

How Physicians Manage Medical Uncertainty: A Qualitative Study and Conceptual Taxonomy

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Background. Medical uncertainty is a pervasive and important problem, but the strategies physicians use to manage it have not been systematically described. **Objectives.** To explore the uncertainty management strategies employed by physicians practicing in acute-care hospital settings and to organize these strategies within a conceptual taxonomy that can guide further efforts to understand and improve physicians' tolerance of medical uncertainty. **Design.** Qualitative study using individual in-depth interviews. **Participants.** Convenience sample of 22 physicians and trainees (11 attending physicians, 7 residents [postgraduate years 1–3], 4 fourth-year medical students), working within 3 medical specialties (emergency medicine, internal medicine, internal medicine–pediatrics), at a single large US teaching hospital. **Measurements.** Semistructured interviews explored participants' strategies for managing medical uncertainty and temporal changes in their uncertainty tolerance. Inductive qualitative analysis of audio-recorded interview transcripts was conducted to identify and categorize key themes and to develop a coherent conceptual taxonomy of uncertainty management strategies. **Results.** Participants identified various uncertainty management strategies that differed in their primary focus: 1) ignorance-focused, 2) uncertainty-focused, 3) response-focused, and 4) relationship-focused. Ignorance- and uncertainty-focused strategies were primarily curative (aimed at reducing uncertainty), while response- and relationship-focused strategies were primarily palliative (aimed at ameliorating aversive effects of uncertainty). Several participants described a temporal evolution in their tolerance of uncertainty, which coincided with the development of greater epistemic maturity, humility, flexibility, and openness. **Conclusions.** Physicians and physician-trainees employ a variety of uncertainty management strategies focused on different goals, and their tolerance of uncertainty evolves with the development of several key capacities. More work is needed to understand and improve the management of medical uncertainty by physicians, and a conceptual taxonomy can provide a useful organizing framework for this work.

Keywords

management, taxonomy, tolerance, uncertainty

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Uncertainty—the conscious, metacognitive awareness of ignorance—is a pervasive and important experience in medicine.¹ It arises in a wide variety of circumstances, affects both providers and recipients of health care, and has numerous, primarily aversive psychological effects, including thoughts and feelings of vulnerability and a propensity toward indecision and inaction.^{2–4} Physicians and other health care providers manage these effects and

their experience of uncertainty itself through various strategies, but principal among these is the effort to seek information to reduce uncertainty.^{5–7} Nearly every major

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clinical activity that physicians undertake—diagnostic, prognostic, and therapeutic—is part of this overarching effort.

However, information seeking ultimately has limited effectiveness as a strategy for managing medical uncertainty. From a practical standpoint, this effort takes time; physicians and patients alike must always endure at least some period of waiting—for the patient's course of illness to unfold, for the diagnostic workup to be completed, for the effects of treatment to become manifest—before medical uncertainty is reduced by added information. In the meantime, they must somehow deal with its aversive effects. From a theoretical standpoint, furthermore, many medical uncertainties are simply not reducible by information. No amount of empirical evidence, for example, can definitively answer the question of what the “right” treatment is for any individual patient. Not only is this ultimately a moral question that depends on the values and preferences of individuals, but scientific knowledge of all medical outcomes is confined to probability estimates that are inherently imprecise and incompletely applicable to individuals.^{3,8,9}

The important task of managing medical uncertainty thus requires more than information seeking; however, there is surprisingly little empirical evidence on broader uncertainty management strategies used by physicians, other health care providers, or patients. In her seminal ethnographic studies of medical school training in the 1950s, sociologist Renée Fox documented how medical students employ various strategies to “manage their emotional reactions” to uncertainty, including “counterphobic, ironic, medical humor, laced through with impiety and self-mockery,”¹⁰ and the adoption of a posture of “detached concern” toward patients.^{11,12} In the early

1980s, physician and legal scholar Jay Katz famously characterized physicians' predominant management strategy as a “disregard of uncertainty”—a tendency to avoid acknowledging and disclosing uncertainty to patients.¹³ The limited empirical research that has since been conducted, however, has focused almost exclusively on information-seeking strategies for managing medical uncertainty.^{14–22} With the exception of a recent study by Ilgen and colleagues,^{23,24} to our knowledge there have been no other attempts to systematically account for the broader range of strategies that physicians use.

This is an important research gap for several reasons. It limits our theoretical understanding of how uncertainty affects both physicians and patients, what uncertainty management strategies are more or less effective, and why. More importantly, it limits our practical ability to help physicians cope with the negative effects of uncertainty on their own well-being and the care they provide to patients. Further empirical research to identify and coherently classify the variety of physicians' uncertainty management strategies is an important first step in overcoming these limitations.

To begin to address this need, we conducted a qualitative study to explore the views of a diverse sample of physicians and physician-trainees representing varying levels of professional experience and practicing in acute-care, high-stakes clinical settings (emergency medicine, inpatient general internal medicine) that generate a high degree of uncertainty about a wide range of issues. The overarching objective of our study was to provide a preliminary description of the strategies that physicians and physician-trainees use to manage the uncertainties they experience in their daily work and the ways in which their tolerance of these uncertainties evolves over time. The study's ultimate goal was to begin to develop a coherent conceptual taxonomy of strategies for managing medical uncertainty, which might serve as a provisional foundation for future research.

Methods

Study Design, Participants, and Recruitment

The study employed in-depth individual qualitative interviews and was led by an experienced behavioral scientist and internal medicine/palliative medicine physician who has conducted conceptual and empirical research on medical uncertainty.^{1–3,8,9,25,26} The study team included other experienced behavioral scientists, clinician-researchers, and clinician-educators representing internal medicine, emergency medicine, nursing, and a range of professional interests including clinical reasoning and

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medical education. Most team members and study participants worked at the same institution, a large urban 637-bed teaching hospital. Participants consisted of a convenience sample of 1) attending physicians and postgraduate residents (postgraduate year [PGY] 1–3), representing 3 specialties that deal with a broad array of problems (emergency medicine, internal medicine, medicine-pediatrics) in inpatient settings (emergency department, hospital medicine service) and 2) fourth-year undergraduate medical students in their final 6 mo of medical school training. Recruitment was purposive and conducted by email invitation, in-person presentations at department meetings, and snowball sampling and aimed at achieving a mix of more senior and junior attending physicians (both greater and less than 10 y of practice experience), residents, and students. Participants were informed of the study's topical focus on medical uncertainty. Recruitment aimed at data saturation but was ultimately driven by available resources and the overall goal of establishing an initial foundation for further research. The study was approved by the medical center Institutional Review Board.

Data Collection and Interview Content

From July 2018–April 2019, 22 individual interviews, lasting approximately 30 to 45 min, were conducted by telephone by 1 of 3 experienced qualitative researchers with no professional relationships with participants. Field notes were kept to track notable findings and the data collection process, and interviews were audio-recorded and transcribed verbatim by a professional transcription service. Interviews were semistructured and followed a moderator guide (Supplementary Appendix), developed by the entire multidisciplinary research team and consisting of open-ended questions and close-ended probes designed to elicit participants' perceptions of 1) the extent and types of uncertainties they experience in clinical practice; 2) their psychological responses to these uncertainties, and any temporal changes in these responses; and 3) the strategies they use to manage medical uncertainties. During the course of the study, minor revisions were made in the interview guide to clarify and explore emergent themes in greater depth.

