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# Experienced physician descriptions of intuition in clinical reasoning: a typology

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## Abstract

**Background:** Diagnostic intuition is a rapid, non-analytic, unconscious mode of reasoning. A small body of evidence points to the ubiquity of intuition, and its usefulness in generating diagnostic hypotheses and ascertaining severity of illness. Little is known about how experienced physicians understand this phenomenon, and how they work with it in clinical practice.

**Methods:** Descriptions of how experienced physicians perceive their use of diagnostic intuition in clinical practice were elicited through interviews conducted with 30 physicians in emergency, internal and family medicine. Each participant was asked to share stories of diagnostic

intuition, including times when intuition was both correct and incorrect. Multiple coders conducted descriptive analysis to analyze the salient aspects of these stories.

**Results:** Physicians provided descriptions of what diagnostic intuition is, when it occurs and what type of activity it prompts. From stories of correct intuition, a typology of four different types of intuition was identified: Sick/Not Sick, Something Not Right, Frame-shifting and Abduction. Most physician accounts of diagnostic intuition linked this phenomenon to non-analytic reasoning and emphasized the importance of experience in developing a trustworthy sense of intuition that can be used to effectively engage analytic reasoning to evaluate clinical evidence.

**Conclusions:** The participants recounted myriad stories of diagnostic intuition that alerted them to unusual diagnoses, previous diagnostic error or deleterious trajectories. While this qualitative study can offer no conclusions about the representativeness of these stories, it suggests that physicians perceive clinical intuition as beneficial for correcting and advancing diagnoses of both common and rare conditions.

**Keywords:** clinical reasoning; intuition; qualitative research.

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## Introduction

A substantial amount of clinical reasoning research focuses on understanding how physicians deductively reason their way through data. Non-analytic reasoning (System 1) and analytic reasoning (System 2) define two modes of processing relevant to the dual process model [1, 2]. System 1 is described as subconscious and effortless while System 2 is defined as conscious and effortful. Different interpretations of this model, taken with experimental evidence from psychology, have led to a spectrum of perspectives on the role of non-analytic reasoning in generating and detecting error. On one end of the spectrum, non-analytic reasoning is considered a primary cause of error when applied without thoughtful reflection [3–5]. Scholars holding this view work to develop analytic approaches to reducing error. In the middle of the spectrum is the perspective that both analytic and non-analytic processes are implicated in diagnostic error [6].

At the opposite end, researchers have provided evidence that rapid, non-analytic reasoning accounts for accurate diagnoses which may be elaborated and confirmed through analytic reasoning [7–9]. Most scholarly attention to date has focused on refining our understanding of analytic reasoning [10–15]. We are left with uncertainty about the role and characteristics of non-analytic reasoning, which creates a significant gap as we strive for a more robust and balanced investigation of the generation and detection of diagnostic error.

There is wide acknowledgment that physicians frequently use non-analytic, unconscious, rapid reasoning, which is sometimes framed as “the art of medicine”, “tacit knowledge” [16] or “clinical acumen”. Existing definitions of intuition tend to be general, such as “*thoughts that come to mind without apparent effort*” [17] or the process of “*making judgments without any awareness of reasoning*” [18]. The word “intuition” is typically used interchangeably with the term “gut feeling” [17, 19–24] to describe the visceral feelings that can inform diagnostic decisions. It has been described as rapid, unconscious, context-sensitive and not reducible to cause-and-effect responses [25].

The concept of intuition is present in both nursing and medical scholarship and is treated differently in each discipline. In nursing, intuition is considered a byproduct of nursing expertise [26, 27], linked closely to the concepts of skill acquisition [28], experience, trust [29, 30] and the relationship to the patient [31]. In medicine, intuition is more closely linked to cognitive and psychological theories. In this discipline, there have been numerous commentaries [25, 32–35] and theoretical papers [17, 36] hypothesizing about the role of intuition in making medical diagnoses. There is evidence that “gut feelings” are ubiquitous amongst physicians and provide a sense of alarm or reassurance [21, 23, 24, 37]. A qualitative study of family physicians [18] identified three types of diagnostic intuition: *gut feelings* (something does not seem right to the physician), *recognitions* (physicians make a quick diagnosis despite a lack of information) and *insights* (physicians draw a sudden diagnostic conclusion following extensive data gathering). Others have demonstrated the transcultural ubiquity of gut feelings experienced as “a sense of reassurance” and “a sense of alarm” [23, 38–40].

