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Diagnostic testing in children: A qualitative study of pediatricians' considerations

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Abstract

Aims and Objectives: Studies in adult medicine have shown that physicians base testing decisions on the patient's clinical condition but also consider other factors, including local practice or patient expectations. In pediatrics, physicians and parents jointly decide on behalf of a (young) child. This might demand more explicit and more complex deliberations, with sometimes conflicting interests. We explored pediatricians' considerations in diagnostic test ordering and the factors that influence their deliberation.

Method: We performed in-depth, semistructured interviews with a purposively selected heterogeneous sample of 20 Dutch pediatricians. We analyzed transcribed interviews inductively using a constant comparative approach, and clustered data across interviews to derive common themes.

Results: Pediatricians perceived test-related burden in children higher compared with adults, and reported that avoiding an unjustified burden causes them to be more restrictive and deliberate in test ordering. They felt conflicted when parents desired testing or when guidelines recommended diagnostic tests pediatricians perceived as unnecessary. When parents demanded testing, they would explore parental concern, educate parents about harms and alternative explanations of symptoms, and advocate watchful waiting. Yet they reported sometimes performing tests to appease parents or to comply with guidelines, because of feared personal consequences in the case of adverse outcomes.

Conclusion: We obtained an overview of the considerations that are weighed in pediatric test decisions. The comparatively strong focus on prevention of harm motivates pediatricians to critically appraise the added value of testing and drivers of low-value testing. Pediatricians' relatively restrictive approach to testing could provide an example for other disciplines. Improved guidelines and physician and patient education could help to withstand the perceived pressure to test.

KEYWORDS

clinical decision making, diagnostic tests, guidelines, low-value care, pediatrics

1 | INTRODUCTION

Advances in diagnostic technology, increases in test volume and reports of overtesting have stimulated research on diagnostic testing. Diagnostic tests are performed if unacceptable uncertainty regarding the patient's health problem persists after gathering information and clinical reasoning.[1,2] Diagnostic tests can yield information and reduce uncertainty sufficiently to enable therapeutic decision-making.[3,4] The ensuing improvement of the therapeutic decision has been described as the 'medical value' of diagnostic testing.[5] Diagnostic information can also generate planning value (e.g. by yielding prognostic information) or psychosocial value (e.g., by providing reassurance or promoting understanding).[5–8] Lastly, performing a test can be valuable for patients or physicians irrespective of the information gain, for example, by conveying to patients that symptoms are taken seriously or by preventing conflict by acceding to patient demand.[9,10] Negative consequences associated with diagnostic tests are direct harm and downstream consequences of misleading, unwanted or unsolicited results. Testing can also have substantial (societal) costs.

Physicians need to weigh the anticipated positive and negative consequences of diagnostic testing to deliver high-quality care. This encompasses multiple interconnected aspects: safety, patient-centeredness, effectiveness, efficiency, timeliness and acting according to professional norms.[11] Although decisions about testing are sometimes straightforward, at other times elements such as patient-centeredness and efficiency may be conflicting.

Substantial research efforts have been directed at revealing the anticipated consequences of testing and other factors physicians consider in their decision-making, especially in light of steadily increasing test volumes. Various approaches have been taken: Qualitative studies elicited relevant factors for test decisions with a focus on specific diagnostic situations[12,13] or tests,[14–16] or on testing in general.[10,17,18] Studies on practice variation and surveys revealed determinants of test volume[19–21] in addition to studies on effects of interventions to reduce testing (reviewed in Colla et al.[22]). These studies were predominantly performed in adult medicine and have resulted in several proposed frameworks for testing and overtesting.[10,23–29]

Some pediatric studies reported on practice variation of diagnostic test use,[30,31] overtesting[32] and effects of interventions to promote appropriate testing,[33,34] but an overview of the spectrum of considerations relevant to test decisions in pediatrics is lacking.

