S., M.S. and M.D.L. individually, then discussed as a team to refine the thematic hierarchy and produce the final coded data set. Step 5 (mapping and interpretation) involved the higher-order linking of themes to the research question and comparison of findings with existing literature.

2.6 | Team reflexivity

At study commencement, we engaged in a team reflexivity exercise exploring our research orientations. This highlighted that we all had prior qualitative education research experience, were supportive of using qualitative methodologies in the present study and shared social constructionism as an epistemological perspective. This exercise did highlight diversity in our experiences related to career stage and discipline, UT research familiarity and research involving medical students. Undertaking this exercise enabled us to understand the strengths of each researcher and engage in ongoing reflexivity throughout our research. In particular, we challenged our own and each other’s beliefs, values and assumptions about the nature of the research (e.g. the nature of the UT construct and the relationship of UT to education and health care). Reflexivity therefore aided the rigour of our data analysis.

3 | RESULTS

The identified uncertainty stimuli were represented by three major themes: (i) educational uncertainty, (ii) professional uncertainty and (iii) clinical uncertainty, all of which were represented across cohorts and data types. Each theme comprises multiple subthemes, which are described in association with illustrative quotations. Pseudonyms are provided to protect participant identities.

3.1 | Educational uncertainty

Educational uncertainty was the dominant stimulus described by both cohorts spanning the study and encompassed student uncertainties about what they needed to learn and how to learn it:

Medicine is so big, and knowledge is infinite, it’s hard to figure out what knowledge to focus on and how to study in order to get there. So, we are simultaneously learning what is clinically applicable, and then what is the most efficient way to learn (Leena, Year 3B, Group Interview).

Subthemes were divided into (A) limits of students’ knowledge and skills and (B) learning structures.

In limits of students’ knowledge and skills, uncertainty stemmed from ‘gaps’ in students’ knowledge and/or skills they perceived as required to optimally perform in their described scenario. These scenarios included formal (e.g. tutorial) and informal (e.g. ward round or theatre) learning settings and typically involved requests to display students’ knowledge and/or skills by a supervising clinician:

A situation which I felt very uncertain is during a ward round when I had to interpret some radiology images in front of the entire cardiology team … and I was very unsure of the findings … I … could not clearly identify any abnormalities with the imaging hence, I definitely felt very uncertain (Nisha, Year 5D, Diary).

Students appeared to believe that the lacking knowledge or skills could be learnt (i.e. known unknowns); they simply had yet to do so. Although this theme largely centred on ‘medical knowledge’ and
clinical/procedural skill unknowns, it also encompassed research knowledge and skills, such as understanding statistical analyses and writing research reports:

I’m currently doing research for a consultant ... I do not know whether what I’m writing about is relevant, or if it’s the ‘right way’ of writing an article (Violet, Year 3B, Diary).

In learning structures, students described uncertainty about how to effectively learn within the health care setting of their clinical placements, including whom students should learn from. Students compared the learning structures of health care settings with their prior campus-based experience and described clinical placements as relatively unstructured. This included discussion about the apparent infrequency of formal learning activities (e.g. tutorials and lectures) and resulting uncertainty about how students were meant to structure learning in their absence:

In preclin [preclinical years] ... we pretty much have a timetable, we know what we are meant to get through ... our days are essentially planned out for us ... whereas now it’s seems like it’s very much up to us to figure out how we get to where we want to get to ... all that uncertainty surrounding ... how we do things, what we learn (Toby, Year 3B, Group Interview).

Clinical placements were thus described largely in terms of informal learning activities, with these divided into passive observation of health care professionals, and active learning through participating in health care-related tasks. However, as health care novices, students were uncertain about how to balance passive with active informal learning opportunities on placement to optimise their learning:

I was on a rotation that was ... primarily a consulting unit. So, there wasn’t too high of a workload, but that also meant that as a learning experience ... we were just asked to wait around to see if there are any interesting consults. And so therefore ... I felt uncertain, because I did not really have much to do at hospital (Patrick, 5D, Individual Interview).

3.2 | Professional uncertainty

Students described uncertainties pertaining to who they are as medical students and who they will be as doctors. The former involved subthemes related to (A) professional identity and (B) professional role, and the latter related to (C) career plans.