We have yet to arrive at a definition of intuition that is sufficiently refined to facilitate further empirical and theoretical work. Without nuance, non-analytic reasoning in a diagnostic context serves as a catch-all term, encompassing a range of varied phenomena. This study seeks to empirically investigate clinical intuition by examining retrospective stories of how experienced physicians make diagnostic decisions in a clinical setting.

## Subjects and methods

We used a qualitative descriptive method [41, 42] to study physician understanding and use of clinical intuition. Stories of intuitive events were collected from internal, emergency and family physicians through semi-structured interviews. The interviewers asked participants to describe an experience of clinical intuition in an acute setting; all but one participant were able to do this.

Our participants were 30 emergency (EM), internal (IM) and family medicine (FM) physicians with 5–36 years (mean=16.5) of independent practice experience (Table 1). The uniting feature of the three chosen specialties is the need to originate diagnoses on undifferentiated patients. Given that intuition draws on past experience, we sampled physicians with enough experience or professional maturity to be able to reflect on their past encounters with patients. We therefore set a threshold of 5 years of independent practice experience.

Using purposive sampling, we recruited participants from our professional networks to ensure a diverse sample of specialties, gender, age and academic and community practices; we strove to include colleagues who were known to be supportive or skeptical of diagnostic intuition. To do so, we asked research team members and other professional contacts to refer colleagues who they knew to speak about their clinical intuition in an avowing way, or those they felt would be skeptical of this concept. Participants were contacted via e-mails sent from research team members. While a representative sample was not our intention, we note that compared to the general population of physicians in Ontario, our participants under-represented family physicians, international medical graduates and those with over 15 years of independent practice [43, 44].

Non-physician interviewers (MV, EC, AP) conducted semi-structured interviews by phone or in person, lasting between 30 and 60 min. Non-physician interviewers were chosen so that participants were more comfortable disclosing stories of times when they may

**Table 1:** Demographic description of participants.

Demographic	Number of physicians (n = 30)
Discipline	
Emergency	12 (40%)
Internists	10 (33%)
Family	8 (27%)
Gender	
Male	19 (63%)
Female	11 (37%)
Training	
Canadian-trained	26 (87%)
IMG	4 (13%)
Type of practice	
Academic	25 (83%)
Community	5 (17%)
Experience	
5–9 years	8 (27%)
10–14 years	7 (23%)
15–19 years	4 (13%)
20–24 years	6 (20%)
25+ years	5 (17%)

have acted in contravention of clinical guidelines or best evidence. These interviewers were trained by the first author, an education scientist and qualitative health researcher (MV), and incorporated insights from their own disciplines, sociology (AP) and psychology (EC). Data collection and analysis proceeded concurrently, and the interview guide was refined to reflect emerging insights. We asked physicians to recount stories about instances where they used diagnostic intuition that turned out to be both correct and incorrect, and times when they had followed and ignored their diagnostic intuition. Each story was elaborated with interviewer prompts about the clinical context, decision-making factors and course of action. Interviews were audio-recorded and transcribed verbatim.

We collected data until sufficiency was reached (26 interviews), which means that our typology categories could accommodate new stories without needing to be modified [45]. We confirmed the adequacy of the typology by eliciting stories from four additional participants (one FM, one IM, two EM), for a total of 30 interviews. The final four interviews also served as member-checking to ensure the resonance and clarity of the typology [46].

The first phase of analysis identified stories of correct intuition (regardless of whether the physician followed or ignored an intuitive thought). For this descriptive analysis, we did not include stories of times that intuition was incorrect because we collected relatively few such examples; many participants had a hard time recalling these instances, telling us that originating multiple hypotheses which turn out to be incorrect is part of the process of creating a differential diagnosis. We also excluded these “incorrect intuition” stories because they may not represent the phenomenon we are trying to describe. Specifically, we were interested in exploring the phenomenon of intuitively knowing the answer in a very ambiguous situation without the availability of comprehensive information.

