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The role of intuitive knowledge in the diagnostic reasoning of hospital specialists

A focus group study

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Abstract

Background and objective

Intuition is an important part of human decision-making and can be explained by the dual-process theory where analytical and non-analytical reasoning processes continually interact. These processes can also be identified in physicians' diagnostic reasoning. The valuable role of intuition, including gut feelings, has been shown among general practitioners and nurses, but less is known about its role among hospital specialists. This study focused on the diagnostic reasoning of hospital specialists, how they value, experience and use intuition.

Design and participants

Twenty-eight hospital specialists in the Netherlands and Belgium participated in 6 focus groups. The discussions were recorded, transcribed verbatim and thematically coded. A circular and iterative analysis was applied until data-saturation was achieved.

Results

Despite initial reservations regarding the term intuition, all participants agreed that intuition plays an important role in their diagnostic reasoning process. Many agreed that intuition could guide them, but were cautious not to be misguided. They were especially cautious since intuition does not have probative force, e.g. in medico-legal situations. 'On-the-job- experience' was regarded as a precondition to relying upon intuition. Some participants viewed intuition as non-rational and invalid. All participants said that intuitive hunches must be followed by

analytical reasoning. Cultural differences were not found. Both the doctor as a person and his/her specialty were seen as important determinants for using intuition.

Conclusions

Hospital specialists use intuitive elements in their diagnostic reasoning, in line with general human decision-making models. Nevertheless they appear to disagree more on its role and value than previous research has shown among general practitioners. A better understanding of how to take advantage of intuition, while avoiding pitfalls, and how to develop 'skilled' intuition, may improve the quality of hospital specialists' diagnostic reasoning.

Strenghts and limitations of this study

- This is the first study exploring the role of intuition in hospital specialists' diagnostic reasoning.
- The study was performed in two European countries.
- The used qualitative approach enabled the researchers to study the views of specialists on the topic, and the meanings they attach to the concept.
- It was not the aim of the researchers to gather data for the calculation of predictive values of intuitive hunches such as gut feelings.

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Competing interests statement

None declared.

Introduction

Intuitive knowledge, i.e. automatically knowing by intuition, is considered an integral part of human decision making [1]. Research among European general practitioners (GPs) has shown that they recognize gut feelings, a specific form of intuition, as a familiar and valuable phenomenon in their diagnostic reasoning process [2]. The positive role of intuition has also been identified in the domain of nursing [3-7]. However, the medical literature does not provide much information about whether hospital specialists use intuitive knowledge such as gut feelings in their daily practice, and how strongly they rely on it [8-14].

The existing theory on diagnostic reasoning is the dual-process theory, involving a human decision making model [1,15]. This theory assumes two continually interacting reasoning processes, analytical (AR) and non-analytical reasoning (NAR). AR is a deliberate and rational process which is slow and demanding. NAR is a fast, automatic and effortless process which is described as intuitive. AR and NAR use the same sources of knowledge and produce a similar amount of errors [16].

The present study focused on the intuitive aspects of the diagnostic reasoning process of hospital specialists and on the way they experience, use and value intuition. We examined which benefits, pitfalls, and differences between specialities exist when using intuitive knowledge like gut feelings.

Methods

The study used a qualitative approach exploring the views of specialists about diagnostic reasoning and intuitive knowledge, and the meanings they attach to these concepts[17-20]. Data was collected via focus group, moderated by expert interviewers and two specifically trained medical students, using a topic guide (Table 1).

Three focus groups were organized in the Netherlands and three in Flanders, the Dutch speaking part of Belgium, among a purposeful sample of 28 hospital specialists. The recruited participants were those specialists who are the first to see a patient at a hospital (see Table 2). They often make quick assessments of the seriousness of a patient's situation, in which intuitive knowledge may play a recognizable role. After each focus group session, the script was adapted to elicit more explanations or to address other topics in the next groups.

Audio recordings of all discussions were transcribed verbatim and checked. Data analysis was initiated with open coding. The code books, created by the Dutch and Flemish researchers, were compared and merged after consensus was reached. Based on these primary codes, a common code book was developed, with the following categories: the description of intuition, determining factors, speciality, medical education, gut feelings, others. These categories were created to support further coding and analysis of the data. A circular and iterative process was applied using cross-analysis of observed recurrent trends and codes. This circular process was terminated when data saturation was achieved. The following themes emerged during the final analysis: terminology, trust in intuition, the intuitive process, determining factors, differences and similarities between specialties, defensive medicine, medical education, and differences between the two countries. All data was analysed using the NVivo software package. The

coding and analysis process was performed separately by the two first authors, at that time final year medical students doing a research elective, and checked by the two last authors.

Patient and Public Involment statement

There were no patients or public involved.

Results

Terminology

All of the participating hospital specialists recognized that intuitive knowledge was a part of their diagnostic reasoning process (quote 1.1 see Table 3) but the way they phrased it varied, e.g. it is something that just arises in you, or it is like fuzzy logic. They described intuition as a subconscious and associative process. Several, sometimes vague, terms were used as synonyms, such as feeling, intuition and gut feelings (quote 1.2). Various terms we used to introduce our topic in the focus groups elicited different reactions in different countries. In Belgium, the participants expressed reservations about the term 'intuition', while in the Netherlands, the phrase 'non-analytical reasoning' elicited more reservations. Some hospital specialists used the term pattern recognition to indicate intuition (quote 1.3).

Trust in intuition

All participants recognized intuitive knowledge in their diagnostic reasoning process, but their views on this concept varied widely. Some specialists said they relied strongly on their intuition, while others were quite mistrusting (quote 2.1-2.2). Some participants said that intuition, gut

feelings and non-analytical reasoning are only based on feelings, and therefore unreliable (quote 2.3). Most of the participants, however, saw intuition as something positive, providing added value to their diagnostic process (quote 2.4). Most specialists agreed that their first hypothesis, based on intuition, usually did not differ much from their final diagnosis, which meant that their intuition had high validity (quote 2.5). A widely discussed pitfall was that intuition can be coloured by prejudice (quote 2.6). Tunnel vision and premature closure were other examples of biases which could lead to missing a diagnosis. Some specialists pointed out that they should also be on the alert for a false sense of reassurance by overestimating themselves (quote 2.7).

The intuitive process

The participants described intuition as presenting itself during the first contact with a patient, e.g. by recognizing previously encountered disease patterns or getting a good or a bad feeling when seeing a patient or hearing their story (quote 3.1). A sense of alarm was said to be triggered by signals emerging from the patient's story or their symptoms and signs. Something does not fit, was how this was expressed. The intuitive process always involves careful observations (quote 3.2). One specialist described it as a multisensory experience (quote 3.3). Intuitively generated working hypotheses may steer the further diagnostic process and treatment (quote 3.4). Some participants stated that this type of reasoning saved a lot of unnecessary investigations (quote 3.5).

All participants said that intuition was an important tool for starting the diagnostic process, but that the final diagnosis would never be solely based on it. Intuition had to be followed by

analytical reasoning (quote 3.6). The participants stated that diagnostic reasoning in fact meant balancing between intuitive and analytical reasoning processes (quote 3.7). Solely using analytical reasoning is not possible due to lack of time (quote 3.8), while solely using intuition would lack substantiation (quote 3.6). The balance and interaction depended on the situation or context (quote 3.9). A sense of alarm, encountering insecurities or vague symptoms, would ensure that a doctor is on his/her guard and will investigate further, while a sense of reassurance can lead to 'watchful waiting'.

Determining factors

Medical knowledge and experience were often mentioned together as the basis for developing intuition (quote 4.1). The participants mentioned experience as the most important determining factor, more specifically 'on-the-job experience' and learning from one's own mistakes. The less experienced a physician is, the more analytical his/her approach will be. Some participants indicated that younger doctors do not, and according to some should not, trust their gut feelings as much, and will therefore consult a specialist-tutor for further guidance (quote 4.2).

Differences and similarities between specialties

Although all participants recognized the role of intuitive knowledge in their diagnostic process, doctors in the various speciailties differed in the way they reached a diagnosis. The more general a speciality is, such as internal medicine or emergency medicine, the greater the role of intuition. In situations where timely decisions could be lifesaving, intuitive knowledge was

regarded as a major source of judgement (quote 3.9). By contrast, some specialities, with a limited set of diagnoses, did not need intuition frequently (quote 5.1). Paediatrics and psychiatry are examples of a specialties in which intuition seems to play a major role because of its more subjective nature (quote 5.2). According to the specialists, the use of intuition is more accepted and appropriate among GPs, who see a large number of patients with very different problems and often vague symptoms in a short time (quote 5.3). GPs' gut feelings were generally regarded as valuable for hospital specialists. Although a specialist's domain is an important determining factor of their use of intuition, their personality and empathic capabilities (quote 5.4) also play a role, as appears from the finding that specialists working in the same setting still differed considerably in their views on intuition.