Due to the triadic setting, test deliberations in pediatrics may be particularly complex but also more explicit compared with adult medicine. In addition, the positive and negative consequences of testing might be weighed differently for pediatric patients. Improved understanding of the complexity of pediatricians' considerations is a prerequisite to reduce overtesting and improve high-quality care. We aimed to explore pediatricians' considerations in diagnostic test ordering and the factors that influence their deliberation.

2 | METHODS

We used semistructured interviews to explore pediatricians' self-reported behaviors, experiences and attitudes regarding test deliberations. We chose a qualitative approach because of the limited knowledge of the spectrum and complexity of pediatricians' considerations. Study methods are reported in accordance to the Consolidated criteria for reporting qualitative studies checklist (COREC; for additional information see Supporting Information: Table 1[35]).

2.1 | Setting

The Dutch healthcare system has large resources and high accessibility. It is collectively financed predominantly through taxes and premiums paid to statutory health insurance. Primary care is delivered to children by general practitioners, also during out-of-office hours. Children may be presented to the emergency department directly. General practitioners can refer patients to pediatricians who work in hospital-based outpatient clinics. Pediatricians are employed and paid by their hospitals. There are only a very few independent pediatric facilities in the country.

2.2 | Recruitment

We recruited a heterogeneous sample of practicing pediatricians, both generalists and specialists across the Netherlands, using exponential discriminative snowball sampling: included participants provided multiple referrals. Of those referrals, participants were purposively selected based on sex, working experience, setting (secondary or tertiary care), specialization (general or specialized pediatricians) and geographic region to ensure maximum diversity within the sample. Inclusion stopped once three consecutive interviews did not provide relevant new information, indicating thematic saturation was reached.[36]

2.3 | Procedure

Two authors (F. R., pediatrician and S. R., undergraduate medical student, both trained in qualitative interviewing by M. H.) conducted 20 semistructured interviews between May and August 2020 via video-conferencing,[37] due to COVID-related contact restrictions. Participants were fully informed before the interview and gave signed informed consent. Interviews lasted approximately 1 h (41–77 min, $M = 60$). All interviews were recorded and anonymously transcribed. The institutional Medical Ethics Review Board waived the need for ethical-legal adjudication and approved the study [N20.083].

2.4 | Interview protocol

The full interview guide can be found in Supporting Information: Table 2. Part A first openly explored pediatricians' deliberations and relevant factors in decisions regarding diagnostic testing, based on diagnostic situations from personal experience. To prompt reflection on the spectrum of positive and negative consequences of testing that are weighed in test decisions, we asked about situations in which the decision whether or not to test was not clear-cut. If not brought up spontaneously, the relevance of additional potential factors identified in the literature[23,24,26,27,38,39] was explored. We also explored situations in which physicians and parents had diverging opinions on potential diagnoses underlying the child's symptoms, and we asked about physicians' experiences with missed diagnoses. Part B focused on the trade-offs and relative weights of consequences and factors mentioned in Part A. Part C (reported elsewhere) explored attitudes towards diagnostics and views of clinical and societal developments regarding diagnostic testing in pediatrics. The topic guide was informed by the literature and designed to probe a broad spectrum of considerations. It was piloted twice and adapted iteratively during the study, using information emerging from previous interviews. As data collection progressed, the emphasis shifted towards Part A, where participants were prompted about examples from their own practice.

2.5 | Data analysis

We used a data-driven (inductive) constant comparative method.[40,41] All transcripts were first read and independently open-coded by F. R. and S. R. using MAXQDA software.[42] The coded transcripts were compared and discussed with input from a psychologist, expert in qualitative research (M. H.), until consensus was established. The coding scheme was revised continuously. Second, during axial coding, codes were merged and renamed and eventually ordered hierarchically, to identify broader relationships. Third, common themes were derived across interviews. Eventually, relationships between the most relevant main and subthemes were visualized. The full research team gave input in three research meetings held during data analysis, providing feedback on the themes that should be explored further and on the structure of the results.