In the second analytic phase, two of us (MV, SM) worked simultaneously to inductively code a portion of these stories using a line-by-line strategy to capture salient aspects of each story. We considered “salient” aspects to be: (1) elements the participant portrayed as important, (2) elements that were consistent, contradictory or recurring across the data set and (3) elements that were relevant to cognitive psychology theories of clinical reasoning. Once we established these salient aspects, three of us (MV, SM, EC) worked to develop, apply and verify this coding schema.

The third phase of analysis involved developing a typology of intuition from our data set, building upon this coding schema. The entire research team discussed which elements of the coding schema may be linked (theoretically, temporally and thematically). We then created a temporary typology and three analysts (MV, SM, EC) independently applied that typology to the data set. We refined our thinking through discussion of discrepancies and ambiguity to produce the final typology. This typology was independently applied to the data set until consensus was reached via discussion on the categorization of each story. N-Vivo 11 (QSR International Pty Ltd., Doncaster, Victoria, Australia) was used to manage the data.

## Ethical approval

Pursuant to the Declaration of Helsinki regarding the ethical conduct of research with human subjects, research ethics approval was received from the Hamilton Integrated Research Ethics Board, 11-409 and 2553, and consent from all participants was recorded.

## Results

Participants offered 89 stories of intuitive reasoning. On average, participants offered three stories, ranging from one to seven. After review and consultation with the team, we excluded 11 stories as either not truly representing intuition (6) or representing incorrect intuition (5). Stories we excluded as not representing intuition included stories of rational reasoning, stories of someone else’s intuition or stories of coincidences. Stories were categorized as incorrect intuition where the participant intuitively originated a diagnosis but later found that diagnosis to be incorrect. All but one participant offered at least one story that we categorized as intuition. That participant, who was purposively recruited for his skepticism of intuition and commitment to rational decision-making, denied the existence of clinical intuition and offered only stories the research team judged to represent rational, analytic thought or coincidence. In total, we analyzed 78 stories of correct intuition.

We identified four types of intuition: (1) Sick/Not Sick, (2) Something Not Right, (3) Frame-shifting and (4) Abduction (Table 2). We gathered several stories where multiple types of intuition were described as the patient encounter progressed, illustrating the overlap between these categories. We describe each type of intuition below and provide illustrative examples of the elements of each type of intuition in Table 2. The typology is organized from broadest to most specific type.

### 1. Sick/Not Sick

The first type of intuition describes the commonly used heuristic of whether a patient is sick or not sick. This broad categorization was very familiar to the participants in our sample, particularly the emergency physicians, who were comfortable talking about the importance of experience in developing the ability to quickly assess whether a patient is sick or not: *“Does a patient look sick or not sick? Well, there might be 50 things that they could look at and then decide on that. Eventually, you stop having to go through the list of 25 things. You’re still doing almost all of them, and you just know, sick or not sick.”* (EP05)

The assessment of Sick/Not Sick occurs early in the encounter, often immediately upon meeting the patient. It is typically expressed by participants as accompanied by a high degree of certainty: *“The other night I had a young woman who came in with belly pain and you could just tell there was something wrong.”* (EP02)

Sick/Not Sick simply categorizes the patient as well or not well, rather than positing any particular condition or