Defensive medicine

According to the participants, society will not accept decisions based purely on intuition; substantiation is needed. Some participants indicated that they underpinned their intuitively gained hypotheses with rational arguments as a form of protection against accusations made by colleagues or charges brought by the legal authorities (quote 6.1). Evidence-Based Medicine (EBM) was viewed as useful in this respect. According to some specialists, however, EBM is not always applicable in daily practice, and there should be a balance between EBM and other types of reasoning (quote 6.2).

Medical education

Intuition as a component of medical education was a much-discussed subject. There was agreement that the development of intuition cannot be taught theoretically. 'On-the-job-experience' was viewed as an important factor to acquire intuitive knowledge (quote 4.1). Helpful approaches include making trainees aware of their gut feelings, and making them look for triggering cues, as well as self-reflection, direct feedback in the workplace, and experienced colleagues thinking along with them (quotes 7.1 – 7.3).

Differences between the two countries

A comparison of the way hospital specialists in Belgium and the Netherlands value, experience and use intuition revealed no differences of importance. The only differences we noticed were the reservations about the terms used and that hospital specialists from Flanders mentioned medico-legal aspects more frequently (quote 6.1-6.2).

Discussion

This focus group study has shown that intuitive reasoning processes play an important role in the diagnostic reasoning of hospital specialists. Despite certain initial reservations towards the term gut feelings, many participants agreed that their intuition did guide them but they were careful not to be misguided. They were especially cautious since intuition does not have probative force, for instance in medico-legal situations. Although opinions concerning the validity of intuition varied, the majority viewed intuition as offering added value. Intuition acts as a guide in the diagnostic process or as a trigger for further investigations making fast decisions possible when needed and reducing unnecessary investigations. Most medical

specialists used a mixture of intuitive and analytical reasoning in their diagnostic process, but the balance between the two approaches was influenced by speciality and personality.

This study was conducted in two countries, in several hospitals, and involved a large variety of specialities, thus providing a broad view of the perceptions and use of intuition in the Dutch speaking countries. Although some focus groups only included a small number of participants, this led to more in-depth conversations. As potential participants for the focus groups we purposefully sampled those specialists, who have the first contact in hospital with the patient implying a larger number of possible diagnoses. Future research among groups of specialists who do not have the first contact with patients, could reveal how intuitive reasoning processes in general play in hospital specialists.

Similar results on the value and experience of intuitive knowledge have been reported in the PhD thesis by the philosopher Van Droogenbroeck [21]. Her ethnographic study concluded that most hospital specialists initially 'fly by the auto pilot' and that a large amount of 'tacit knowledge' is involved in the diagnostic process. When a story triggers a sense of alarm, or happens in an unusual, uncertain or complex context, doctors will switch to analytical reasoning (AR). The role of experience-based knowledge is related to pattern recognition and pattern failure, suggesting the relation between experience and non-analytical reasoning (NAR). Despite the involvement of a lot of tacit knowledge in the diagnostic process, hospital specialists still expressed reservations about it. The fact that our results match those by Van Droogenbroeck substantiates the validity and the importance of our findings.

Studies previously performed among GPs have yielded similar findings [2]. Whereas GPs mainly talk about gut feelings [2], the hospital specialists used a variety of terms and seemed to have more reservations about the terms intuition, gut feelings and NAR, and also more often mentioned the possible negative consequences of intuitive reasoning processes. In general, they did agree on the determinants and triggers of intuitive reasoning processes, viz. 'on-the-job experience', personality, and recognizing a picture/or signs and symptoms that do or do not fit. While GPs stressed the important role of contextual information in the diagnostic process [2], this was hardly mentioned by the hospital specialists, who emphasized experience instead. The diagnostic processes of both GPs and hospital specialists consists of an interaction between intuitive and analytical processes, as described in the dual-process theory [2,15]. Among GPs, a gut feeling confirms whether the GP is on the right track or warns them that taking action is necessary [15]. A sense of alarm triggers a GP or hospital specialist to be on his/her guard [2]. Most hospital specialists, however, agreed that a hypothesis based on intuition must be followed by analytical reasoning and thus substantiated by further investigations. GPs use gut feelings more as a compass, steering them through uncertain and complex situations and busy office hours [2].

Nevertheless, there is still much controversy about the use of intuition in the medical world [22,23], even though current insights show that everybody uses a combination of intuitive and analytical reasoning and that so-called 'skilled intuition' can be trusted [24-26]. In any case, young doctors can be made aware of these current insights during their training. GPs are more positive than specialists about the possibility of including intuition in medical education [2].

Sharing the insights gained in the present study could help optimise the development of intuitive reasoning processes in the training of residents.

Self-reflection, and quick and expert feedback from experienced colleagues pertaining to intuitive reasoning processes can improve the quality of their training and improve medical care[27]. Learning to optimise the interaction between intuitive and analytical processes may be the best way to prevent diagnostic errors. This approach perfectly matches the EBM concept, which is all about integrating the best available evidence, the doctor's knowledge and experience and the patient's preferences [28]. Implementing intuition in the training of residents is consistent with the educational point of view arguing for the recognition of tacit knowledge and corresponding theories [21]. Lastly, accepting intuition as an important and valuable part of diagnostic reasoning can help it gain more recognition. Decisions made by Dutch medical disciplinary tribunals show that intuition is viewed by these colleges as part of the professional standards for doctors [29], underlining the importance of gaining more recognition for intuition in medico-legal contexts.

A remarkable observation we made was that the terminology regarding intuitive processes remains vague; different terms were being used as synonyms, and there were different interpretations for the same words. Based on the results of similar research done among GPs [30], a Delphi procedure among hospital specialists could lead to a precise and valid description of intuitive processes in a hospital setting. This will increase the feasibility of implementing intuition in residency training and start future additional research.

In conclusion, intuitive knowledge plays an undeniable part in diagnostic reasoning of physicians, evidently also in hospitals settings. A better understanding of how to take advantage of intuition, while avoiding pitfalls, and how to develop 'skilled' intuition, may improve the quality of hospital specialists' diagnostic reasoning.

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Ethical approval: No ethical review was required for this study because no patients were involved, and the hospital specialists were only asked about their opinions and perceptions.

Authorship

All authors contributed substantially to the study.

- N. van den Brink: collecting of the data, analysis, drafting the manuscript, final approvement.
- B. Holbrechts: collecting of the data, analysis, drafting the manuscript, final approvement.
- P. Brand: collecting of the data, analysis, drafting the manuscript, final approvement.
- C.F. Stolper: conducting the study design, collecting of the data, analysis, drafting the manuscript, final approvement.
- P. Van Royen: conducting the study design, analysis, drafting the manuscript, final approvement.

DATA SHARING STATEMENT: all data –the 6 transcripts, the code book, the results of the thematic analysis- are available for sharing via the corresponding author.

Tables

Table 1 – Topic guide

Description of NAR, and more specifically intuition and gut feelings
Interaction between intuition and analytical processes
Balance between intuition and analytical processes
Triggers of intuition
Relying on intuition
Determining factors of intuition
Differences between specialties

Table 2 - Participant specifications

	Date	**Location**	**Participants**		
1	2013-11-28	NL	6	♂: 1 ♀: 5	Internal medicine, paediatrics, cardiology, neurology, emergency medicine, pulmonology
2	2014-01-29	NL	8	♂: 2 ♀: 6	Cardiology, endocrinology, gastro-enterology and hepatology, general surgery, infectious diseases, neurology, paediatrics, psychiatry
3	2014-06-23	NL	3	♂: 2 ♀: 1	Dermatology, nephrology, neurology
4	2015-03-16	BE	5	♂: 3 ♀: 2	Abdominal surgery, emergency medicine, neurology, neurosurgery, paediatrics
5	2015-10-22	BE	4	♂: 2 ♀: 2	Hepatobiliary, transplantation and endocrine surgery, neurosurgery, psychiatry, sexology