Data Analysis

Line-by-line software-assisted coding and in-depth qualitative analysis of anonymized interview transcripts were conducted using the program MaxQDA. The analysis used an inductive, constant comparative, grounded theory approach aimed at minimizing preconceptions,

allowing key themes to emerge, and generating new theoretical understandings.^{27,28} Two researchers—the lead investigator and an experienced qualitative data analyst and doctoral-level medical anthropologist—first developed a working codebook by reading 10 transcripts, inductively identifying themes in participants' verbatim statements (open coding), and then categorizing emergent themes according to their content (axial coding).^{27,29,30} The investigators met after coding each transcript to compare coding decisions, resolve areas of disagreement, and refine the codebook. The lead investigator and a second experienced master's-level qualitative data analyst then applied the working codebook to analyze all remaining transcripts, comparing new data, concepts, and themes to those previously identified, highlighting potential interpretive biases, and achieving consensus by triangulating investigators' differing perspectives. The investigators met regularly to compare, harmonize, and validate interpretations and coding decisions. Finally, the lead investigator conducted a secondary analysis of final codes and coded text to organize primary themes into higher-order conceptual categories according to logical relationships between them, triangulating these categories with theoretical constructs from the broader psychological literature to create an overall conceptual taxonomy that the entire research team reviewed and refined. Participant feedback on study findings was obtained from 5 extensively quoted members (23%) of the study sample.

Results

The study sample (Table 1) consisted of 22 participants: 11 attending physicians (practice experience 1–41 y), 7 resident physicians (PGY 1–3), and 4 medical students (MS-4). Participants described multiple uncertainties in their daily clinical work, which were primarily related to the diagnosis, prognosis, and treatment of their patients, and various primarily negative psychological responses to these uncertainties, including feelings of insecurity, fear, and anxiety. Participants described various strategies for managing these uncertainties, which we classified within 1 of 4 conceptual categories corresponding to their primary focus or target: 1) ignorance-focused, 2) uncertainty-focused, 3) response-focused, and 4) relationship-focused. This classification does not preclude multiple focus areas for any given uncertainty management strategy but simply assigns a logically primary focus to each. Several participants also described a temporal evolution in their management of uncertainty, which they attributed to the development of several key

Table 1 Participant Characteristics^a

	<i>n</i>	%
Gender		
Female	8	36
Male	14	64
Race		
White/Caucasian	22	100
Other	0	0
Specialty		
Emergency medicine	9	41
Internal medicine	7	32
Internal medicine–pediatrics	2	9
N/A (medical student)	4	18
Professional role		
Attending physician	11	50
Resident physician (PGY1–3)	7	32
Medical student (MS-4)	4	18
Posttraining experience (y)		
0 (medical students and residents)	11	50
1–10	6	27
>10	4	23

PGY, postgraduate year; MS-4, fourth-year medical student; N/A, not applicable.

^aParticipant quotations throughout the text are identified by specialty and training level, using the following abbreviations: specialty: EM (emergency medicine), IM (internal medicine), IMP (internal medicine–pediatrics); training level: A (attending), R (resident), MS (medical student).

capacities: epistemic maturity, humility, flexibility, and openness.

Ignorance-Focused Strategies

A major category of uncertainty management strategies is ignorance-focused, that is, directed at reducing or “curing” medical uncertainty by decreasing the ignorance that constitutes its object or root cause as a metacognitive state. These commonly cited strategies form the foundation of routine clinical care and encompass *initiating diagnostic evaluation*, *instituting therapeutic trials*, *consulting with colleagues*, and *searching the medical literature*. Illustrative quotes are presented in Table 2, and a conceptual taxonomy of strategies is presented in Figure 1.

Uncertainty-Focused Strategies

A second major category of uncertainty management strategies is uncertainty-focused, that is, directed not at the ignorance that represents the object of one’s uncertainty but at the higher-order, conscious awareness of this ignorance that is necessary for uncertainty to exist as a metacognitive state.¹

One commonly cited strategy, reinforced by the prevailing culture of medical practice and education, consisted of *maximizing attention* to one’s ignorance (e.g., by “double-checking” or maintaining a “high index of suspicion”), thereby maintaining one’s uncertainty. Participants noted, however, that this strategy promoted emotional distress and needed to be counterbalanced by efforts aimed at *minimizing attention* to one’s ignorance: ignoring one’s ignorance or restricting the scope of one’s awareness of it—thereby reducing or curing one’s uncertainty. A related strategy was *disengaging from uncertainty*: psychologically letting go by either emotionally distancing oneself from uncertainty or transferring the responsibility of dealing with it to others. Another important strategy was *adjusting epistemic expectations*: acknowledging the impossibility of perfect medical knowledge and thereby relinquishing the quest for certainty. A final uncertainty-focused strategy was *ordering uncertainty*: imposing some logical structure or process to make it more manageable. Examples included adopting a rational risk-benefit analytic framework or having an order of operations or clinical pathway to follow.

Response-Focused Strategies

A third major category of uncertainty management strategies is response-focused, that is, directed neither at ignorance nor one’s consciousness of it but at one’s own psychological responses to uncertainty. These differ from ignorance- and uncertainty-focused strategies in attempting not to reduce or “cure” uncertainty but to mitigate or palliate its aversive psychological effects.

A primary response-focused strategy identified by several participants consisted of *withstanding negative effects*: somehow resisting or stoically enduring the “feeling of angst,” as one EM attending physician described it, incited by uncertainty (EM-A-18). Another frequently cited response-focused strategy was *cultivating virtues*: enacting moral values such as industriousness, thoroughness, or due diligence in patient care as guiding ideals or surrogate goals that could be achieved despite the incurability of uncertainty. *Compartmentalizing* psychological responses—uncoupling and sequestering cognitive, emotional, or behavioral responses to uncertainty order to limit their deleterious effects—was another frequently cited coping strategy. Another important strategy was *self-affirmation*: an acknowledgment of one’s own core strengths or positively valued attributes that transcend one’s limitations. *Self-forgiveness* was a final related strategy that involved not only absolving oneself from guilt and blame but caring less about the negative evaluation of other people—both clinicians and patients.