**Table 2:** Typology of diagnostic intuition.

Category	Description	#	Illustrative example
1. Sick/Not Sick	<ul style="list-style-type: none"> <li>– Broad categorization that is not related to a specific diagnosis</li> <li>– Instantaneous</li> <li>– Confident</li> </ul>	9	<i>“Yeah, I had an older gentleman who came in, was short of breath, and I’m not completely sure I ignored my intuition, I thought he was sick. He did not want to stay in the hospital, he had COPD emphysema, and his breathing was quite poor, but again, his numbers, his vital signs didn’t look that bad. I let him go home, and he actually passed away the next day, but I had said to him, ‘you should stay, but it’s up to you whether you stay or not’. I think I should have pushed him a little bit more, with my intuition, saying, you know what, you’re sick.” (EP09)</i>
2. Something Not Right	<ul style="list-style-type: none"> <li>– Not specific to a diagnosis</li> <li>– Emerges as new information is presented</li> <li>– Accompanied by feelings of worry, concern, dread, confusion or unease</li> </ul>	27	<i>“It was a child that came in, again, kind of low-grade fever, upper respiratory tract symptoms, but the mom kept saying something that just didn’t make sense to me, which was that the child kept tripping and stumbling. Objective testing, there was maybe a little bit, like the muscle tone in the lower half of his body just seemed a little weak, but he had a fever and sometimes fever will do that. It was just the way he was walking, it just didn’t have totally a normal gait to it. So I thought, okay, I really don’t know how to connect the dots on this, there was no other acute neurological symptoms. So that was an example where I got on the phone and said, I really don’t have a clue what, but there’s just something weird about this situation. Everybody knows the, ‘I just don’t like the look of this kid.’” (FP03)</i>
2a. Mismatch	<ul style="list-style-type: none"> <li>– Subcategory of Something Not Right</li> <li>– Discrepancy between subjective appraisal of a patient and objective evidence</li> <li>– Patient appears sicker than evidence suggests</li> </ul>	12	<i>“So for example, we had a young woman, 30 years old, who had an episode where she passed out, and she was seen in the rapid assessment area of the Emergency Department because she had no symptoms at the time she presented, and she was just getting checked out. There was something about her that was off, and it was difficult to quantify because she had normal vital signs, and she looked pretty well. But there was something off about her, and so we ordered her placed in the resuscitation area. She turned out to have a sub massive pulmonary embolism that would have certainly been fatal, had she been discharged from the hospital... She was Wells negative and PERC negative, and so statistically unlikely to have a pulmonary embolism.” (EP07)</i>
3. Frame-shifting	<ul style="list-style-type: none"> <li>– Flash insight that suggests a new diagnosis or new illness script</li> <li>– New information crystallizes realization about what existing information is relevant, or related, and in what way.</li> <li>– Occurs later in the diagnostic process</li> </ul>	9	<i>I remember a patient who was very sick. I was seeing them in clinic and I saw them one day and then I worried about them. I had sent the investigation, but something kept bothering me about it. Then I sort of thought that she actually had cirrhosis from alcohol, even though she had denied drinking alcohol. I brought her in more rapidly, went through things again, and indeed that was ... It’s almost like its pattern recognition, but happening in the background, kind of thing. (IP09)</i>
4. Abduction	<ul style="list-style-type: none"> <li>– Logical leap to a specific diagnosis or illness script without sufficient information</li> <li>– Feelings of concern or worry are absent</li> <li>– Can occur throughout the diagnostic process</li> </ul>	15	<i>“One of the stories that comes to mind is a patient who had what looked like a clear, sort of, cardiac event and pneumonia. Both of which could account for why they were short of breath and needing some help with their respiratory status without a lot else in the way of risk factors for having a pulmonary embolus, a blood clot in the lung. But despite having two alternative diagnoses, the gut feeling was I suspect there may be a pulmonary embolus here. I wanted to do the investigation, which led to multiple phone calls in the middle of the night to convince someone to do a CT scan which was positive in the end.” (IP03)</i>
4a. Eureka	<ul style="list-style-type: none"> <li>– Arrival at a specific diagnosis</li> <li>– An extreme form of abduction resulting from skipping a significant number of logical steps</li> <li>– Can occur throughout the diagnostic process</li> </ul>	6	<i>“It was a kid who had fever, sore throat, that sort of thing. And, probably, looked like every other kid that I’d seen in the previous week or month. But I guess there was something that triggered, she went home and about an hour and a half or two hours later, it hit me like a thunderbolt. I can still remember it, I went “Shit! That kid’s got bacterial tracheitis”. And I phoned the mother and said, how is Johnny, Suzie and she said well, he’s not much worse but he’s still coughing and whatever the symptom is. And I said, I want you to take that kid directly to the Emergency, like right now. And she said, really? And I said, yeah, and I don’t want you to ask me any questions. I just want you to take him there now, don’t want you to call an ambulance, just put him in the car and drive. You’re less than 10 minutes from the Children’s Emergency, just go.” (FP07)</i>
Total		78	