6	2015-12-15	BE	2	♂: 2 ♀: 0	Emergency medicine

Table 3 Quotes

	Focus group	Quote
Description intuition		
1.1	NL 2	We all have this, if we first meet a patient, those first couple of seconds that you see somebody, you get a feeling of whether the situation is serious or not, alarming or not.
1.2	NL 2	Yes, when you mention intuitive thinking I obviously immediately think about my professional domain and about gut feeling.
1.3	NL 3	For me the word intuition is more…erm… something that doesn't rely on knowledge or experience, but more a sort of feeling, and to me what you're referring to, and what I mean, is not a feeling but pattern recognition.
Relying on intuition		
2.1	NL 1	Well, at a certain moment you feel this is what it is, more or less, and that's a feeling I have very strongly with patients and // at the hospital I rely on my feelings… well… for about 80%.
2.2	BE 3	I also distrust it. I do use it, but I also distrust it, right?
2.3	NL 3	Some of us in the group are very allergic to the word gut feelings. They think that as a doctor you can't use that term. But at the same time, I think that everyone knows that it does exist.
2.4	BE 2	It offers a certain advantage I think. You argue more correctly if you also use that intuition.
2.5	NL 2	Yes, I don't experience a discrepancy either between the initial gut feeling, or whatever you want to call it, and what comes out in the end.
2.6	BE 2	I actually agree with what you say about the initial thought being biased, that gut feeling, by what you know before the patient enters, by what you saw in C2M [electronic medical record], by what the secretary has said when introducing the patient, by what

		you might have heard from the GP on the phone. So, you often get a biased picture.
2.7	BE 2	Then you tell yourself I can skip that clinical examination, because last time nothing came out.
Intuition in the process of diagnostic reasoning		
- Presentation of intuition		
3.1	BE 2	Even if you just hear a story from an assistant // Then the first thing is that there is something in in your guts, something that says this is alarming or reassuring. And then you listen very critically, to the whole story… By also building up a systemic picture.
- Triggers of intuition		
3.2	BE 2	But well, observations are always partly intuitive, aren't they? You first look at what is going on with the person in front of you. What he's saying. I think it's like that in all specialities. You don't immediately work systematically.
3.3	BE 1	There's a lot more involved then. What does the patient look like? At that moment it's a kind of multisensory experience. What does the patient look like? How is his breathing, and you listen to that for a while. Yes, there's a lot more to it than listening to their story on the phone. On the phone, it's purely factual, based on a number of questions. If you can actually see the patient, it's totally different.
- Intuition provides guidance		
3.4	NL 2	But the intuition helps you, gives you guidance.
3.5	NL 1	That's how I've spared a hundred children some complicated investigation.
- NAR is followed by AR		
3.6	BE 3	I often find it an important tool at the start, but it's never going to be the only factor in the eventual conclusion and the eventual decision on the diagnosis and therapy for the patient.
- Interaction and balance between NAR and AR		
3.7	BE 2	You have to find the balance between intuition and systematic approach.
3.8	BE 3	I think it's obvious that at busy moments, simply because there's no other option, you sometimes have to rely on gut feelings. Even if it's only because you don't have time for analytical reasoning.

3.9	BE 3	But I'm convinced that experienced emergency specialists regularly rely on their gut feelings, to make a quick first assessment of the degree of urgency. Maybe even more than in other disciplines.
Determinants of intuition		
4.1	NL 2	Because intuition is made up of experience and knowledge.
4.2	BE 2	I think some doctors who are less able to rely on that experience, on that intuition, they have to fall back on systematics. And so as you gain more experience, you can let go of that to some extent.
Differences and similarities between specialities		
5.1	NL 1	I always think, cardiology is of course a very different discipline, because we have, I believe, something like ten illness scripts, yes and I just check them all. Could it be this, or that? And we can actually image everything, so we can often figure it out.
5.2	BE 2	Subjectivity plays an important part, so you automatically start to make more use use of the intuitive. (*a psychiatrist*)
5.3	BE 3	No, but general practitioners also need to deal with a different form of uncertainty, and are not held to account for that, the way it happens at a hospital. GPs are able to work with uncertainties. And that's a lot more difficult for a hospital doctor.
5.4	BE 3	For individual doctors, that depends on how soon they can use that experience, allowing them to skip things. And one of those indicators, for example, is empathy. So the better you're able to understand what the patient means or feels, the better of course you can assess the situation // There are people who are simply purely scientifically oriented and have no empathic ability. Those are people who are less likely to develop this kind of intuition, or they develop it in a less valuable way.
Defensive medicine		
6.1	BE 2	That [I've made this decision based on my intuition] is not something you can say before a court, right?
6.2	BE 3	And of course in situations where you don't yet have the experience, you'll need to rely on the evidence to some extent, and after you have gained the experience, you still have to keep looking at the evidence from the literature, and maintain a balance between the two.
Medical education		
7.1	NL1	Yes, that's exactly when you have to check, I think always, or

		occasionally, why do I get this feeling, right? And that's what's so good about a hospital like this, that there is a trainee doctor sitting beside you. And when you tell them it's this or that, you need to explain why you get that feeling.
7.2.	BE 1	It should encourage you to recognize that feeling that arises and then to think right, I need to do something about this, in the sense of further reflection or especially thinking why do I get this feeling with this particular patient? // In my case, that often induces me to broaden my scope or to discuss it with someone else or consult another book…
7.3	BE 2	When trainees see patients they get feedback on their findings. I think that's very important. Also with regard to this intuitive thinking. But I think, erm, what you could also do in their training. is emphasise its value more.

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The role of intuitive knowledge in the diagnostic reasoning of hospital specialists. A focus group study.

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Abstract

Background and objective

Intuition is an important part of human decision-making and can be explained by the dual-process theory where analytical and non-analytical reasoning processes continually interact. These processes can also be identified in physicians' diagnostic reasoning. The valuable role of intuition, including gut feelings, has been shown among general practitioners and nurses, but less is known about its role among hospital specialists. This study focused on the diagnostic reasoning of hospital specialists, how they value, experience and use intuition.

Design and participants

Twenty-eight hospital specialists in the Netherlands and Belgium participated in 6 focus groups. The discussions were recorded, transcribed verbatim and thematically coded. A circular and iterative analysis was applied until data-saturation was achieved.

Results

Despite initial reservations regarding the term intuition, all participants agreed that intuition plays an important role in their diagnostic reasoning process. Many agreed that intuition could guide them, but were cautious not to be misguided. They were especially cautious since intuition does not have probative force, e.g. in medico-legal situations. 'On-the-job- experience' was regarded as a precondition to relying upon intuition. Some participants viewed intuition as non-rational and invalid. All participants said that intuitive hunches must be followed by analytical reasoning. Cultural differences were not found. Both the doctor as a person and his/her specialty were seen as important determinants for using intuition.

Conclusions

Hospital specialists use intuitive elements in their diagnostic reasoning, in line with general human decision-making models. Nevertheless they appear to disagree more on its role and value than previous research has shown among general practitioners. A better understanding of how to take advantage of intuition, while avoiding pitfalls, and how to develop 'skilled' intuition, may improve the quality of hospital specialists' diagnostic reasoning.

Strenghts and limitations of this study

- This is the first study exploring the role of intuition in hospital specialists' diagnostic reasoning.
- The study was performed in two European countries.
- The used qualitative approach enabled the researchers to study the views of specialists on the topic, and the meanings they attach to the concept.
- It was not the aim of the researchers to gather data for the calculation of predictive values of intuitive hunches such as gut feelings.

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Competing interests statement

None declared.

Introduction

Intuitive knowledge, i.e. automatically knowing by intuition, is considered an integral part of human decision making and also a phase of clinical reasoning [1,2]. Research among European general practitioners (GPs) has shown that they recognize gut feelings, a specific form of intuition, as a familiar and valuable phenomenon in their diagnostic reasoning process [3]. In fact, when diagnosing serious infections in children, the GP's feeling 'there is something wrong' is the best predictor among all signs and symptoms[4]. The positive role of intuition has also been identified in the domain of nursing [5-7]. However, the medical literature does not provide much information about whether hospital specialists use intuitive knowledge such as gut feelings in their daily practice, and how strongly they rely on it [8-11].

The existing theory on diagnostic reasoning is the dual-process theory, involving a human decision making model [1,12,13]. This theory assumes two continually interacting reasoning processes, analytical (AR) and non-analytical reasoning (NAR). AR is a deliberate and rational process which is slow and demanding. NAR is a fast, automatic and effortless process which is described as intuitive. AR and NAR use the same sources of knowledge and produce a similar amount of errors [14].

The present study focused on the intuitive aspects of the diagnostic reasoning process of hospital specialists, i.e. physicians who are working clinically mainly within a hospital setting. How do they experience, use and value intuition? Which benefits, pitfalls, and differences between specialities do exist when using intuitive knowledge like gut feelings?

Methods

A qualitative descriptive study design was used, exploring the views of specialists about diagnostic reasoning and intuitive knowledge, and the meanings they attach to these concepts[15-17]. Data was collected via focus groups, moderated by expert interviewers and two specifically trained medical students, using a topic guide (Table 1).