3 | RESULTS

3.1 | Interviews

Sample characteristics of participants are reported in Table 1. In the paediatricians' reflections we identified various steps in diagnostic decision-making (Figure 1). Reported considerations and relevant factors for decision-making are presented in Figure 2. A full overview of quotes supporting Figures 1 and 2 can be found in the supplemental material.

TABLE 1 Characteristics of study participants ($n = 20$).

Age in years, median (range)	49 (35–62)
Sex female, *n* (%)	12 (60%)
Country of pediatric residency	
Netherlands	18 (90%)
Other	2 (10%)
Clinical working experience (since graduation from medical school) in years, median (range)	23 (9-37)
Pediatric subspecialty training, *n* (%)	11 (55%)[a]
Present working environment	
University hospital, *n* (%)	6 (30%)
General hospital *n* (%)	14 (70%)

[a]Subspecialty (*n*): neonatology (1), rheumatology/immunology (3), cardiology (2), nephrology (1), infectiology–immunology (2), oncology (1).

3.2 | Information gathering and assessment (Figure 1)

Pediatricians used information from the parent and child on the child's history as well as the physical examination to assess the medical situation. For their differential diagnosis and decision regarding diagnostic testing, they highlighted the importance of suspicious findings potentially indicative of serious underlying disease, as well as their own gut feeling.

> 'I find diagnostic testing medically necessary if a symptom alarms me—whether it is weight loss, or vomiting in the morning, or you name it—one of the known warning signs. And also when I see a patient at the outpatient clinic and I have a feeling something is wrong, without really being able to pinpoint the reason. That is something I have learned. It helped me detect serious conditions.' (Interview 10)

Pediatricians described parents' input and judgement as particularly important for their initial assessment of the situation and subsequent decision-making, especially when they perceived the parents were realistic people who nevertheless were extremely worried.

> 'What I find very relevant is the parent's judgment. And I have learned that if parents say: "it's really not that bad," and if they are surprised you want to perform testing, then that is an important sign. The moment they are worried, then I take that into