illness script. In a typical example, an internist describes a case he saw in the Emergency Department: *“despite all the numbers looking pretty good, this patient looked like death.”* (IP07) This type of broad categorization of a patient being sick or not sick is a preliminary intuition that informs later decisions in the encounter.

## 2. Something Not Right

The second category of intuition arises when a physician has a feeling that something is not right, or that something does not fit amongst the information available to the physician. The intuition that Something is Not Right is distinct from Sick/Not Sick because it requires information in order to manifest, and often emerges over time as more information becomes available. *“We had a patient who came in with chest pain, an elderly woman, diabetic, obese and referred with myocardial infarction... We are like, ‘this doesn’t sound like myocardial infarction, there’s something else going on’... There I would say was a pure gut feeling that we are missing something.”* (IP02)

The stories we categorized as Something Not Right make clear that this kind of intuition is not definitive. It tends to be an unspecified intuition that something is wrong, does not fit or does not match. Among internists, Something Not Right often manifested as an intuition that the diagnosis or label already applied to the patient is incorrect: *“I remember pausing with the resident and saying ‘this doesn’t really fit. There are too many things going in too many different Directions.’ ... I don’t think this woman has had a heart attack even though that’s what she was treated for and that’s what it seems on balance.”* (IP01)

Many participants described this feeling in emotional, affective terms: *“you get that intuition, like you actually feel it”* (EP08), *“it’s kind of like a rush of anxiety, so many, many thoughts”* (FP02), *“a feeling of dread ... if I’ve got a feeling of angst about it ... a feeling of unease, that there’s something that’s not quite right.”* (EP03)

Other participants described the experience of Something Not Right as a cognitive worry or discomfort, or an inability to stop thinking about the case: *“I use the sleep test, so if you can get to sleep or not. ... it’s just that sort of nagging, impossible-to-get-out-of-your-head idea.”* (IP03)

### 2a. Mismatch

Mismatch stories are a sub-category of Something Not Right. In these stories, the feeling that Something is Not Right arises when physicians identify a mismatch between the subjective (e.g. overall appraisal of the patient) and objective (e.g. test results, vital signs) information available. Typically, this manifests as a Sick/Not Sick intuition (non-specific, occurs upon first glance) wherein the quick

judgment does not fit the objective information available in the form of vital signs, mechanism of injury or illness, investigations or diagnosis already applied. In other words, the patient looks worse or is in more pain than the physician would expect when looking at objective information. This disjuncture results in an uneasy feeling: *“We have this guy who is simply coming with leg edema, being treated as heart failure but the gut feeling is he looks too unwell for someone with just heart failure with a normal echocardiogram.”* (IP02) The key aspect of the Mismatch stories is the demonstration of interplay between analytic and non-analytic reasoning: the clinical pieces look like they should fit together, but the physician’s subjective appraisal indicates that there is something that requires additional investigation:

*“A guy comes in and looks generally unwell. ... He’s about 33 years old, comes in complaining of flu-like symptoms. I just looked at him and went through a review of systems and didn’t find anything but instead I decided to do a full work up. He didn’t complain of any cough but it turns out he had a lung malignancy. ... When you saw him, you would never have imagined in a million years he had lung cancer. He just felt like crap, very non-specific. As soon as you started to talk to him, my spider senses started to tingle.”* (FP01)