Three focus groups were organized in the Netherlands and three in Flanders, the Dutch speaking part of Belgium among a purposeful sample of 28 hospital specialists. The recruited participants were those specialists who are the first to see a patient at a hospital (see Table 2). They often make quick assessments of the seriousness of a patient's situation, in which intuitive knowledge may play a recognizable role[8]. After each focus group session, the script was adapted to elicit more explanations or to address other topics in the next groups.

Audio recordings of all discussions were transcribed verbatim and checked for errors. Data analysis was initiated with open coding. The code books, created by the Dutch and Flemish researchers, were compared and merged after consensus was reached. Based on these primary codes, a common code book was developed, with the following categories: the description of intuition, determining factors, speciality, medical education, gut feelings, others. These categories were created to support further coding and analysis of the data. A circular and iterative process was applied using cross-analysis of observed recurrent trends and codes. This circular process was terminated when data saturation was achieved. The following themes emerged during the final analysis: terminology, trust in intuition, the intuitive process, determining factors, differences and similarities between specialties, defensive medicine,

medical education, and differences between the two countries. All data was analysed using the NVivo software package. The coding and analysis process was performed separately by the two first authors, at that time final year medical students doing a research elective, and checked by the two last authors.

Patient and Public Involment statement

There were no patients or public involved.

Results

Terminology

All participants recognized that intuitive knowledge was a part of their diagnostic reasoning process (quote 1.1 see Table 3) but the way they phrased it varied, e.g. it is something that just arises in you, or it is like fuzzy logic. They described intuition as a subconscious and associative process. Several, sometimes vague, terms were used as synonyms, such as feeling, intuition and gut feelings (quote 1.2). Some hospital specialists used the term pattern recognition to indicate intuition (quote 1.3).

Trust in intuition

All participants recognized intuitive knowledge in their diagnostic reasoning process, but their views on this concept varied widely. Some specialists said they relied strongly on their intuition, while others were quite mistrusting (quote 2.1-2.2). Some participants said that intuition, gut feelings and non-analytical reasoning are only based on feelings, and therefore unreliable (quote 2.3). Most of the participants, however, saw intuition as something positive, providing

added value to their diagnostic process (quote 2.4). Most specialists agreed that their first hypothesis, based on intuition, usually did not differ much from their final diagnosis, which meant that their intuition had high validity (quote 2.5). A widely discussed pitfall was that intuition can be coloured by prejudice (quote 2.6). Tunnel vision and premature closure were other examples of biases which could lead to missing a diagnosis. Some specialists pointed out that they should also be on the alert for a false sense of reassurance by overestimating themselves (quote 2.7).

The intuitive process

The participants described intuition as presenting itself during the first contact with a patient, e.g. by recognizing previously encountered disease patterns or getting a good or a bad feeling when seeing a patient or hearing their story (quote 3.1). A sense of alarm was said to be triggered by signals emerging from the patient's story or their symptoms and signs. Something does not fit, was how this was expressed. The intuitive process often involves automatically perceived findings (quote 3.2). One specialist described it as a multisensory experience of intuitively received impressions of the patient (quote 3.3).

Intuitively generated working hypotheses may steer the further diagnostic process and treatment (quote 3.4). Some participants stated that this type of reasoning saved a lot of unnecessary investigations (quote 3.5).

All participants said that intuition was an important tool for starting the diagnostic process, but that the final diagnosis would never be solely based on it. Intuition had to be followed by analytical reasoning (quote 3.6). The participants stated that diagnostic reasoning in fact meant

balancing between intuitive and analytical reasoning processes (quote 3.7). Solely using analytical reasoning is not possible due to lack of time (quote 3.8), while solely using intuition would lack substantiation (quote 3.6). The balance and interaction depended on the situation or context (quote 3.9). A sense of alarm, encountering insecurities or vague symptoms, would ensure that a doctor is on his/her guard and will investigate further, while a sense of reassurance can lead to 'watchful waiting'.

Determining factors

Medical knowledge and experience were often mentioned together as the basis for developing intuition (quote 4.1). The participants mentioned experience as the most important determining factor, more specifically 'on-the-job experience' and learning from one's own mistakes. The less experienced a physician is, the more analytical his/her approach will be. Some participants indicated that younger doctors do not, and according to some should not, trust their gut feelings as much, and will therefore consult a specialist-tutor for further guidance (quote 4.2).

Differences and similarities between specialties

Although all participants recognized the role of intuitive knowledge in their diagnostic process, doctors in the various speciaties differed in the way they reached a diagnosis. The more general a speciality is, such as internal medicine or emergency medicine, the greater the role of intuition. In situations where timely decisions could be lifesaving, intuitive knowledge was regarded as a major source of judgement (quote 3.9). By contrast, some specialities, with a

limited set of diagnoses, did not need intuition frequently (quote 5.1). Paediatrics and psychiatry are examples of a specialties in which intuition seems to play a major role because of its more subjective nature (quote 5.2). According to the specialists, the use of intuition is more accepted and appropriate among GPs, who see a large number of patients with very different problems and often vague symptoms in a short time (quote 5.3). GPs' gut feelings were generally regarded as valuable for hospital specialists. Although a specialist's domain is an important determining factor of their use of intuition, their personality and empathic capabilities (quote 5.4) also play a role. One participant viewed empathy as a prerequisite for the use of intuition. Additionally, we found that specialists working in the same domain still differed considerably in their views on intuition.

Defensive medicine

According to the participants, society will not accept decisions based purely on intuition; substantiation is needed. Some participants indicated that they underpinned their intuitively gained hypotheses with rational arguments as a form of protection against accusations made by colleagues or charges brought by the legal authorities (quote 6.1). Evidence-Based Medicine (EBM) was viewed as useful in this respect. According to some specialists, however, EBM is not always applicable in daily practice, and there should be a balance between EBM and other types of reasoning (quote 6.2).

Medical education

Intuition as a component of medical education was a much-discussed subject. There was agreement that the development of intuition cannot be taught theoretically. 'On-the-job-experience' was viewed as an important factor to acquire intuitive knowledge (quote 4.1). Helpful approaches include making trainees aware of their gut feelings, and making them look for triggering cues explaining the sense of alarm, as well as self-reflection, direct feedback in the workplace, and experienced colleagues thinking along with them (quotes 7.1 – 7.3).

Differences between the two countries

A comparison of the way hospital specialists in Belgium and the Netherlands value, experience and use intuition revealed no differences of importance. The only differences we noticed were the reservations about certain terms used in the introduction. In the Netherlands,when using the term non-analytical reasoning, some participants in the first group showed resistance, 'since specialists should think analytically'. In the next two Dutch groups, we used the term intuition during the introduction, leading to an open discussion without problems. In Flanders, to avoid the same misunderstanding as in the Netherlands, we started by asking for descriptions of their diagnostic reasoning process. Participants from Flanders expressed reservations against the term intuition. They mentioned medico-legal aspects frequently (quote 6.1-6.2). In the Netherlands, these aspects were hardly discussed.

Discussion

This focus group study has shown that intuitive reasoning processes play an important role in the diagnostic reasoning of hospital specialists. Despite certain initial reservations towards the

term gut feelings, many participants agreed that their intuition did guide them but they were careful not to be misguided. They were especially cautious since intuition does not have probative force, for instance in medico-legal situations. Although opinions concerning the validity of intuition varied, the majority viewed intuition as offering added value. Intuition acts as a guide in the diagnostic process or as a trigger for further investigations making fast decisions possible when needed and reducing unnecessary investigations. Most medical specialists used a mixture of intuitive and analytical reasoning in their diagnostic process, but the balance between the two approaches was influenced by speciality and personality.

This study was conducted in two countries, in several hospitals, and involved a large variety of specialities, thus providing a broad view of the perceptions and use of intuition in the Dutch speaking countries. Although some focus groups only included a small number of participants, this led to more in-depth conversations. As potential participants for the focus groups we purposefully sampled those specialists, who have the first contact in hospital with the patient implying a larger number of possible diagnoses. Future research among groups of specialists who do not have the first contact with patients, could reveal how intuitive reasoning processes in general play in hospital specialists.