Discussion of professional identity uncertainties centred around students’ attitudes, values and beliefs about who they are within the context of clinical placements and uncertainty about how this professional identity relates to their personal identity. This especially pertained to beliefs about how to demonstrate care to patients. Students described that in their personal experience (e.g. platonic relationships), they identified care with expressions of physical touch or closeness, but as medical students, recognised that such expressions could transgress professional boundaries. Thus, students were uncertain about how to balance responding to patients as they would fellow human beings, with the ‘propriety’ of medical student-patient relationships:

I encountered a patient who had basically been given a terminal diagnosis ... it sort of stirred up quite a bit of emotion in the patient ... I wasn’t sure entirely how to respond ... whether my prime responsibility is to comfort them and make sure they are okay, as opposed to in professional circumstances where you probably should not be hugging patients or putting your arm around them ... balancing who I might normally be in a social circumstance, versus who I imagine doctors are supposed to be in some sort of professional distancing (Raimon, Year 3B, Individual Interview).

Professional role uncertainty stemmed from the ambiguous boundaries of medical students’ expected functions and responsibilities on placement. Students described the functions of their role primarily in terms of learning and recognised their capacity to contribute to the workings of their senior clinical colleagues as they gained relevant experience, alongside their major responsibility as maximising learning whilst ensuring the safety of patients. Professional role uncertainty thus arose when another’s expectations about the functions of a student’s role differed from how the student perceived these, with the potential for these expectations to impact students’ responsibilities to patient safety and/or learning. This theme was described in relation to the role expectations of doctors, other health professionals, fellow students and patients. Students were thus uncertain about whether they should complete requested tasks that were in conflict with students’ own professional role definitions:

I found that ... nurses, allied health staff and even patients and their family members would approach the other medical student and I to ask questions or make a request. When the questions were straightforward, I had no issues helping out. However, occasionally I felt unsure whether I had the authority to convey messages or make decisions that ward staff asked of me (Pallavi, Year 5D, Diary).

Career plans incorporated uncertainties about career intentions and prospects from internship (i.e. first post-graduate year), through to specialist practice. Aspects of this discussion included uncertainty about the adequacy of students’ preparation for practice, how to identify an enjoyable specialty and balancing the practical and personal implications of postgraduate training. For example, some students discussed uncertainties about training-related relocations and how these could impact personal relationships and planning of major life events:
Uncertainty. Recently about the future. What happens after we graduate? ... Some of us are looking at starting families, getting married, or buying houses and it's difficult when you do not know how many sites around Victoria or even Australia you'll be moved between (Hannah, 3B, Diary).

If a student had already chosen a preferred specialty pathway, uncertainty was described in relation to the likelihood of successfully being accepted into their desired specialist training programme. This was especially in the case of highly competitive programmes, such as surgical training:

All the way throughout medicine we use words like ‘calling’ and ‘passion’ with impunity as if this was our lot in life. I wonder what it does to our mental health when we fail that [surgical training] application for the 3rd and final time ... Like medical school, acceptance into specialist training seems almost random at times ... and not everyone can get what they want at the end of the day (Chen, 5D, Diary).

Thus, although career plan uncertainties centred on becoming and being a doctor, by extension, this theme encompassed uncertainties about how these plans might impact students' future lives holistically.

3.3 | Clinical uncertainty

Clinical uncertainty stemmed from students' involvement with patient care, and across all three major themes was the least represented among student discussion in either cohort. Distinct from the limits of students' knowledge and skills, where uncertainties can conceivably be resolved by gaining further knowledge or practising skills (i.e. known unknowns), clinical uncertainty represents the unknown unknowns relating to lacking evidence, indeterminacy of future outcomes, complexities of patient care and medically unexplained events. Subthemes included (A) management of conflicting conditions and (B) uncertainties approaching end-of-life.

Management of conflicting conditions related to uncertainties about how to optimally manage co-morbidity, where the optimal treatment of one pathology could worsen another. Specific examples described by students included managing concomitant renal and cardiac failure, and haemorrhage and thrombo-embolism:

The dichotomy between risking another bleed versus leaving the PE [pulmonary embolism]. If we did not manage his PE, he would inevitably arrest and die; if we did not manage his UGIB [upper gastrointestinal bleed], he would inevitably arrest and die (Chen, Year 5D, Diary).

Uncertainties approaching end-of-life involved questions as to whether aspects of medical or palliative care may hasten death, how to maintain quality of life and the indeterminacy of life expectancy:

This patient was palliative and the [Hartmann's] procedure was done for symptomatic benefit ... and would greatly improve her quality of life ... The procedure was done without many hiccups ... However, whilst on the ward, things began to deteriorate ... A palliative care referral was done however not processed in time. She died on the ward without being assessed by palliative care ... I felt extremely uncertain whether this operation should have been performed on this patient (Cathy, Year 5D, Diary).