Interestingly, these stories all demonstrate the same conservative, cautious practice: the objective information available to the physician indicates that the patient should be well, or have no significant problem, but the physician’s subjective assessment is that the patient is unwell or otherwise in need of further investigation or care. One physician articulated that *“as a responsible clinician, your practice should be based on evidence, and that when you deviate from the evidence, it should be on the side of conservatism, and it should be informed by your intuition.”* (EP07) During a member-checking interview, one emergency physician emphasized the significance of this type of intuition for patient care: *“this is every case of necrotizing fasciitis, ischemic bowel, anything that is vascular and ischemic, pain out of proportion, this is the definition of ischemia. If you don’t listen to your subjective appraisal, people will die.”* (EP10)

## 3. Frame-shifting

Frame-shifting stories are related to pattern recognition, and are characterized as a shift from one pattern to another. The intuitive event is the rapid insight of knowing when to shift from the existing pattern and simultaneously knowing what pattern to shift to. The stories we categorized as frame-shifting involve a flash of insight that changes the physician’s way of looking at a constellation of symptoms, shifting from one illness script to another: *“It dawned on me that ... it was no longer an infectious*

issue at all but rather something related to a rheumatologic condition.” (IP10). The shift to working through the applicability of the new pattern demonstrates the interwoven nature of non-analytic and analytic reasoning.

Often, though not always, this insight is elicited by an external cue and as a result, the course of action or diagnosis is changed: “It’s kind of one of those sort of clues that triggered a rethinking.” (IP03)

This type of intuition occurs later in the diagnostic process and requires some initial information. These stories involve a starting place – the physician must have a potential diagnosis or working hypothesis about a patient to shift from. Frame-shifting stories are characterized by positive intuition, which means intuition that a patient has a specific diagnosis or that symptoms are related in a particular way, as opposed to an intuition that the applied diagnosis is wrong without a potential substitution. During a member-checking interview, one participant described frame-shifting as a correction of previous errors in reasoning.

*“You either had continuity bias where you are going down a road that everyone else has gone down and you haven’t assessed the patient properly, or you made a premature conclusion and so you put the blinders on. Frame-shifting occurs because you have already made an error and cognitive thinking has been wrong and you have gone down a pathway you shouldn’t have gone down and fortunately something or someone says ‘hey.’” (EP10)*

#### 4. Abduction

We have named the category of “abduction” after Peirce’s description of a logical leap [47]. Peirce describes abductive reasoning as parallel to inductive or deductive reasoning, and logically fallible. Our stories of abduction were ones where intuition allowed the physician to make a leap to a specific diagnosis (or illness script) without having available the necessary information to come to that conclusion deductively. “This was someone who was chronically unwell but not very sick. They had a headache, they had a lot of non-specific symptoms. For some reason, I decided to do a CAT scan of their head, for their headache, and it identified a pituitary tumour. ... [pause] it’s one of those ‘I don’t know why’. If I were to logically follow recommendations, I probably would not have done the CAT scan.” (IP09)

Abductive stories are those in which the physician recounts a cognitive tale of a rapid inference to the best explanation. These stories are told as cognitive feats, as opposed to the emotional or visceral feelings associated with Something Not Right stories. Participants often referenced their experience or clinical acumen when recounting these stories: “a student might say that they had ischemic chest pain whereas a more experienced

physician [pause] you could just tell that it wasn’t typical of someone normally having a clot in their coronaries.” (EP02) In a member-checking interview, an emergency physician described the frequency of abductive inference when working efficiently through vague presentations: “The patients who come in with belly pain. A lot of the times when we see them, just on your initial assessment you’re like ‘it’s this’. And the parents are like ‘are you sure?’ I’m positive. I’m going to do a bunch of steps. I’m going to do a bunch of things now to prove it, but this is what it is, 100% this is what it is.” (EP12)

These stories demonstrated a range of logical leaps, sometimes quite small and sometimes rather large. Many, but not all, participants characterized these stories themselves as leaps, or pointed out that they did not have sufficient information to make the diagnosis. For example, one emergency physician told us about a case where he ordered a computed tomography (CT) for a child with a headache and diagnosed a brain tumor: “If you were to dictate the case to another physician, would they instantly leap to the same decision that you leapt to in terms of this kid clearly needs a CT of their head? If the answer to that question is no, they wouldn’t have done those imaging tests, then there must have been something intuitive about the case that wasn’t proven in anything objective.” (EP04) These stories typically ended with specific diagnoses, or at least confidence that the diagnosis was related to a specific physiological system. During member-checking, a participant cautioned us about the metaphor of “skipping steps” in making this logical leap: “I haven’t skipped any steps, it’s just that my brain has processed all the steps intuitively.” (EP10)