Table 2 Uncertainty Management Strategies^a

General Strategy	Specific Strategy	Illustrative Quotes
Ignorance-focused	Initiating diagnostic evaluation	Well, everybody comes in uncertain in our world. . . . And so then you tease that through history taking, physical exam, and then testing . . . your uncertainty goes down as you get more and more data back. (EM-A-18) I definitely want to reduce my uncertainty. I definitely do testing to accomplish that. (IM-A-7) So in cases where it's truly unclear and I'm uncertain, then I just test for everything I can think of that is remotely relevant or just try to single it out. That's what I end up doing. (EM-A-13)
	Instituting therapeutic trials	A lot of the times in primary care or less acute situations, you can be uncertain and you probably are at times, but the stakes might not be that high. You have the time and the relationship with the patient to try different things over time. And if one thing works, great, and if it doesn't then you prescribe one antihypertensive medication and you see if it works. And you bring them back in 3 or 4 weeks and you check it again and you're like, okay, I was uncertain about that choice, but let's try again. (MS-21) Just that we don't sometimes have the tools at our disposal to be certain all of the time. And like I said, we end up being fairly certain. But you know, there's a lot of hypothesis testing, meaning you start a patient on a treatment and if it's not working you have to step back and be okay with saying, "Well maybe that wasn't the correct diagnosis," and kind of reevaluate what's going on. I think that's a part of medicine. (IM-R-14) And then abdominal pain where I find nothing, I might say, "We're not really sure what caused your pain. We've taken the really bad things off the list. If you get worse you have to come back. If anything changes you have to come back. If you get a fever you have to come back or see your doctor. We're going to trial this course of antacids to see if it's an ulcer or some gastritis upsetting your stomach. And you probably need to get a scope. And they're going to go down and look at your stomach lining, something we don't do in the emergency department. And here's the number to call the gastroenterologist. And I've put in the consult." (EM-A-17)
	Consulting with colleagues	But then I think ultimately in most academic centers, there's always someone to bounce the idea off of and help take away your uncertainty. But even if you've exhausted your possibility of taking away uncertainty through testing and imaging or diagnostics, you can always in an academic center generally bounce what the case has been up to that point off a colleague . . . that certainly helps people I think in terms of feeling better about what uncertainty they have left after completing a workup. (MS-19) I have an attending physician who I'm running everything by. And that takes my anxiety levels down a lot because I feel like I have a sounding board. (IM-R-14) I definitely talk with my colleagues all the time. We all run cases by each other—I don't know. I don't know where I lie on the curve, but I frequently talk about cases with colleagues to make sure I'm not crazy. . . . We all sometimes will come into the office and say, "I need a consult." And we're joking because we're talking to our colleagues, we're not calling a special—we're talking to each other. We may question each other frequently, "Am I crazy, or am I missing something here?" Nobody has ever said uncertainty itself as a word, but other terms for it. (IMP-A-11)
	Searching the medical literature	And then implicitly you sort of just run into that all the time as a learner who is trying to understand what's happening with your patients in facing uncertainty and doing research to try and minimize that as much as you possibly can. And by research I mean reading. (MS-22) I think one thing I do a lot is read, in a specific situation, clinically. So if I'm uncertain about something, I tend to look it up and think of all the different possibilities that it could be to make sure that I cross my T's and dot my I's. (IMP-R-8) I guess I would turn back to, "Do I have all the knowledge?" So there are times where I'll look stuff up around uncertainty if it's a case we see infrequently. Because there's a lot of stuff you do in medicine that is rote or a known entity. But there are things that will roll into an ED that is not in our wheelhouse. So I always—if there's a knowledge deficit on my side, then I will turn to resources like that. (EM-A-17)
Uncertainty-focused	Maximizing attention	So it's stressful, and it probably interferes with your work with other patients, because you're not really thinking about anything else other than that particular patient in that case at that moment. And I'm someone who kind of like needs to quote "finish" that case before I can really mentally engage in anything else. So I'm sort of just perseverating on all the things and possibilities I can be considering or missing or whatever until it just gets settled. But it's all consuming I would say. . . . In any way, I rethink and think through everything over and over. It's almost like a cycle where you just cycle, cycle, cycle through, until you're sure there's nothing else you could have done or do differently at the moment. (EM-A-13) Well, I think one thing I do is I double-check. So I don't—when I go home at night I review all my charts again. So I don't just stop work at the end of the day, hang up my stethoscope and then come back in the next day. I tend to go back over things in the evenings and that gives me a fresh perspective sometimes. It also helps you stay on top of things, of course. But I think that second check is very useful. (IM-A-7)

(continued)

Table 2 (continued)

General Strategy	Specific Strategy	Illustrative Quotes
	Minimizing attention	<p>So to be able to focus my attention once there's—or not focus my attention on things that can't be undone. I made a decision, regardless of the consequences. Having the mental flexibility to say, from an emotional standpoint, I'm not going to focus on this anymore because there's nothing I can do about it. (MS-21)</p> <p>I may not know what ultimately is the final, final, final diagnosis that they find out upstairs in 2 or 3 days, but for the most part, I know what needs to be done and happen over the next 6 hours in the ER. (EM-A-13)</p> <p>And if you ask me, I would say I've probably become a bit more not necessarily less tolerant of uncertainty. . . . I feel like I've honed down more on the high-risk things that we do every day and pay more attention to those. Things like heart attacks and neurologic presentations. Those are the ones that tend to be fraught with risk for us in emergency medicine. Unclear presentations are high risk. Old patients, very small babies, those are high-risk patient populations for us. Intoxicated patients, high risk. And so part of my evolution in my career has served to kind of hone the patients that I tend to pay more attention to and become more conservative with. And that's something that's evolved over time. And by the flip side, experience after 15, 20 years of doing this has helped with some of the other complaints. So I have become more apt to be a minimalist just because of my clinical experience. (EM-A-16)</p>
	Disengaging from uncertainty	<p>I think from an intellectual standpoint, if you can remove yourself emotionally from it, it's really valuable to be able to go back through decisions and learn from them. But it's hard to do that if you haven't separated from it emotionally. (MS-21)</p> <p>In a big way, I get a lot of solace from reminding myself and reminding the patient that I'm an emergency physician, and so what I'm equipped for and I have the training for are ruling out life-threatening issues, treating what I can, and determining if a patient needs to be admitted to the hospital or discharged. (EM-R-3)</p> <p>We'd love to say that all the time, it's 100% clear that you walk in with a problem and by the end we diagnosed the problem and set out a reasonable treatment plan. But there are not insignificant numbers of patients where you may be able to tell them this is what's not wrong, but I can't tell you what exactly is causing your symptoms. So we try to rule out the life-threatening things and set them on a path, if we can't diagnose it in the emergency department for what's the next step to try to get the diagnosis. Check off boxes and move them along. (EM-A-16)</p>
	Adjusting epistemic expectations	<p>There's always going to be things that you haven't been exposed to. And the frequency with which you encounter those will decrease over time. And then you can't read everything in the world. So there's always going to be that. And then patients present with things that may not be clear to anybody based on a thorough workup and everything like that sometimes, there's just no very good answer for what is going on with a patient. (MS-22)</p> <p>I mean that you just, before I went into medicine, my impression of doctors and testing and all that was that, again, you do a test and it says, "Aaah, this is definitely what we're treating." But a lot of times, you just don't get that. And I think at first that was frustrating. And kind of the further I'm getting, I'm still relatively new in practice, but the further I get into it, the more kind of comfortable I am just saying, you know what, I might not ever have a definite answer to this, but what I did made the patient better and so that's the point. And that's okay if I can never say what this is, pneumonia, or COPD exacerbation, or both. (IM-R-14)</p> <p>Yeah, I think I'm used to uncertainty because I've been doing medicine long enough that I don't expect anything to be certain. So I think I look at a lot of things with skepticism. So I'm comfortable with a certain level of uncertainty. . . . I know when a certain level of uncertainty is just to be expected, and then that's okay. (IM-A-6)</p>
	Ordering uncertainty	<p>So having sort of a mind to take uncertainty and to try to break it down into a risk-benefit analysis is what I think is the best way for me to, I guess deal with it. But it's something that I really enjoy is having that risk-benefit analysis going on in my mind. (MS-19)</p> <p>So I think there's a couple of things there. I think one is that the difference between being a second and a third year is that you know the system and you know the order of operations, so to speak. You know what to do if things go wrong. Like at that point, you've been trained enough that you know what to do. And so, I think that takes some of the fear out of it because you know how to respond. (IM-R-2)</p> <p>It's kind of sequential. You start with a name, an age, a gender, and a chief complaint. Then you have a patient interview, history and physical that helps to remove some uncertainty. And then there's laboratory tests and X-rays and CT scans that help again, hone down the diagnosis. So it's a process. And so something that may start wholly uncertain and undifferentiated, hopefully by the end of an encounter, is a lot more clear. (EM-A-16)</p>