Similar results on the value and experience of intuitive knowledge have been reported in the PhD thesis by the philosopher Van Droogenbroeck [18]. Her ethnographic study concluded that most hospital specialists initially 'fly by the auto pilot' and that a large amount of 'tacit knowledge' is involved in the diagnostic process. A physician's knowledge can be conceptualized as a rich network with many interlinked knowledge nodes. Most of the

physician's knowledge is tacit, but can often be retrieved easily and mobilized. It is induced by initially for the greater part unconsciously perceived cues in a specific medical problem resulting in a recognised pattern or triggering a sense of alarm, or by causal reasoning[13,19]. Relevant tacit knowledge becomes mostly automatically conscious knowledge (NAR), and therefore available for analysis of the medical problem (AR). It depends on the quality of the physician's knowledge and expertise how accurate and effective this automatic retrieval process of relevant knowledge will work out[20]. Sometimes one cue is enough to point to the correct solution but more often different cues make sense only in the context of each other[21]. Despite the involvement of a lot of tacit knowledge in the diagnostic process, hospital specialists still expressed reservations about it. The fact that our results match those by Van Droogenbroeck substantiates the validity and the importance of our findings.

Studies previously performed among GPs have yielded similar findings[3]. Whereas GPs mainly talk about gut feelings[3], the hospital specialists used a variety of terms and seemed to have more reservations about the terms intuition, gut feelings and NAR, and also more often mentioned the possible negative consequences of intuitive reasoning processes. In general, they did agree on the determinants and triggers of intuitive reasoning processes, viz. 'on-the-job experience', personality, and recognizing a picture/or signs and symptoms that do or do not fit. While GPs stressed the important role of contextual information in the diagnostic process [3], this was hardly mentioned by the hospital specialists, who emphasized experience instead. The diagnostic processes of both GPs and hospital specialists consists of an interaction between intuitive and analytical processes, as described in the dual-process theory [3,13]. Among GPs, a gut

feeling confirms whether the GP is on the right track or warns them that taking action is necessary[13]. A sense of alarm triggers a GP or hospital specialist to be on his/her guard [3]. Most hospital specialists, however, agreed that a hypothesis based on intuition must be followed by analytical reasoning and thus substantiated by further investigations. GPs use gut feelings more as a compass, steering them through uncertain and complex situations and busy office hours [3].

Nevertheless, there is still much controversy about the use of intuition in the medical world [22,23], even though current insights show that everybody uses a combination of intuitive and analytical reasoning and that so-called 'skilled intuition' can be trusted[24-26]. In any case, young doctors can be made aware of these current insights during their training. GPs are more positive than specialists about the possibility of including intuition in medical education[3]. Sharing the insights gained in the present study could help optimise the development of intuitive reasoning processes in the training of residents.

Self-reflection in the diagnostic phase, and quick and expert feedback from experienced colleagues pertaining to intuitive reasoning processes can improve the quality of their training and improve medical care[27]. Learning to optimise the interaction between intuitive and analytical processes may be the best way to prevent diagnostic errors. This approach perfectly matches the EBM concept, which is all about integrating the best available evidence, the doctor's knowledge and experience and the patient's preferences[28]. Implementing intuition in the training of residents is consistent with the educational point of view arguing for the recognition of tacit knowledge and corresponding theories[18]. Lastly, accepting intuition as an important and valuable part of diagnostic reasoning can help it gain more recognition.

Decisions made by Dutch medical disciplinary tribunals show that intuition is viewed by these colleges as part of the professional standards for doctors[29], underlining the importance of gaining more recognition for intuition in medico-legal contexts.

A remarkable observation we made was that the terminology regarding intuitive processes remains vague; different terms were being used as synonyms, and there were different interpretations for the same words. Based on the results of similar research done among GPs[30], a Delphi procedure among hospital specialists could lead to a precise and valid description of intuitive processes in a hospital setting. This will increase the feasibility of implementing intuition in residency training and start future additional research. Nevertheless, it might not be a big problem that the concept intuition is a bit vague but it will become a problem when the outcome of the intuitive process is ignored instead of integrated in the whole diagnostic reasoning process. In conclusion, intuitive knowledge plays an undeniable part in diagnostic reasoning of physicians, evidently also in hospitals settings. A better understanding of how to take advantage of intuition, while avoiding pitfalls, and how to develop 'skilled' intuition, may improve the quality of hospital specialists' diagnostic reasoning.

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Ethical approval: No ethical review was required for this study because no patients were involved, and the hospital specialists were only asked about their opinions and perceptions.

Authorship

All authors contributed substantially to the study.

- N. van den Brink: collecting of the data, analysis, drafting the manuscript, final approvement.
- B. Holbrechts: collecting of the data, analysis, drafting the manuscript, final approvement.
- P. Brand: collecting of the data, analysis, drafting the manuscript, final approvement.
- C.F. Stolper: conducting the study design, collecting of the data, analysis, drafting the manuscript, final approvement.
- P. Van Royen: conducting the study design, analysis, drafting the manuscript, final approvement.

DATA SHARING STATEMENT: all data –the 6 transcripts, the code book, the results of the thematic analysis- are available for sharing via the corresponding author.

Tables

Table 1 – Topic guide

Description of NAR, and more specifically intuition and gut feelings
Interaction between intuition and analytical processes
Balance between intuition and analytical processes
Triggers of intuition
Relying on intuition

Determining factors of intuition
Differences between specialties

Table 2 - Participant specifications

	Date	**Location**	**Participants**		
1	2013-11-28	NL	6	♂:1 ♀:5	Internal medicine, paediatrics, cardiology, neurology, emergency medicine, pulmonology
2	2014-01-29	NL	8	♂:2 ♀:6	Cardiology, endocrinology, gastro-enterology and hepatology, general surgery, infectious diseases, neurology, paediatrics, psychiatry
3	2014-06-23	NL	3	♂:2 ♀:1	Dermatology, nephrology, neurology
4	2015-03-16	BE	5	♂:3 ♀:2	Abdominal surgery, emergency medicine, neurology, neurosurgery, paediatrics
5	2015-10-22	BE	4	♂:2 ♀:2	Hepatobiliary, transplantation and endocrine surgery, neurosurgery, psychiatry, sexology
6	2015-12-15	BE	2	♂:2 ♀:0	Emergency medicine

Table 3 Quotes

	Focus group	**Quote**
Description intuition		
1.1	NL 2	We all have this, if we first meet a patient, those first couple of seconds that you see somebody, you get a feeling of whether the situation is serious or not, alarming or not.
1.2	NL 2	Yes, when you mention intuitive thinking I obviously immediately think about my professional domain and about gut feeling.
1.3	NL 3	For me the word intuition is more…erm… something that doesn't rely on knowledge or experience, but more a sort of feeling, and to me what you're referring to, and what I mean, is not a feeling but pattern recognition.
Relying on intuition		
2.1	NL 1	Well, at a certain moment you feel this is what it is, more or less, and that's a feeling I have very strongly with patients and // at the

		hospital I rely on my feelings… well… for about 80%.
2.2	BE 3	I also distrust it. I do use it, but I also distrust it, right?
2.3	NL 3	Some of us in the group are very allergic to the word gut feelings. They think that as a doctor you can't use that term. But at the same time, I think that everyone knows that it does exist.
2.4	BE 2	It offers a certain advantage I think. You argue more correctly if you also use that intuition.
2.5	NL 2	Yes, I don't experience a discrepancy either between the initial gut feeling, or whatever you want to call it, and what comes out in the end.
2.6	BE 2	I actually agree with what you say about the initial thought being biased, that gut feeling, by what you know before the patient enters, by what you saw in C2M [electronic medical record], by what the secretary has said when introducing the patient, by what you might have heard from the GP on the phone. So, you often get a biased picture.
2.7	BE 2	Then you tell yourself I can skip that clinical examination, because last time nothing came out.
Intuition in the process of diagnostic reasoning		
- Presentation of intuition		
3.1	BE 2	Even if you just hear a story from an assistant // Then the first thing is that there is something in in your guts, something that says this is alarming or reassuring. And then you listen very critically, to the whole story… By also building up a systemic picture.
- Triggers of intuition		
3.2	BE 2	But well, observations are always partly intuitive, aren't they? You first look at what is going on with the person in front of you. What he's saying. I think it's like that in all specialities. You don't immediately work systematically.
3.3	BE 1	There's a lot more involved then. What does the patient look like? At that moment it's a kind of multisensory experience. What does the patient look like? How is his breathing, and you listen to that for a while. Yes, there's a lot more to it than listening to their story on the phone. On the phone, it's purely factual, based on a number of questions. If you can actually see the patient, it's totally different.
- Intuition provides guidance		