#### 4a. Eureka

The category of abduction holds a sub-category, Eureka, which describes intuitive events that happen very infrequently, and are often about rare and life-threatening diagnoses. We conceptualize this category as an extreme form of abduction where the cognitive progression through logical steps is so rapid and unconscious that physicians are unable to retrospectively rationalize what pieces of information were drawn upon to make the diagnosis. Eureka stories are a sub-category because they are told in a different way—while stories of Abduction are narrated as cognitive feats, stories of Eureka are told as confident, certain insights. The conclusions (diagnoses) are typically more specific than stories of Abduction, and the conditions are more severe or life-threatening: “I walked in to see him and he turned around and looked at me, and I thought ‘he’s got esophageal cancer’ ... I was so sure that it was esophageal cancer that I remember

*I did x-ray studies rather than try and get a scope done which was going to take a long time because I had nothing to go on.” (FP04)*

During member-checking interviews, participants discussed that what may seem like a “magic” Eureka moment is really just the result of experience:

*“This is just experience. An inexperienced person with exactly the same training as me, if we were to stand at the entryway to the emergency department and I start calling out these diagnoses, yes it might appear magic to your colleague who has no experience but then after they spend some time there they would see these patterns, they would be able to make the same diagnosis, so there is no magic. ... Magic I would say is just experience.” (EP11)*

## Discussion

From the stories of experienced generalist physicians, we inductively identified four recurring types of intuition: Sick/Not Sick, Something Not Right, Frame-shifting and Abduction. This typology both complements and refines existing attempts to categorize diagnostic intuition. This typology also offers additional evidence of the critical role that non-analytic cognitive processes play in complex clinical decision-making.

### Relevance to literature on clinical intuition

Existing research has established the transcultural validity, universality and prevalence of gut feelings in general practice [38–40]. In this study, we offer a refined understanding of how these gut feelings are perceived and interact with other forms of analytic reasoning. Specifically, we illustrate the way that intuition and analytic reasoning interact, by describing Mismatch, a category related to the feeling that something is not right. Mismatch, which occurs when physicians experience a discrepancy between objective evidence and their holistic, intuitive appraisal of a patient, resonates with Stolper and colleagues’ sense of alarm [19]. However, our findings suggest the need for a more nuanced definition, as we provide examples of intuition which go beyond a sense of alarm or non-specific vague feelings.

Our categories of Frame-shifting and Abduction relate to two modes of thinking that are captured in Woolley and Kostopoulou’s categories of Recognition and Insight; however, our findings offer greater detail about the relationship between existing information and intuitive events. For example, Woolley and Kostopoulou [18]

describe “Insights” as occurring when “a clear interpretation is suddenly and rapidly formed”, whereas Frame-shifting and Abduction describe different aspects of the process through which insights arise. Eureka moments, the extreme form of Abduction, occur when physicians arrive at a correct diagnosis with little or no information. While all non-analytic reasoning is unconscious and thus seems sudden, Eureka moments stand out due to their extremely rapid, seemingly random and highly accurate nature. This specificity of characterizations of intuition offers nuance to our understanding of the distinctions between these complementary and intertwined modes of thinking. Notably, none of these categories involve the feeling of “something is wrong here” which characterize Stolper’s sense of alarm [48], suggesting that they may be active through different cognitive mechanisms.

While we did not identify a category related to Stolper’s sense of reassurance, we see throughout our categories that what we describe as confidence in intuition sounds much like sense of reassurance’s defining feature: “the certainty of what a [physician] had to do” [21]. We find it noteworthy that our participants did not choose to tell stories about this type of intuition, perhaps indicating that they take this sense of reassurance for granted, or that it is normalized in their clinical practice to the point that it is no longer noteworthy.