(continued)

Table 2 (continued)

General Strategy	Specific Strategy	Illustrative Quotes
Response-focused	Withstanding negative effects	<p>I think those are the situations where it starts to gnaw, and that's the patient you think about when you're done with a shift or when you get home at night. That's when it becomes much more challenging to—because if you've exhausted your ability to mitigate the uncertainty, then you're left with that. And nobody, that's very human to not want to leave something unaddressed like that. And the only thing I can think of is just perspective, and that I think particularly for emergency medicine, the one tool that frequently can't be used to mitigate uncertainty is time. And sometimes it takes time for a disease to declare itself, or something to change in the way that takes away uncertainty for the patient or for the provider. The encounters are short. You're only seeing that patient over the course of hours in one day. So having the perspective to say that this patient might need time, the one thing I can't use to address their concerns and this uncertainty. (MS-19)</p> <p>I think it just, you kind of try to stop and order the tests that you think you need to do. And then for me generally, I think about those patients all night, because I'm like, "Oooh, I really feel uncomfortable about that." But I don't know if I ever feel like I deal with it. I think it's more that I feel just a sense of unease. . . . I think another piece is that being in the game this long you realize that it's okay to not have the answers, even though it's uncomfortable, but it's okay, and sometimes you just have to live with it. . . . It's just sort of like an accumulated wisdom of, and knowledge of the system, and then also feeling more okay with having that fear in the back of your head. (IM-R-2)</p>
	Cultivating virtue	<p>You sit in it. You honestly try to make the best choice that you can and you wonder if you did. (EM-A-18)</p> <p>But you do run into situations where you're not going to make a slam dunk diagnosis. And if I really have done my due diligence and I still—we just don't—it's a clinical situation where for what we have available, we cannot say yes or no with some sort of certainty, then I feel okay about that. But I make sure to do due diligence to get to that point. (IM-R-14)</p> <p>I think I try to make sure I've done what I can to kind of answer the question—that I've done due diligence in reviewing a chart and doing a good physical exam, and involving the patient's family members . . . if I've done the due diligence, then the uncertainty is kind of part of the job, and I've managed it to a level where it's not unexpected. (IM-A-6)</p>
	Compartmentalizing psychological responses	<p>I get solace from knowing that I did everything that I could and I communicated everything that I could to this person to make sure that they understood what to watch out for. (EM-A-13)</p> <p>You can learn to compartmentalize. You can learn to focus your attention on, okay, I've made a decision even though I wasn't certain in my ability to make it or whether it was right. It's been made and now I have to see where the result is and know . . . I think you can learn to focus your attention and compartmentalize your feelings based off, you know, separate that from your analytical decision making. . . . I think certainly for me as an individual exercise and meditation are things that I use to help me compartmentalize emotionally. (MS-21)</p> <p>For me personally, how I deal with that kind of stuff is I'm fortunate to have a wife, 2 kids that I can come home to, and kind of turn off my medical brain. Exercise is a huge component. . . . And then the other piece of it is the balance of my clinical work with my academic and administrative stuff. (EM-A-16)</p> <p>The emotional reaction, the visceral reaction, I think is harder. I think it depends on what your coping strategies are. For me, it's spending time with family. I went out for a long bike ride last night, and that was helpful. So it's in the same way I manage any other stress. It's trying to find outlets that either distract me or kind of diminish what my heart rate, my sweating, those type of things induced by emotionally. (IM-A-6)</p>

(continued)

Table 2 (continued)

General Strategy	Specific Strategy	Illustrative Quotes
Self-affirmation		<p>Yeah, I think from the beginning of intern year to now, I think that I've become much more okay with uncertainty and definitely okay with uncertainty and even the mistakes that I've made. . . . I literally last night was talking to one of the hospitalists who is a few years older than me. Two years ahead of me, rather, and I was like, "Did you ever discharge someone and then you realize 5 days later that you should have done something different?" She's like, "All the time. I do that all the time." And just that little thing kind of makes you feel better. (IM-R-1)</p> <p>For me personally, when I first started being an attending, I really felt like a fraud; felt like, what am I doing here? I'm not smart enough to do this. And it's gotten better as the years have gone by. And I definitely feel much more comfortable in my own ability to practice medicine. And I guess why I came to that conclusion about the 3 things that I try to do, which is be nice, be smart, be careful, which is I'm taking care of somebody and I'm not doing those 3 things then I should stop, reflect, and say, "What can I do to do this better?" (EM-A-5)</p> <p>But then it [uncertainty] can tip the scales and become a self-injurious process, you know? Where you never give yourself credit for what you do know and for the skills that you do bring to the table. I think that's where it becomes really harmful for people who are experiencing that. . . . But I really think medicine is evolving, and we've made a lot of progress in our ability to say, like there's a lot to learn and at any one point you might be working on X, and that's just overall going to make you even that much better of a physician. . . . It's part of the culture of changing the culture of medicine from one of being completely invulnerable to anything to admitting that we're human . . . you can be a good doctor and make mistakes at the same time. (EM-A-18)</p>
Self-forgiveness		<p>So I think I stopped really caring as much about what the patients think . . . because I don't think it's based on clinical competencies . . . so a good example is being an intern on nights is like the prime example of this. When you're making these decisions and you know that the day team is going to judge you on those decisions. And it's really kind of scary where you're like, "Wow, I hope that they think I'm smart. I hope they don't think that I don't know what I'm doing." And I think it just gets a little bit easier. I found that as I've grown too, I felt like I'm a little bit more confident, and I don't care as much about if the people that are accepting the patients that I admit or the people who are going to see the decisions that I've made overnight, I don't know if I—I still care what they think, but I don't care as much, I guess. . . . But sometimes, I can't do anything and I think my way of coping is just, "Well, you know, we did the best we could, but that was beyond my control." So I don't feel that as hard as I think some other people feel, like deaths that were completely just luck and it had nothing to do with medical care. . . . So it's one of those things that I think if you beat yourself up for every mistake, you'll never be able to get through it. And I think as a medical student, a lot of medical students beat themselves up over every mistake, but you get to the point in residency where you just can't do that. (IM-R-1)</p> <p>I haven't done it as much as I should, but when I drive home, I try and forgive myself. If you have a rough shift and you just—you feel like you really didn't do anything for anybody because you were spread so thin, it's easy to take that home and feel guilty. Maybe that's not necessarily uncertainty specific, but it's certainly plays a part in that. (EM-A-10)</p> <p>I think things have changed a lot in the last 20 years, and I think that there's definitely recognition for the wellness piece of it, the peer-to-peer piece of it, the kind of open dialogue. The uncertainty I think to some extent used to may be more than a weakness, more of a kind of, well if you're uncertain, then you're not a good doc, you're not smart enough, you're not whatever. But I think that seeing the evolution certainly with some of my peers is to be more open about admitting your uncertainty and also besides just internalizing it and looking at references yourself is to kind of get some help from other people just to bounce it off people. . . . When I started, if you were on rounds and you didn't know the answer to something, that was embarrassing. You were to some extent even demeaned. I mean, it depends on what rotations you were on, surgery especially. But I think there's much more acceptance that it's not an expectation that you have all the answers. It's expectation that you've kind of done the work, you've gone through the process, and you're thinking about this in the right way. (IM-A-6)</p>