3.4	NL 2	But the intuition helps you, gives you guidance.
3.5	NL 1	That's how I've spared a hundred children some complicated investigation.
- NAR is followed by AR		
3.6	BE 3	I often find it an important tool at the start, but it's never going to be the only factor in the eventual conclusion and the eventual decision on the diagnosis and therapy for the patient.
- Interaction and balance between NAR and AR		
3.7	BE 2	You have to find the balance between intuition and systematic approach.
3.8	BE 3	I think it's obvious that at busy moments, simply because there's no other option, you sometimes have to rely on gut feelings. Even if it's only because you don't have time for analytical reasoning.
3.9	BE 3	But I'm convinced that experienced emergency specialists regularly rely on their gut feelings, to make a quick first assessment of the degree of urgency. Maybe even more than in other disciplines.
Determinants of intuition		
4.1	NL 2	Because intuition is made up of experience and knowledge.
4.2	BE 2	I think some doctors who are less able to rely on that experience, on that intuition, they have to fall back on systematics. And so as you gain more experience, you can let go of that to some extent.
Differences and similarities between specialities		
5.1	NL 1	I always think, cardiology is of course a very different discipline, because we have, I believe, something like ten illness scripts, yes and I just check them all. Could it be this, or that? And we can actually image everything, so we can often figure it out.
5.2	BE 2	Subjectivity plays an important part, so you automatically start to make more use of the intuitive. (*a psychiatrist*)
5.3	BE 3	No, but general practitioners also need to deal with a different form of uncertainty, and are not held to account for that, the way it happens at a hospital. GPs are able to work with uncertainties. And that's a lot more difficult for a hospital doctor.
5.4	BE 3	A necessary condition for using intuition is, for example, empathy. So the better you're able to understand what the patient means or feels, the better of course you can assess the situation // There are people who are simply purely scientifically

		oriented and have no empathic ability. Those are people who are less likely to develop this kind of intuition, or they develop it in a less valuable way.
Defensive medicine		
6.1	BE 2	That [I've made this decision based on my intuition] is not something you can say before a court, right?
6.2	BE 3	And of course in situations where you don't yet have the experience, you'll need to rely on the evidence to some extent, and after you have gained the experience, you still have to keep looking at the evidence from the literature, and maintain a balance between the two.
Medical education		
7.1	NL1	Yes, that's exactly when you have to check, I think always, or occasionally, why do I get this feeling, right? And that's what's so good about a hospital like this, that there is a trainee doctor sitting beside you. And when you tell them it's this or that, you need to explain why you get that feeling.
7.2.	BE 1	It should encourage you to recognize that feeling that arises and then to think right, I need to do something about this, in the sense of further reflection or especially thinking why do I get this feeling with this particular patient? // In my case, that often induces me to broaden my scope or to discuss it with someone else or consult another book…
7.3	BE 2	When trainees see patients they get feedback on their findings. I think that's very important. Also with regard to this intuitive thinking. But I think, erm, what you could also do in their training. is emphasise its value more.

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The role of intuitive knowledge in the diagnostic reasoning of hospital specialists. A focus group study.

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Abstract

Background and objective

Intuition is an important part of human decision-making and can be explained by the dual-process theory where analytical and non-analytical reasoning processes continually interact. These processes can also be identified in physicians' diagnostic reasoning. The valuable role of intuition, including gut feelings, has been shown among general practitioners and nurses, but less is known about its role among hospital specialists. This study focused on the diagnostic reasoning of hospital specialists, how they value, experience and use intuition.

Design and participants

Twenty-eight hospital specialists in the Netherlands and Belgium participated in 6 focus groups. The discussions were recorded, transcribed verbatim and thematically coded. A circular and iterative analysis was applied until data-saturation was achieved.

Results

Despite initial reservations regarding the term intuition, all participants agreed that intuition plays an important role in their diagnostic reasoning process. Many agreed that intuition could guide them, but were cautious not to be misguided. They were especially cautious since intuition does not have probative force, e.g. in medico-legal situations. 'On-the-job- experience' was regarded as a precondition to relying upon intuition. Some participants viewed intuition as non-rational and invalid. All participants said that intuitive hunches must be followed by analytical reasoning. Cultural differences were not found. Both the doctor as a person and his/her specialty were seen as important determinants for using intuition.

Conclusions

Hospital specialists use intuitive elements in their diagnostic reasoning, in line with general human decision-making models. Nevertheless they appear to disagree more on its role and value than previous research has shown among general practitioners. A better understanding of how to take advantage of intuition, while avoiding pitfalls, and how to develop 'skilled' intuition, may improve the quality of hospital specialists' diagnostic reasoning.

Strenghts and limitations of this study

- This is the first study exploring the role of intuition in hospital specialists' diagnostic reasoning.
- The study was performed in two European countries.
- The used qualitative approach enabled the researchers to study the views of specialists on the topic, and the meanings they attach to the concept.
- It was not the aim of the researchers to gather data for the calculation of predictive values of intuitive hunches such as gut feelings.

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Competing interests statement

None declared.

Introduction

Intuitive knowledge, i.e. automatically knowing by intuition, is considered an integral part of human decision making and also a phase of clinical reasoning [1,2]. Research among European general practitioners (GPs) has shown that they recognize gut feelings, a specific form of intuition, as a familiar and valuable phenomenon in their diagnostic reasoning process [3]. In fact, when diagnosing serious infections in children, the GP's feeling 'there is something wrong' is the best predictor among all signs and symptoms[4]. The positive role of intuition has also been identified in the domain of nursing [5-7]. However, the medical literature does not provide much information about whether hospital specialists use intuitive knowledge such as gut feelings in their daily practice, and how strongly they rely on it [8-11].

The existing theory on diagnostic reasoning is the dual-process theory, involving a human decision making model [1,12,13]. This theory assumes two continually interacting reasoning processes, analytical (AR) and non-analytical reasoning (NAR). AR is a deliberate and rational process which is slow and demanding. NAR is a fast, automatic and effortless process which is described as intuitive. AR and NAR produce a similar amount of errors [14].

The present study focused on the intuitive aspects of the diagnostic reasoning process of hospital specialists, i.e. physicians who are working clinically mainly within a hospital setting. How do they experience, use and value intuition? Which benefits, pitfalls, and differences between specialities do exist when using intuitive knowledge like gut feelings?

Methods

A qualitative descriptive study design was used, exploring the views of specialists about diagnostic reasoning and intuitive knowledge, and the meanings they attach to these concepts[15-17]. Data was collected via focus groups, moderated by expert interviewers and two specifically trained medical students, using a topic guide (Table 1).

Three focus groups were organized in the Netherlands and three in Flanders, the Dutch speaking part of Belgium among a purposeful sample of 28 hospital specialists. The recruited participants were those specialists who are the first to see a patient at a hospital (see Table 2). They often make quick assessments of the seriousness of a patient's situation, in which intuitive knowledge may play a recognizable role[8]. After each focus group session, the script was adapted to elicit more explanations or to address other topics in the next groups.

Audio recordings of all discussions were transcribed verbatim and checked for errors. Data analysis was initiated with open coding. The code books, created by the Dutch and Flemish researchers, were compared and merged after consensus was reached. Based on these primary codes, a common code book was developed, with the following categories: the description of intuition, determining factors, speciality, medical education, gut feelings, others. These categories were created to support further coding and analysis of the data. A circular and iterative process was applied using cross-analysis of observed recurrent trends and codes. This circular process was terminated when data saturation was achieved. The following themes emerged during the final analysis: terminology, trust in intuition, the intuitive process, determining factors, differences and similarities between specialties, defensive medicine, medical education, and differences between the two countries. All data was analysed using the

NVivo software package. The coding and analysis process was performed separately by the two first authors, at that time final year medical students doing a research elective, and checked by the two last authors.

Patient and Public Involment statement

There were no patients or public involved.

Results

Terminology

All participants recognized that intuitive knowledge was a part of their diagnostic reasoning process (quote 1.1 see Table 3) but the way they phrased it varied, e.g. it is something that just arises in you, or it is like fuzzy logic. They described intuition as a subconscious and associative process. Several, sometimes vague, terms were used as synonyms, such as feeling, intuition and gut feelings (quote 1.2). Some hospital specialists used the term pattern recognition to indicate intuition (quote 1.3).

Trust in intuition

All participants recognized intuitive knowledge in their diagnostic reasoning process, but their views on this concept varied widely. Some specialists said they relied strongly on their intuition, while others were quite mistrusting (quote 2.1-2.2). Some participants said that intuition, gut feelings and non-analytical reasoning are only based on feelings, and therefore unreliable (quote 2.3). Most of the participants, however, saw intuition as something positive, providing added value to their diagnostic process (quote 2.4). Most specialists agreed that their first

hypothesis, based on intuition, usually did not differ much from their final diagnosis, which meant that their intuition had high validity (quote 2.5). A widely discussed pitfall was that intuition can be coloured by prejudice (quote 2.6). Tunnel vision and premature closure were other examples of biases which could lead to missing a diagnosis. Some specialists pointed out that they should also be on the alert for a false sense of reassurance by overestimating themselves (quote 2.7).