### Relevance to literature on medical diagnosis and diagnostic error

Many scholars have argued that intuition is more likely to lead to errors when compared to taking an analytic approach to decision-making [3–5, 36, 49–52]. Those who take this position typically presume that intuition is most often applied in routine medical cases with easily recognizable diagnoses, but assert that the potential for cognitive errors must be mitigated in this context because intuition problematically “misses the patient who presents atypically” [36]. In contradiction to this position, our findings demonstrate that when physicians talk about intuition, they often discuss its role in recognizing atypical clinical presentations and making complex or unexpected diagnoses. In our data, diagnostic intuition often played a foundational role in identifying uncommon diagnoses like Kawasaki disease or aortic ulceration. Without making any claim to representativeness or generalizability, many stories described instances “when the patient’s signs and symptoms are not readily recognized as belonging to a specific illness category, or do not follow a particular script”, [36] suggesting

future research ought to explore the use of non-analytic reasoning in contexts other than routine clinical presentations. Our findings, therefore, lend themselves to perspectives on the spectrum that emphasize the important relational qualities of analytic and non-analytic modes of reasoning. Our study offers evidence that intuition or non-analytic reasoning can detect error and correct the outcome of analytic reasoning. One recommendation in the literature is to engage in cognitive decoupling in order to improve the ability to override non-analytic reasoning [53], but our findings provide important cautions for proceeding with such a strategy.

We are not positing that diagnostic intuition is a substitute for evidence-based analytic reasoning, nor that physicians should be overconfident in their intuition. Rather, we have presented evidence that physicians experience intuition as an important part of the diagnostic process and that it deserves careful attention. In the stories we encountered, intuition was closely tied to conventional reasoning approaches and interwoven with rational processes to play a critical role in decision-making. For example, intuition often galvanized physicians to seek out specific types of evidence needed to make or confirm a diagnosis, sometimes when there was no “objective” reason to seek that particular evidence. The vast majority of the physicians we interviewed promote the cultivation of diagnostic intuition through experience as a way to complement analytic, evidence-based approaches. Diagnostic intuition was deemed useful because it assisted the physician in knowing what pieces of information to attend to, how disparate pieces of information may be linked or when a crucial piece of information or link is missing in a proposed diagnosis. Thus, given the intimate role intuition plays in prompting physicians to seek out empirical evidence, the results of this study question the notion that intuition is disproportionately linked to diagnostic error, particularly in the form of cognitive biases. Indeed, our study suggests that intuition has an important role in correcting incorrect conclusions that may arise from an analytic approach.

## Limitations

Given that non-analytic, intuitive reasoning is an unconscious phenomenon, and that the data comprise retrospective accounts of events, we are unable to draw conclusions about the success rate or value of intuition. When asked to tell stories about times when their intuition was wrong, physicians typically responded that they were so frequently wrong that specific instances

were difficult to recount, whereas the times they were correct were far more memorable. Physicians’ recall of correct intuition may be influenced by any number of factors such as professional identity, sense of expertise, enjoyment of the practice of medicine or sense of pride in making a difficult diagnosis. Memories of incorrect intuition may be suppressed if associated with a negative emotion. Additionally, explicit statements may not always match with reality or even subconscious representations [54]. Accordingly, these results should not be interpreted as a value judgment on the individual components of intuition, nor of the aggregate concept. Rather, they can be used to parse the abstract concept of “intuition” or “non-analytic reasoning” into definable components for future research.

## Conclusions

This paper has proposed four types of diagnostic intuition: Sick/Not Sick, Something Not Right, Frame-shifting and Abduction. Our aim was to provide a more nuanced vocabulary for the concept of *clinical intuition* to enable researchers and physicians to better understand which types of non-analytic reasoning might be at play in a given situation. In the process of providing this categorization, we have produced evidence that intuition is an important part of the way experienced physicians process information to make or disprove key diagnoses. The results also indicate that intuition is active in all parts of the encounter, occurs in both common and uncommon presentations and is helpful not just in generating diagnoses but also for detecting incorrect diagnoses.

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