(continued)

Table 2 (continued)

General Strategy	Specific Strategy	Illustrative Quotes
Relationship-focused	Sharing with colleagues	<p>It's for the learning, too. But it's probably more for the emotional support. And to hear how they would have handled it and to see if it's any different. But I think you're hoping, you're kind of hoping that they would have done it similarly, to be honest. You really are, if that makes sense. So there is a learning part, but it's yeah, its part. Does that make sense? (IM-R-15)</p> <p>Well, I'm always a big proponent for talking about things. So I feel like getting it out in the open. And for people, like it was really helpful for me to understand that other people would feel that same way. That helps maybe decrease the feeling of isolation that you have with that process. I actually think, again, it's the power of sharing stories. Like this happens to everyone. And the first thing you're told when you're going through that process is, don't talk to anybody about it. All the lawyers and stuff tell you that. So, not only are you experiencing one of the biggest work stressors you can imagine, you're then told to clam up about it. And you can see how that might not be helpful, right? So I actually encourage people to talk to somebody they trust about it. And you don't have to go through the details of the case, so that when you're asked, "have you talked about your case with anybody?" you can say, no I haven't talked about the case. That you can go through how it feels to be in that process. (EM-A-18)</p>
	Sharing with patients	<p>And, yes, I find myself sharing that [uncertainty] with my patients much more so than I did 10 years ago. And also sharing that with colleagues. I am much more likely, for something that is uncertain, to, for instance, call a colleague in hospitalist medicine. So internal medicine—those that admit people to the hospital and say, "This is what I have. I've got a 60-year-old with chest pain. Everything is looking okay here. But something just doesn't seem quite right. I'm a little worried about letting this person go home. I can't give you a definitive reason for why they definitely need to stay in the hospital. But let's talk about it and see if we can come up with a reasonable plan." And, personally, I have found that I have found that being able to say not only to your patients, but to your colleagues, "I don't know, I've tried my best to get to an answer, but I need your help," has been very, very fruitful. (EM-A-16)</p> <p>At the end of the day, you need to be able to communicate that with the patient. Like, hey, say we've done a bunch of tests and we've tried to do all these things to figure it out and we haven't, you need to sort of establish with the patient that it's not exactly clear what's going on. And that your effort has been to understand that and especially to rule out the most concerning things that we have a test for. And so you sort of communicate the uncertainty but also try and sort of demonstrate that you've done a thorough workup and that the most concerning things that you might find that haven't been found, at least it's reassuring that that's the case. (MS-22)</p> <p>And, yes, I find myself sharing that with my patients much more so than I did 10 years ago. And also sharing that with colleagues. I am much more likely, for something that is uncertain, to for instance, call a colleague in hospitalist medicine. So internal medicine—those that admit people to the hospital and say, "This is what I have. I've got a 60-year-old with chest pain. Everything is looking okay here. But something just doesn't seem quite right. I'm a little worried about letting this person go home. I can't give you a definitive reason for why they definitely need to stay in the hospital. But let's talk about it and see if we can come up with a reasonable plan." And personally, I have found that that being able to say not only to your patients, but to your colleagues, "I don't know, I've tried my best to get to an answer, but I need your help," has been very, very fruitful. (EM-A-16)</p> <p>I think finding ways to have that conversation with a patient or family about the fact that I am uncertain and what the consequences of that uncertainty—what the range of consequences are, and try to bring them into the conversation so I can share some of that decision making with the patient and family and not carry it solely on my shoulders. . . . And then I'm still uncertain what's the matter with the patient, but we've had some shared decision making on what to do with that uncertainty and how to play that out for the patient. So they've taken some ownership in that. And it doesn't get me off the hook. I'm still the doctor, but emotionally, it discharges some of the anxiety that I may have had going into the room before. (EM-A-4)</p>

^aParticipant quotations identified by specialty and training level, using the following abbreviations: specialty: EM (emergency medicine), IM (internal medicine), IMP (internal medicine–pediatrics); training level: A (attending), R (resident), MS (medical student).