The intuitive process

The participants described intuition as presenting itself during the first contact with a patient, e.g. by recognizing previously encountered disease patterns or getting a good or a bad feeling when seeing a patient or hearing their story (quote 3.1). A sense of alarm was said to be triggered by signals emerging from the patient's story or their symptoms and signs. Something does not fit, was how this was expressed. The intuitive process often involves automatically perceived findings (quote 3.2). One specialist described it as a multisensory experience of intuitively received impressions of the patient (quote 3.3).

Intuitively generated working hypotheses may steer the further diagnostic process and treatment (quote 3.4). Some participants stated that this type of reasoning saved a lot of unnecessary investigations (quote 3.5).

All participants said that intuition was an important tool for starting the diagnostic process, but that the final diagnosis would never be solely based on it. Intuition had to be followed by analytical reasoning (quote 3.6). The participants stated that diagnostic reasoning in fact meant balancing between intuitive and analytical reasoning processes (quote 3.7). Solely using

analytical reasoning is not possible due to lack of time (quote 3.8), while solely using intuition would lack substantiation (quote 3.6). The balance and interaction depended on the situation or context (quote 3.9). A sense of alarm, encountering insecurities or vague symptoms, would ensure that a doctor is on his/her guard and will investigate further, while a sense of reassurance can lead to 'watchful waiting'.

Determining factors

Medical knowledge and experience were often mentioned together as the basis for developing intuition (quote 4.1). The participants mentioned experience as the most important determining factor, more specifically 'on-the-job experience' and learning from one's own mistakes. The less experienced a physician is, the more analytical his/her approach will be. Some participants indicated that younger doctors do not, and according to some should not, trust their gut feelings as much, and will therefore consult a specialist-tutor for further guidance (quote 4.2).

Differences and similarities between specialties

Although all participants recognized the role of intuitive knowledge in their diagnostic process, doctors in the various speciaties differed in the way they reached a diagnosis. The more general a speciality is, such as internal medicine or emergency medicine, the greater the role of intuition. In situations where timely decisions could be lifesaving, intuitive knowledge was regarded as a major source of judgement (quote 3.9). By contrast, some specialities, with a limited set of diagnoses, did not need intuition frequently (quote 5.1). Paediatrics and

psychiatry are examples of a specialties in which intuition seems to play a major role because of its more subjective nature (quote 5.2). According to the specialists, the use of intuition is more accepted and appropriate among GPs, who see a large number of patients with very different problems and often vague symptoms in a short time (quote 5.3). GPs' gut feelings were generally regarded as valuable for hospital specialists. Although a specialist's domain is an important determining factor of their use of intuition, their personality and empathic capabilities (quote 5.4) also play a role. One participant viewed empathy as a prerequisite for the use of intuition. Additionally, we found that specialists working in the same domain still differed considerably in their views on intuition.

Defensive medicine

According to the participants, society will not accept decisions based purely on intuition; substantiation is needed. Some participants indicated that they underpinned their intuitively gained hypotheses with rational arguments as a form of protection against accusations made by colleagues or charges brought by the legal authorities (quote 6.1). Evidence-Based Medicine (EBM) was viewed as useful in this respect. According to some specialists, however, EBM is not always applicable in daily practice, and there should be a balance between EBM and other types of reasoning (quote 6.2).

Medical education

Intuition as a component of medical education was a much-discussed subject. There was agreement that the development of intuition cannot be taught theoretically. 'On-the-job-

experience' was viewed as an important factor to acquire intuitive knowledge (quote 4.1). Helpful approaches include making trainees aware of their gut feelings, and making them look for triggering cues explaining the sense of alarm, as well as self-reflection, direct feedback in the workplace, and experienced colleagues thinking along with them (quotes 7.1 – 7.3).

Differences between the two countries

A comparison of the way hospital specialists in Belgium and the Netherlands value, experience and use intuition revealed no differences of importance. The only differences we noticed were the reservations about certain terms used in the introduction. In the Netherlands,when using the term non-analytical reasoning, some participants in the first group showed resistance, 'since specialists should think analytically'. In the next two Dutch groups, we used the term intuition during the introduction, leading to an open discussion without problems. In Flanders, to avoid the same misunderstanding as in the Netherlands, we started by asking for descriptions of their diagnostic reasoning process. Participants from Flanders expressed reservations against the term intuition. They mentioned medico-legal aspects frequently (quote 6.1-6.2). In the Netherlands, these aspects were hardly discussed.

Discussion

This focus group study has shown that intuitive reasoning processes play an important role in the diagnostic reasoning of hospital specialists. Despite certain initial reservations towards the term gut feelings, many participants agreed that their intuition did guide them but they were careful not to be misguided. They were especially cautious since intuition does not have

probative force, for instance in medico-legal situations. Although opinions concerning the validity of intuition varied, the majority viewed intuition as offering added value. Intuition acts as a guide in the diagnostic process or as a trigger for further investigations making fast decisions possible when needed and reducing unnecessary investigations. Most medical specialists used a mixture of intuitive and analytical reasoning in their diagnostic process, but the balance between the two approaches was influenced by speciality and personality.

This study was conducted in two countries, in several hospitals, and involved a large variety of specialities, thus providing a broad view of the perceptions and use of intuition in the Dutch speaking countries. Although some focus groups only included a small number of participants, this led to more in-depth conversations. As potential participants for the focus groups we purposefully sampled those specialists, who have the first contact in hospital with the patient implying a larger number of possible diagnoses. Future research among groups of specialists who do not have the first contact with patients, could reveal how intuitive reasoning processes in general play in hospital specialists.

Similar results on the value and experience of intuitive knowledge have been reported in the PhD thesis by the philosopher Van Droogenbroeck [18]. Her ethnographic study concluded that most hospital specialists initially 'fly by the auto pilot' and that a large amount of 'tacit knowledge' is involved in the diagnostic process. A physician's knowledge can be conceptualized as a rich network with many interlinked knowledge nodes. Most of the physician's knowledge is tacit, but can often be retrieved easily and mobilized. It is induced by initially for the greater part unconsciously perceived cues in a specific medical problem

resulting in a recognised pattern or triggering a sense of alarm, or by causal reasoning[13,19]. Relevant tacit knowledge becomes mostly automatically conscious knowledge (NAR), and therefore available for analysis of the medical problem (AR). It depends on the quality of the physician's knowledge and expertise how accurate and effective this automatic retrieval process of relevant knowledge will work out[20]. Sometimes one cue is enough to point to the correct solution but more often different cues make sense only in the context of each other[21]. Despite the involvement of a lot of tacit knowledge in the diagnostic process, hospital specialists still expressed reservations about it. The fact that our results match those by Van Droogenbroeck substantiates the validity and the importance of our findings.

Studies previously performed among GPs have yielded similar findings[3]. Whereas GPs mainly talk about gut feelings[3], the hospital specialists used a variety of terms and seemed to have more reservations about the terms intuition, gut feelings and NAR, and also more often mentioned the possible negative consequences of intuitive reasoning processes. In general, they did agree on the determinants and triggers of intuitive reasoning processes, viz. 'on-the-job experience', personality, and recognizing a picture/or signs and symptoms that do or do not fit. While GPs stressed the important role of contextual information in the diagnostic process [3], this was hardly mentioned by the hospital specialists, who emphasized experience instead. The diagnostic processes of both GPs and hospital specialists consists of an interaction between intuitive and analytical processes, as described in the dual-process theory [3,13]. Among GPs, a gut feeling confirms whether the GP is on the right track or warns them that taking action is necessary[13]. A sense of alarm triggers a GP or hospital specialist to be on his/her guard [3]. Most

hospital specialists, however, agreed that a hypothesis based on intuition must be followed by analytical reasoning and thus substantiated by further investigations. GPs use gut feelings more as a compass, steering them through uncertain and complex situations and busy office hours [3].

Nevertheless, there is still much controversy about the use of intuition in the medical world [22,23], even though current insights show that everybody uses a combination of intuitive and analytical reasoning and that so-called 'skilled intuition' can be trusted[24-26]. In any case, young doctors can be made aware of these current insights during their training. GPs are more positive than specialists about the possibility of including intuition in medical education[3]. Sharing the insights gained in the present study could help optimise the development of intuitive reasoning processes in the training of residents.