This subtheme also encompassed uncertainties pertaining to psychological and social aspects of end-of-life care, including how to balance differing beliefs and values held by the patient, their family and the treating teams. These uncertainties could be further compounded by health systems constraints that impacted the capacity to enact preferred care plans:

One of our patients ... had requested to return to the hospital in her home town where she wished to be managed in close proximity to her family before she passed. The dilemma that arose was that she ... required to be fed via a NJ [nasojugal] tube. The hospital facility in her hometown ... would not “technically” be able to manage her NJ feeds ... If we were to remove her NJ tube before transferring to the other hospital, this may unnecessarily hasten her death, which was against the wishes of the patient, her family and us the treating team ... the least we could do was get her home and fulfil her and her family's wishes ... Yet ... I also understood how it would be difficult to balance this empathy towards a dying patient, and one's need to uphold the standards of practice (Muriel, Year 3B, Diary).

So, although death is ironically one of life's only certainties, students described uncertainties about how to truly optimise the care of a dying patient within the complexities of real-world medical care.

Accordingly, these major and subthemes indicate that our participants experienced a breadth and depth of uncertainty stimuli. This is perhaps best encapsulated by Year 3B student Leena, who aptly described clinical years medical student experiences as 'a whole lotta uncertainty'.

4 | DISCUSSION

This research explored uncertainty stimuli as experienced by medical students during their clinical years. We identified a broad range of educational and professional uncertainty stimuli, in addition to the clinical uncertainties that are described by previous research. Among these, educational uncertainty was the dominant stimulus and represents students' uncertainty about how to learn within the placement context and known unknowns that can be overcome by gaining...
further knowledge and experience. This latter aspect is similar to Fox’s `incomplete or imperfect mastery of available knowledge’. The dominance of educational uncertainty in the present study may thus be representative of the substantial increase in the volume of medical knowledge that students are required to learn in more than half-century since Fox’s research was published. Although more contextually focussed, educational uncertainty also has similarities to the stimulus ‘studying anatomy’ identified in our earlier study, wherein students described uncertainty about the breadth of knowledge they required and how to most effectively study anatomy. Educational uncertainty in the present study extends this stimulus by incorporating uncertainty about learning skills as well as knowledge and structuring learning within the complexities of health care settings.

In contrast with the known unknowns described in educational uncertainty, the unknown unknowns of clinical uncertainty were less typically described by students. Clinical uncertainty is similar to the ‘limitations in current medical knowledge’ described by Fox, although in the present study extends beyond medical knowledge to additionally encompass social and psychological aspects of patient care approaching end of life. The relative lack of discussion about clinical uncertainty may be reflective of students’ learning stage, in that until greater mastery of medical knowledge is obtained, students might have limited ability to distinguish known from unknown unknowns.

Professional uncertainty as a stimulus only has limited links to existing UT literature. Nevalainen et al. describe the ‘tolerating oneself as a good-enough doctor-to-be’ in their study of students’ experiences of uncertainty. Although the inclusion of ‘doctor-to-be’ sounds like it could incorporate elements of professional identity formation, this is not explicitly discussed in their work. Associations between medical student UT and preferences for careers are reported in multiple studies (e.g. higher UT associated with a preference for psychiatry and lower UT associated with procedural specialties); however, these studies did not explore how career planning uncertainty might additionally impact medical students’ UT. Professional uncertainty may thus be ripe for further exploration and ideally incorporate existing theory on professional identity formation within study designs.

Much prior research in medical students’ UT is based on UT scale implementation. Review of these scales reveals that some scale items refer to uncertainty generically (i.e. no specific stimuli or contexts are incorporated within items), whereas others include stimuli related to clinical uncertainty. The uncertainty stimuli described by medical students in our research raise questions about how both these item types may be interpreted by this population. Considering items incorporating clinical uncertainty, the relative lack of discussion of this theme in our study raises questions about the validity of these items among student populations. For example, the Tolerance for Ambiguity in Medical Students and Doctors scale includes the item ‘The unpredictability of a patient’s response to medication would bring welcome complexity to a doctor’s role’. Does the unpredictability relate to unknown individual patient responses? Or could this instead be interpreted as the doctor lacking necessary knowledge to understand likely patient responses? For students with limited health care experience who are still mastering the basic mechanism of action of common medications, this item may be ironically ambiguous and therefore limit scale validity. In contrast, if a generic item is implemented, our research suggests that students could be conceptualising any one of a broad range of uncertainty stimuli. Students’ conceptualisation of a broad range of uncertainty stimuli could explain the inconsistent results identified in prior research implementing UT scales among this population and highlights the need to ensure participant perspectives are assessed during scale development.