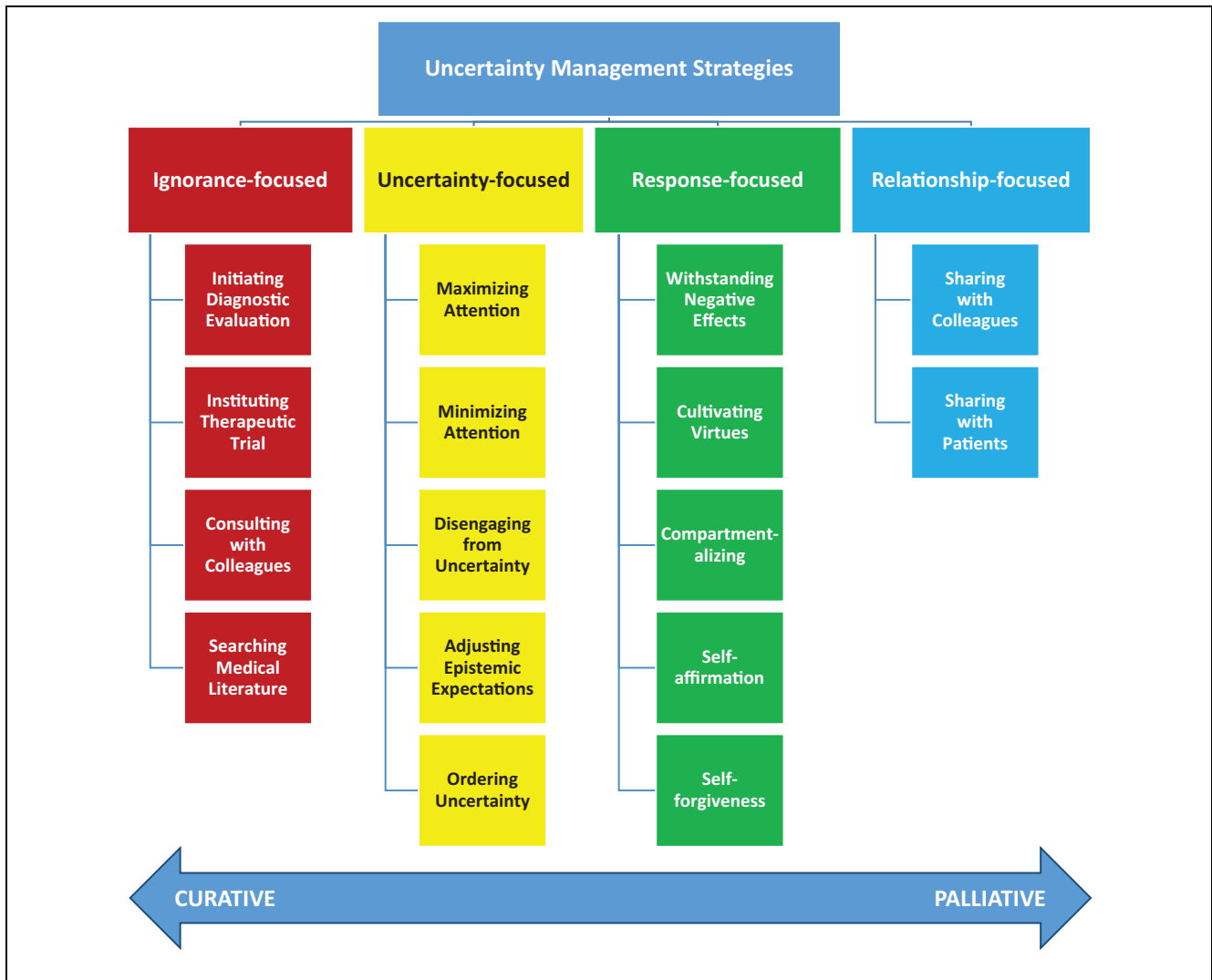


Figure 1 Physicians' uncertainty management strategies: conceptual taxonomy.

Relationship-Focused Strategies

A fourth major category of uncertainty management strategies is relationship-focused, that is, directed not at ignorance, uncertainty, or psychological responses to uncertainty but at social relationships between physicians, other health professionals, and patients. These differ from ignorance-focused information-seeking strategies in relating with other persons not as a means of curing uncertainty but of palliating its aversive psychological effects.

Sharing with colleagues was the most commonly cited relationship-focused strategy, which helped physicians and trainees to cope with uncertainty by fostering mutual feelings of trust, support, and self-worth and preventing feelings of isolation. As one IM resident put it, “You

don't want to just be like an island and by yourself” (IM-R-14). *Sharing with patients*—giving them “a little bit of investment in the decision-making process,” as one EM attending physician put it (EM-A-13)—was another strategy that multiple participants valued as a means of lightening the emotional burden of uncertainty.^{31,32}

Evolution of Uncertainty Tolerance

An important cross-cutting theme that emerged throughout all interviews was a temporal change in physicians' responses to medical uncertainty. Participants at all levels of experience described how their own set of negative and positive psychological responses—that is, their

“uncertainty tolerance”^{2,26}—evolved over time and how this process involved the acquisition of various key capacities (Table 3).

The first consisted of what educational psychologists have called *epistemic maturity*: a developmental state characterized by beliefs about knowledge that affirm its fundamentally limited nature and the need for caution and flexibility in evaluating truth claims.^{33–39} Epistemic maturity develops over time with learning and experience and involves a shift—reported in other studies of medical trainees⁴⁰—from a naïve view of knowledge as dualistic (right v. wrong), absolute, and definitive to a more mature view of knowledge as pluralistic, relative, and provisional.^{34,36,41–43}

Humility was a second key capacity in the evolution of the physicians’ uncertainty tolerance. The most experienced physicians related that clinical experience paradoxically made them both more confident and more humble about the limits of medical knowledge and open to the unknown. This humility, in turn, was tied to other changes, including greater willingness to seek help and to communicate openly with colleagues and patients, skepticism about medical truth claims, and emotional tolerance of uncertainty.

Flexibility was a third key capacity in the evolution of physicians’ uncertainty tolerance. Physicians also affirmed how uncertainty permitted them to approach their work in a more adaptive, creative manner aimed at understanding the uniqueness of individual patients and personalizing medical care without any definitive answers on how to do so. Physicians saw the adoption of this approach as freeing them up to “shift more from the science to the art” of medicine—from its technical to its humanistic aspects (IM-A-9)—and entailing greater empathy “towards the situation patient and families are in” (EM-A-4).

A final key capacity in the evolution of uncertainty tolerance was *openness* toward medical uncertainty, what Fox characterized as an “affirmative attitude” toward uncertainty,¹⁰ which enabled physicians to acknowledge not only its negative but also its positive aspects and to view uncertainty not only as a threat but an opportunity. One manifestation of this capacity was an affirmation of the possibility of positive outcomes, for example, an ability to acknowledge that “people can just do a lot better than we expect” (MS-20), and to see uncertainty as an opportunity for both “personal growth and intellectual growth” (MS-21) and meaningful engagements with colleagues and patients.

Discussion

This qualitative study explored the uncertainty management strategies of physicians caring for general medical patients in acute-care hospital settings. To our knowledge, this is the first study to attempt to systematically describe these strategies among a diverse, multispecialty sample of physicians with varying levels of training and experience. Ilgen et al. recently conducted a qualitative study of 12 emergency medicine faculty physicians, which identified several activities and processes they use to judge and manage their comfort and discomfort with uncertainty.^{23,24} The current study extends that work by identifying additional previously undescribed strategies, classifying these strategies according to their psychological targets, organizing them within a conceptual taxonomy, and identifying key individual capacities that appear to be associated with the evolution of uncertainty tolerance. We believe the current study thus provides useful data to guide future efforts to understand and improve the management of medical uncertainty by physicians.

The study’s main finding was the wide variety of uncertainty management strategies that physicians and physician-trainees employ in their daily work. Importantly, these strategies focus on much more than medical ignorance and its reduction through information seeking, the overriding focus of medical practice and education. They center on various other phenomena, including uncertainty itself, psychological responses to uncertainty, and social relationships, that together constitute the experience of medical uncertainty and also on different goals. Both ignorance- and uncertainty-focused strategies focus primarily on “curing” (i.e., rejecting or eliminating) uncertainty, by reducing either medical ignorance or one’s conscious awareness of it. Response- and relationship-focused strategies focus primarily on “palliating” (i.e., accepting and ameliorating) uncertainty, either by altering one’s psychological responses to it or sharing the experience of uncertainty with others. Uncertainty management strategies, in other words, are not all created equal, and the taxonomy clarifies how they differ in their substance, functions, and ultimate goals.

This new taxonomy further reveals how managing uncertainty in medicine requires engaging in multiple, often conflicting strategies at the same time. Although the default strategy of medicine is to strive to cure uncertainty, both the practical and theoretical limits to medical knowledge and the cognitive burden and deleterious psychological effects of uncertainty require physicians to balance efforts to cure uncertainty with equal efforts to