Self-reflection in the diagnostic phase, and quick and expert feedback from experienced colleagues pertaining to intuitive reasoning processes can improve the quality of their training and improve medical care[27]. Learning to optimise the interaction between intuitive and analytical processes may be the best way to prevent diagnostic errors. This approach perfectly matches the EBM concept, which is all about integrating the best available evidence, the doctor's knowledge and experience and the patient's preferences[28]. Implementing intuition in the training of residents is consistent with the educational point of view arguing for the recognition of tacit knowledge and corresponding theories[18]. Lastly, accepting intuition as an important and valuable part of diagnostic reasoning can help it gain more recognition. Decisions made by Dutch medical disciplinary tribunals show that intuition is viewed by these

colleges as part of the professional standards for doctors[29], underlining the importance of gaining more recognition for intuition in medico-legal contexts.

A remarkable observation we made was that the terminology regarding intuitive processes remains vague; different terms were being used as synonyms, and there were different interpretations for the same words. Based on the results of similar research done among GPs[30], a Delphi procedure among hospital specialists could lead to a more precise and valid description of intuitive processes in a hospital setting. This will increase the feasibility of implementing intuition in residency training and start future additional research. Although a precise definition of intuitive processes in hospital settings is lacking upon till now, ignoring the outcome of these processes in stead of integrating them in diagnostic reasoning might be a more important problem. In conclusion, intuitive knowledge plays an undeniable part in diagnostic reasoning of physicians, evidently also in hospitals settings. A better understanding of how to take advantage of intuition, while avoiding pitfalls, and how to develop 'skilled' intuition, may improve the quality of hospital specialists' diagnostic reasoning.

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Ethical approval: No ethical review was required for this study because no patients were involved, and the hospital specialists were only asked about their opinions and perceptions.

Authorship

All authors contributed substantially to the study.

- N. van den Brink: collecting of the data, analysis, drafting the manuscript, final approvement.
- B. Holbrechts: collecting of the data, analysis, drafting the manuscript, final approvement.
- P. Brand: collecting of the data, analysis, drafting the manuscript, final approvement.
- C.F. Stolper: conducting the study design, collecting of the data, analysis, drafting the manuscript, final approvement.
- P. Van Royen: conducting the study design, analysis, drafting the manuscript, final approvement.

DATA SHARING STATEMENT: all data –the 6 transcripts, the code book, the results of the thematic analysis- are available for sharing via the corresponding author.

Tables

Table 1 – Topic guide

Description of NAR, and more specifically intuition and gut feelings
Interaction between intuition and analytical processes
Balance between intuition and analytical processes
Triggers of intuition
Relying on intuition
Determining factors of intuition
Differences between specialties

Table 2 - Participant specifications

	Date	Location	Participants		
1	2013-11-28	NL	6	♂:1 ♀:5	Internal medicine, paediatrics, cardiology, neurology, emergency medicine, pulmonology
2	2014-01-29	NL	8	♂:2 ♀:6	Cardiology, endocrinology, gastro-enterology and hepatology, general surgery, infectious diseases, neurology, paediatrics, psychiatry
3	2014-06-23	NL	3	♂:2 ♀:1	Dermatology, nephrology, neurology
4	2015-03-16	BE	5	♂:3 ♀:2	Abdominal surgery, emergency medicine, neurology, neurosurgery, paediatrics
5	2015-10-22	BE	4	♂:2 ♀:2	Hepatobiliary, transplantation and endocrine surgery, neurosurgery, psychiatry, sexology
6	2015-12-15	BE	2	♂:2 ♀:0	Emergency medicine

Table 3 Quotes

	Focus group	Quote
Description intuition		
1.1	NL 2	We all have this, if we first meet a patient, those first couple of seconds that you see somebody, you get a feeling of whether the situation is serious or not, alarming or not.
1.2	NL 2	Yes, when you mention intuitive thinking I obviously immediately think about my professional domain and about gut feeling.
1.3	NL 3	For me the word intuition is more…erm… something that doesn't rely on knowledge or experience, but more a sort of feeling, and to me what you're referring to, and what I mean, is not a feeling but pattern recognition.
Relying on intuition		
2.1	NL 1	Well, at a certain moment you feel this is what it is, more or less, and that's a feeling I have very strongly with patients and // at the hospital I rely on my feelings… well… for about 80%.
2.2	BE 3	I also distrust it. I do use it, but I also distrust it, right?
2.3	NL 3	Some of us in the group are very allergic to the word gut feelings.

		They think that as a doctor you can't use that term. But at the same time, I think that everyone knows that it does exist.
2.4	BE 2	It offers a certain advantage I think. You argue more correctly if you also use that intuition.
2.5	NL 2	Yes, I don't experience a discrepancy either between the initial gut feeling, or whatever you want to call it, and what comes out in the end.
2.6	BE 2	I actually agree with what you say about the initial thought being biased, that gut feeling, by what you know before the patient enters, by what you saw in C2M [electronic medical record], by what the secretary has said when introducing the patient, by what you might have heard from the GP on the phone. So, you often get a biased picture.
2.7	BE 2	Then you tell yourself I can skip that clinical examination, because last time nothing came out.
Intuition in the process of diagnostic reasoning		
- Presentation of intuition		
3.1	BE 2	Even if you just hear a story from an assistant // Then the first thing is that there is something in in your guts, something that says this is alarming or reassuring. And then you listen very critically, to the whole story… By also building up a systemic picture.
- Triggers of intuition		
3.2	BE 2	But well, observations are always partly intuitive, aren't they? You first look at what is going on with the person in front of you. What he's saying. I think it's like that in all specialities. You don't immediately work systematically.
3.3	BE 1	There's a lot more involved then. What does the patient look like? At that moment it's a kind of multisensory experience. What does the patient look like? How is his breathing, and you listen to that for a while. Yes, there's a lot more to it than listening to their story on the phone. On the phone, it's purely factual, based on a number of questions. If you can actually see the patient, it's totally different.
- Intuition provides guidance		
3.4	NL 2	But the intuition helps you, gives you guidance.
3.5	NL 1	That's how I've spared a hundred children some complicated investigation.

- NAR is followed by AR		
3.6	BE 3	I often find it an important tool at the start, but it's never going to be the only factor in the eventual conclusion and the eventual decision on the diagnosis and therapy for the patient.
- Interaction and balance between NAR and AR		
3.7	BE 2	You have to find the balance between intuition and systematic approach.
3.8	BE 3	I think it's obvious that at busy moments, simply because there's no other option, you sometimes have to rely on gut feelings. Even if it's only because you don't have time for analytical reasoning.
3.9	BE 3	But I'm convinced that experienced emergency specialists regularly rely on their gut feelings, to make a quick first assessment of the degree of urgency. Maybe even more than in other disciplines.
Determinants of intuition		
4.1	NL 2	Because intuition is made up of experience and knowledge.
4.2	BE 2	I think some doctors who are less able to rely on that experience, on that intuition, they have to fall back on systematics. And so as you gain more experience, you can let go of that to some extent.
Differences and similarities between specialities		
5.1	NL 1	I always think, cardiology is of course a very different discipline, because we have, I believe, something like ten illness scripts, yes and I just check them all. Could it be this, or that? And we can actually image everything, so we can often figure it out.
5.2	BE 2	Subjectivity plays an important part, so you automatically start to make more use of the intuitive. (*a psychiatrist*)
5.3	BE 3	No, but general practitioners also need to deal with a different form of uncertainty, and are not held to account for that, the way it happens at a hospital. GPs are able to work with uncertainties. And that's a lot more difficult for a hospital doctor.
5.4	BE 3	A necessary condition for using intuition is, for example, empathy. So the better you're able to understand what the patient means or feels, the better of course you can assess the situation // There are people who are simply purely scientifically oriented and have no empathic ability. Those are people who are less likely to develop this kind of intuition, or they develop it in a less valuable way.

Defensive medicine		
6.1	BE 2	That [I've made this decision based on my intuition] is not something you can say before a court, right?
6.2	BE 3	And of course in situations where you don't yet have the experience, you'll need to rely on the evidence to some extent, and after you have gained the experience, you still have to keep looking at the evidence from the literature, and maintain a balance between the two.
Medical education		
7.1	NL1	Yes, that's exactly when you have to check, I think always, or occasionally, why do I get this feeling, right? And that's what's so good about a hospital like this, that there is a trainee doctor sitting beside you. And when you tell them it's this or that, you need to explain why you get that feeling.
7.2.	BE 1	It should encourage you to recognize that feeling that arises and then to think right, I need to do something about this, in the sense of further reflection or especially thinking why do I get this feeling with this particular patient? // In my case, that often induces me to broaden my scope or to discuss it with someone else or consult another book…
7.3	BE 2	When trainees see patients they get feedback on their findings. I think that's very important. Also with regard to this intuitive thinking. But I think, erm, what you could also do in their training. is emphasise its value more.

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