4.1 Implications for medical education

When considering the described uncertainty stimuli from the perspective of a medical educator, some stimuli can be considered intrinsic to the medical student experience. These include the limited knowledge and skills base of clinical novices, forming a professional identity and learning to manage clinical uncertainties within the constraints of available evidence and resources. However, other stimuli may have at least partial capacity to be modified by educators and provide students with a degree of scaffolding of exposure to uncertainty. Learning structure uncertainty could be modified by ensuring adequate placement orientation and educating students about how to effectively structure and regulate learning in clinical placement contexts. If these modifiable uncertainties are addressed, students may be able to devote greater attention to inherent learning uncertainties and, in turn, improve their capacity for learning about clinical uncertainty.

As appreciation of clinical uncertainty is increasingly considered a graduate attribute for medical students, our research suggests that educators may need to pay greater attention to students’ subject mastery and purposefully introduce clinical uncertainties relevant to students’ learning stage. Concomitant with introducing this stimulus, research suggests that specific educational interventions and curricular adaptations may act as moderators of uncertainty and assist students to develop skills for managing uncertainty. For example, clinical ‘grey cases’ are a team-based active learning approach, wherein students apply their existing knowledge to a clinical case, which purposefully integrates ambiguity. Based on the available information and limitations of evidence, multiple answers are possible, with students asked to discuss their thought processes in deciding on the answer they believe is most appropriate. Approaches to case-based learning may be further enhanced by educators who practise intellectual candour, whereby educators express to their own struggles with uncertainty in a related case and then reveal their thought processes for constructively managing the uncertainty to care for their patients. These approaches may consequently allow students to develop an appreciation of the intrinsic uncertainties of medical practice as distinct from their knowledge gaps and build their skills for managing uncertainties.

4.2 Implications for further research

Building on this research describing uncertainty stimuli, next steps in researching clinical medical students’ UT would benefit from exploring the remaining aspects of the integrative model (e.g. moderators,
appraisals and responses). Further research could also focus on exploring UT longitudinally across training and career stages. Understanding how clinicians at various career stages experience UT may shed light particularly on clinical uncertainties that were not a dominant theme in this study and how skills for managing clinical uncertainty develop.

4.3 | Methodological strengths and challenges

Our study has a number of methodological strengths, with some challenges. Key strengths include data volume and depth, theory-informed analysis and our reflexive, team-based approach to data analysis. A key challenge for our study was the interruption to clinical placements experienced by some students during the pandemic. Although this did potentially facilitate discussion of a wide range of themes to be discussed, it may have limited the depth of discussion on clinical uncertainty that may be expected to arise through in-depth interactions with patients and supervising clinicians. However, given Year 5D students (who had minimal placement disruptions) did not describe clinical uncertainty as a dominant theme, this could indicate that our findings reflect students' learning stage generally and not the pandemic context.

5 | CONCLUSIONS

We found that clinical medical students experienced a broad range of uncertainty stimuli. Themes encompassed educational, professional and clinical uncertainties, dominant among which was educational uncertainty. Our findings, in relation to educational and professional uncertainty in particular, suggest that students' uncertainty stimuli may differ from those of clinicians with more established knowledge and careers. Although some of the described stimuli might be expected as part of learning clinical medicine and becoming a medical professional, others highlight areas where uncertainties that are not core to learning could be modified by educators. Such modifications may allow students to devote greater attention to learning about clinical uncertainty, which was not a dominant stimulus of uncertainty described by our participants. Educators may thus need to pay greater attention to facilitating students' learning about clinical uncertainty, such as purposeful incorporation of clinical uncertainty relevant to students' learning stage.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

AUTHOR CONTRIBUTIONS

M.D.L. secured funding for the study. All authors designed the study protocol and secured ethics approval for the study. G.C.S. and M.D.L. were involved in recruiting participants for the study. G.C.S. collected data. All authors were involved in analysing and interpreting data. G.C.S. drafted the paper. All authors critically reviewed and edited various iterations of the paper. All authors gave their final approval for this version to be published and agree to be accountable for all aspects of the work.

ETHICS STATEMENT

We received ethical approval from the Monash University Human Research Ethics Committee (Project ID 20933).

DATA AVAILABILITY STATEMENT

Our institutional ethics approval did not include provisions for the release of the raw dataset due to the potentially identifying nature of the primary data.

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