Table 3 Key Capacities in the Evolution of Physicians' Uncertainty Tolerance^a

Key Capacity	Illustrative Quotes
Epistemic maturity	<p>I think another piece is that, being in the game this long, you realize that it's okay to not have the answers, even though it's uncomfortable, but it's okay, and sometimes you just have to live with it. Whereas, as a med student or an intern, you're kind of like, "Oh I wish," you're accustomed to the board answer, like, "Oh, there's an answer to everything." You realize that there isn't. (IM-R-2)</p> <p>I think earlier, at least in my career, it was very stressful. But the more you practice medicine, the more you realize how much uncertainty is involved with everything that we do, the more comfortable I've become with it. And when you first start, at least when I first started practicing medicine, the uncertainty that patients and their family felt was very stressful to me because I didn't have enough experience to tell them in broad strokes what to expect. So now, I see the same kind of uncertainty over and over—patients and their families, and I can give them better advice about what's going to happen. Not necessarily specific events but broad strokes about how things are going to go, and I can say that with confidence and with ease. And I think that puts people and their families at ease, if that makes sense. (EM-A-4)</p> <p>Well, and it does kind of go to this other thing where there's some problems in life that are very technical, like the faucet is leaking . . . beautiful, simple, it's broken, you fix it, boom. And then there are these other problems that are kind of like, these complex adaptive problems, like . . . how do you raise a child? Well that's complex, adaptive, it's incremental, it's based on culture. Are the individuals involved or relationships or thoughts over time. And you don't have one right answer at one time, and the problem is sort of forever with you. And it evolves. And people will disagree and potentially have very high emotions. But it's not like fixing a broken faucet. And so I think that's where as you kick around long enough in medicine, you say, well this area is not very certain, and we could try to ask these evidence-based clinical questions about this particular case. But in the end, there's not gonna be one right answer for this patient, and I won't have all the studies to put my finger on to walk in and say, "Here's the most certain compelling way to approach the diagnosis or the treatment." So you have to sort of find that space interesting . . . in some ways, you kind of like uncertainty. It's a challenge. (IM-A-9)</p>
Humility	<p>I used to think that anytime a patient complained about me, they were just a complainer and that I was perfect and they were always wrong. And I think those were my younger years, and I think I've come to realize no, I do make mistakes and that patient was probably right. . . . And I think the humility that I've learned over time has helped me have those conversations, accept my less-than-perfect state of knowledge as a physician, and so consequently have conversations around uncertainty that kind of make me feel a little more relaxed that we're moving ahead in a way that we all agree is probably the best for the patient. And that's come over time with me, and it's come as a result of feedback from colleagues and patients. I guess in my life outside of medicine as a father and a spouse, you go through life crises with your children and your spouse and you learn from those things, too. And it all, I think has made me be a better listener and not so much thinking that I have all the answers. (EM-A-4)</p> <p>Yeah, I think that you really have to be humble when you're a doctor. . . . You have to know when you don't know what's going on and have to know when to ask for help. . . . So I think that you have to be flexible and reflect on your own abilities as you practice and be willing to say, you know, "I don't know what's going here. We need to figure this out." When I first started practicing as an attending, if the resident said something that I'd never heard about, I would be more apt to sort of go along with it because I thought I should know that. But now, I will say, "I don't know what you're talking about. Teach me what you're saying," or "I'll have to look that up, or before I make that management decision on the patient I need to understand this part for myself." So I think the number one strategy is self-awareness and appreciation that you just can't know everything. (EM-A-5)</p> <p>"Oh, this is the way to figure out someone's stroke risk in A-fib. Here's this equation called CHADSVASC" . . . we plug in all these variables. We get a number and we turn to the patient and say, "Well here's this likelihood of a stroke." And it feels really like a really mathematical experience. You know, somebody is in A-fib, you pull out your iPad, you get the App. You put it in CHADSVASC, you get a number, then you can turn to the patient and say, "This is a validated equation and we can tell you based on this that your annual risk of stroke is blah, bah, dee blub, and with that information we advise or recommend you look at the risk benefit of like you know, anticoagulation." And it's a beautiful thing because without an equation, I think we're all sort of, it's disorganized and there are loose strings. And so you can say, we can use a body of research in literature to help us validate the numerical score. And I think in that way, we sometimes get really certain about it. But then a year or 2 from now, you say, we've researched it, we realize there's this other part of the equation that needs to go in there. And there's this other thing where you apply the equation. It's like screening. Where you apply a mammogram to a certain population. The certainty of the risk of something depends on who you apply it on. So I think sometimes, we have this false sense of certainty with certain tests that the inherent nature of the test or the way we're applying the test, we think they're more absolute tools than they are. (IM-A-9)</p>

(continued)

Table 3 (continued)

Key Capacity	Illustrative Quotes
Flexibility	<p>I think maybe from my vantage point now, I would say I guess the more mature and experienced I became, the more I realized that I underestimated, was maybe a bit naïve in thinking that clinical practice would have these relevant definitive arenas of black and white and very statistically quantitative processes. And then the more I got into it, the more I realized there's more gray, and that even when we try to quantify things and create almost mathematical approaches, they're not always as certain as we would think. And so that the uncertainty to me has become more interesting over my practice, over my career. And it's helped me shift more from the science to the art. Because I think then the art is acknowledging the uncertainty and then making the practice of medicine be basically accounting for the uncertainty and applying it to an individual, which is kind of the art, so it's really, with all the different things that are uncertain about the clinical element, maybe a diagnosis or treatment or prognosis, what you can do is say, "Yeah, there's gonna be an uncertainty here." And so where we aren't certain, we give the patient information, help them make their choice, and make it more of a personalized element. So I think the more I realize there's uncertainty—part of you wants to get rid of uncertainty. Like, "Well let's get a better equation." But then, I think another part of me says it is what it is. We're gonna probably at least have some degree of it. And so, you kind of have to embrace it and then say, how do you bring it to your practice? How do you bring uncertainty to patients and help—I think we like to think we're helping them with it, but I think sometimes we're helping ourselves as much as we're helping them. (IM-A-9)</p> <p>I think that I try to personalize medicine. I try to let them know everybody's different. That when we look at diagnostic testing, we look at pretest probabilities. That's a statistical tool that doesn't necessarily apply concretely to them because there's outliers on either side. So I feel much better about involving a patient in the uncertainty discussion than just bearing it myself. I think that that's something that patients probably expect, although I'm certain that there's some that don't. I talk a lot about how medicine is not—it's a science, but it's application is not cut and dry, and that we're not as smart as we think we are is one of my favorite phrases to patients. And that we do the best that we can with the evidence we have. But outcomes don't necessarily follow a linear path. And I think I'm very comfortable talking to patients about that. When I struggle with a decision about whether to do a certain treatment, I think it's very helpful to involve the patient in that discussion, or family, especially family members to come deliberate, well what are the ups and the downsides potentially of one way or the other? (IM-A-7)</p> <p>I've definitely seen a change in myself over time. Not necessarily that I've intellectually developed this paradigm for dealing with uncertainty. But my attitude towards patients, towards medicine, has changed greatly over the 40 years that I've done it. And I'm more empathetic towards the situation patients and families are in, and I've redefined the role that I play. When I was younger, I used to think I was more the scientist. Would come in, gather data, do a test or 2, and then bring all this vast knowledge that I had and tell the people this is the problem and this is what you need to do. Whereas, now I'm much more inclined to have a conversation, talk about the uncertainty, talk about the weaknesses in our workup, the holes, and blend my experience in that. And I guess as an older guy, I can kind of sit down with most of the older patients that we have where this seems to be the more common scenario, and I think we're speaking at the same level. It's not like I'm 29 talking to an 80-year-old person. This could be their grandchild, you know. So anyway, so I have changed. It hasn't just been a kind of a linear, just because I've gotten older, but I've had experiences that have taught me valuable lessons. And I've evolved, I think, because of feedback and so forth over time. (EM-A-4)</p>
Openness	<p>I think just the fact that we don't know anything—the fact that you don't know everything can go both ways. Like people can just do a lot better than we expect, even though they could do a lot worse than we expect. I think that can be kind of nice of the doctor, even if the people are still frustrated. . . . But I don't know, I think there's just an element of uncertainty in medicine, like we don't know everything. And I see doctors who think they know everything, they're often probably know less than most other doctors. So I think it's as important to remember like there's a lot of stuff in medicine you can't control, and I'm not sure I would call it miracles or whatever, but there is stuff that happens that you see, you're like this is crazy, like, you should not have lived. All the data says you shouldn't have lived, and you did. And I don't know why, but it's awesome. So I think that uncertainty can be good too. (MS-20)</p> <p>I think that it can be, I guess, kind of frustrating to not know what the right answer is. But it's also kind of exciting from a certain standpoint. If you knew exactly what the right answer was all the time, it would take some of the learning out of it. So I think not being certain of having to go through the exercise of making decisions without certainty, lends itself to personal growth and intellectual growth, which I find kind of rewarding and exciting, even though it can be frustrating in the moment to not have all the information that you need. (MS-21)</p> <p>I think it [uncertainty] also forces you or helps you reach out to other people that you think might have the answers. I think it helps you engage your peers and engage the resources around you. And it also helps motivate you to learn more. And I think that makes you a better doctor in the end . . . I think it's—the age-old thing, that medicine is an art and a science, and I think uncertainty kind of belies the art of it, the messiness of medicine. And it can be terrifying, but it could also be kind of a beautiful thing, too. (IM-R-2)</p>

^aParticipant quotations are identified by specialty and training level, using the following abbreviations: specialty: EM (emergency medicine), IM (internal medicine), IMP (internal medicine–pediatrics); training level: A (attending), R (resident), MS (medical student).

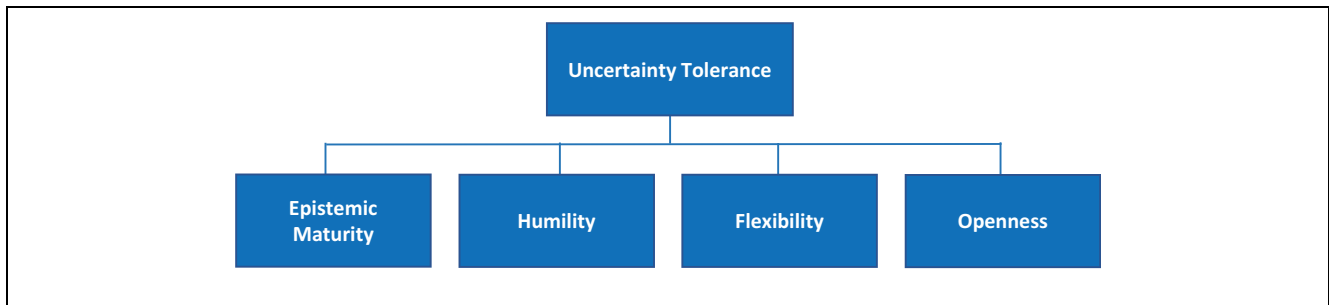


Figure 2 Normative goals of uncertainty management: key capacities.

palliate it. Every physician must achieve some adaptive equilibrium between resisting and engaging with one's uncertainty and accepting and disengaging from it, between pursuing knowledge and abandoning the pursuit, between eliminating the problem and mitigating its sequelae. The taxonomy catalogues the range of strategies that serve these essential functions and promotes an understanding of uncertainty management as a dynamic metacognitive process of self-regulation, by which individuals exert control over themselves and their environment by monitoring and adaptively changing their own responses or inner states.^{25,44} The importance of such an adaptive process has also been highlighted by “situativity” theories, which locate human knowledge, thinking, and learning in the continuous, dynamic interactions of individuals with their physical, cultural, and social environments. These theories emphasize how these interactions not only give rise to mental states such as uncertainty but also provide ways for individuals to regulate these states.^{45,46}

The taxonomy can thus assist efforts to understand and improve the management of medical uncertainty. It can help researchers to more systematically measure the effects of different uncertainty management strategies and to develop new theoretical understandings of uncertainty management as a broader psychological process. The taxonomy's categories are simply heuristic abstractions that may apply to multiple strategies; however, they enable these strategies to be disentangled and better understood. Many of the strategies identified in the taxonomy map onto discrete, well-described constructs in the broader psychological literature (e.g., coping,⁴⁷ categorization,⁴⁸ resilience,^{49,50} self-affirmation⁵¹). The taxonomy can enable researchers to bridge these insights to develop a richer, more integrative, evidence-based understanding of uncertainty management, with broader applicability beyond medicine and physicians. It could also guide research on the effects of different uncertainty management strategies on not only patient-centered but

also physician-centered outcomes, including well-being and burnout.^{26,52–54} At the same time, the taxonomy might also enable clinicians and educators to manage uncertainty in a more intentional, systematic, and rational manner. Applied as a tool for clinical practice or training, it could help physicians take inventory of alternative management strategies and select the most appropriate strategy based on various factors, for example, the particular diagnosis (i.e., source and issue) of the uncertainty at hand as well as its prognosis (i.e., reducibility).¹ It could help make the process of uncertainty management more active, intentional, and deliberative rather than passive, organic, and driven primarily by the “hidden curriculum” of medical care and training.

Yet the taxonomy is purely descriptive; it offers no definitive answers to the normative question of how physicians ought to manage different uncertainties. Our study, however, offers preliminary insights on this question. In reflecting on the evolution of their own uncertainty tolerance, participants identified epistemic maturity, humility, flexibility, and openness as acquired capacities that helped them to tolerate uncertainty—that is, to palliate its negative effects and realize its positive ones. These capacities may thus represent key components of uncertainty tolerance and instrumental goals in managing medical uncertainty (Figure 2); however, more research is needed to determine whether they can be intentionally cultivated^{52,55} and to identify other important normative goals.

This study had several limitations that qualify its findings. It used a relatively small convenience sample of racially homogeneous physicians practicing in general medical specialties and acute-care settings at a single hospital. These factors may have privileged some types of uncertainties (e.g., diagnostic, therapeutic) or management strategies over others and may have favored the selection of participants who were more tolerant of uncertainty or otherwise willing to talk about it. Furthermore, although the frequent recurrence of


particular themes across the interviews suggested a high degree of thematic saturation, recruitment was ultimately limited by study resources; important uncertainty management strategies thus could have been missed. Multiple factors including physician specialty, practice setting, or uncertainty tolerance may produce variation in their uncertainty management strategies^{2,26}; larger studies of more diverse physician samples are needed to fully capture this variation and confirm the transferability of our findings. Finally, qualitative interviews allow physicians themselves to describe the uncertainty management strategies they use but preclude the assessment of unconscious strategies; a more complete assessment requires direct observation of their actual behaviors.

For all of these reasons, our study simply provides an orienting framework for further research; however, this is also its greatest value. To begin to understand how physicians undertake the critical, consequential task of managing medical uncertainty, we need some way of imposing useful order on the problem. Our conceptual taxonomy and the prototypical uncertainty management strategies it identifies provide a provisional starting point. It remains for future research to identify additional strategies, to build on and refine the taxonomy, and to demonstrate its usefulness in efforts to understand and improve the management of medical uncertainty.

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Supplemental Material

Supplementary material for this article is available on the *Medical Decision Making* website at <http://journals.sagepub.com/home/mdm>.

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