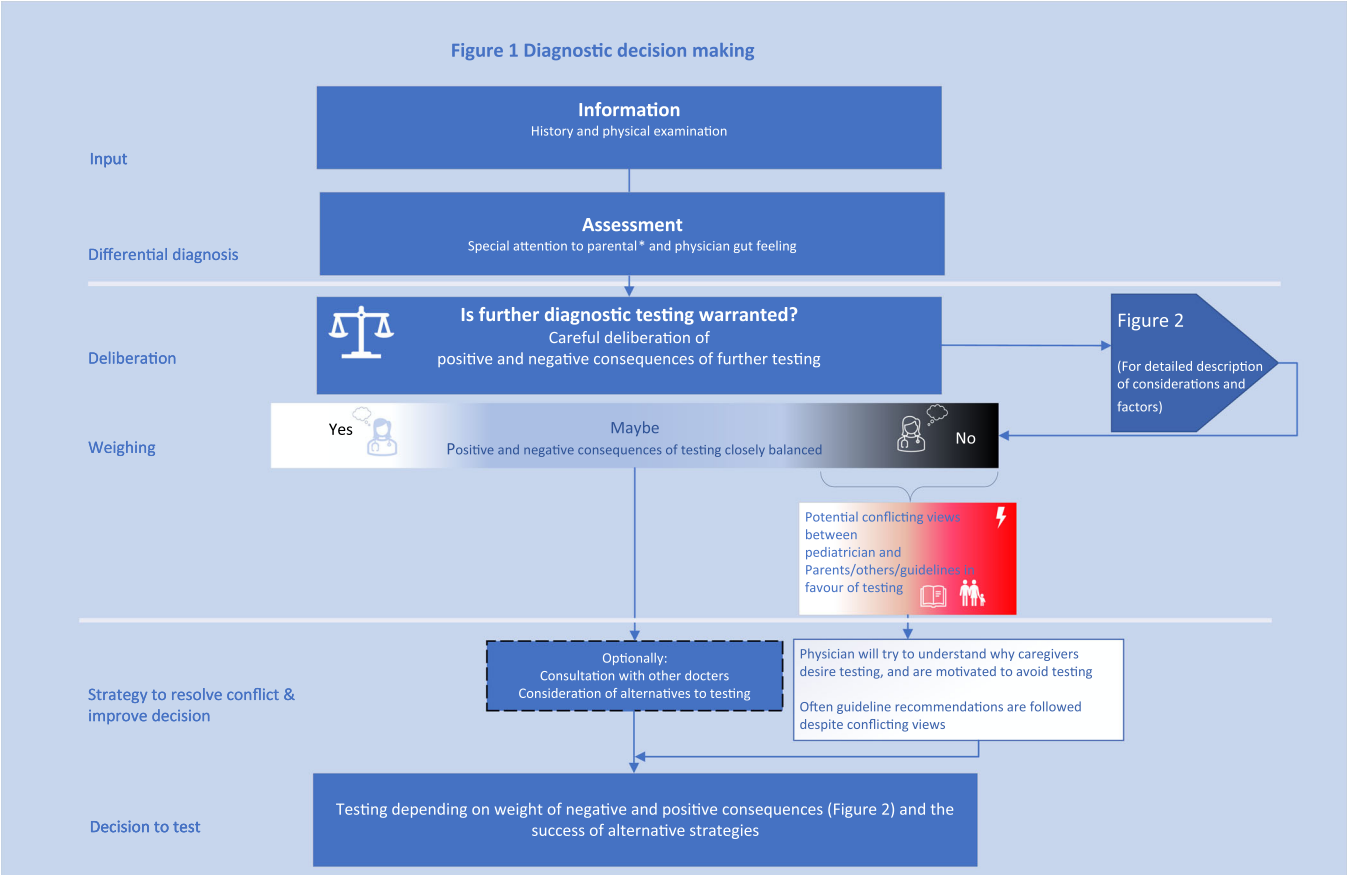

FIGURE 1 Schematic representation of the deliberation process from medical problem to decision for or against testing based on the interviews. Supporting quotes can be found in the Result section and Supporting Information: Table 3. *Parent is used to describe any legal substitute decision-maker.

> account, because they know their child well. […] So the parents' gut feeling is important.' (Interview 15)

3.3 | Careful deliberation regarding further testing

Pediatricians described carefully weighing multiple factors. They considered medical consequences (both positive and negative) to be the most important, yet also included other anticipated consequences of testing such as satisfaction or reassurance (Figure 2). Sometimes this led to a straightforward decision: pediatricians would pursue testing if the probability of disease or the medical consequences of missing it outweighed the negative consequences of testing, or vice versa. A cited example was ordering an MRI for children with signs of increased intracranial pressure.

> 'If you see a child with a headache and you think it might be a brain tumor, well that is something you cannot miss. If you really consider that diagnosis, you have to rule that out. And fortunately, the chances of the child having a brain tumor are very small, but you have to rule it out, period. Because the consequences are so far-reaching. As opposed to someone who has had abdominal pain for the past 4 months: if you propose to start with laxatives and re-evaluate the symptoms a month later, that is fine. So it is all about the consequences of not ruling out a diagnosis.' (Interview 19)

Yet, most often the decisions were reportedly not straightforward and required a multifaceted deliberation. Importantly, pediatricians never spontaneously mentioned situations in which they favored testing and parents did not.

In this 'grey' diagnostic area of situations that are not straightforward, pediatricians distinguished (1) situations in which they perceived *a close balance between expected positive and negative consequences of testing*, from (2) situations in which they felt *testing was not needed but externally prompted* (Figure 1, italicized topics correspond to items in Figures 1 and 2). In the former situations, expected positive consequences were small or balanced by negative consequences such as burden, harm/complications, cost and/or scarce resources (see '*Maybe*' in Figure 1). Examples of such situations were mild traumatic head injury, fever of unknown origin without signs of critical disease, headache and abdominal pain without warning signs. In the latter situations, pressure to perform tests would result from *guidelines* (e.g., for traumatic head injury or short

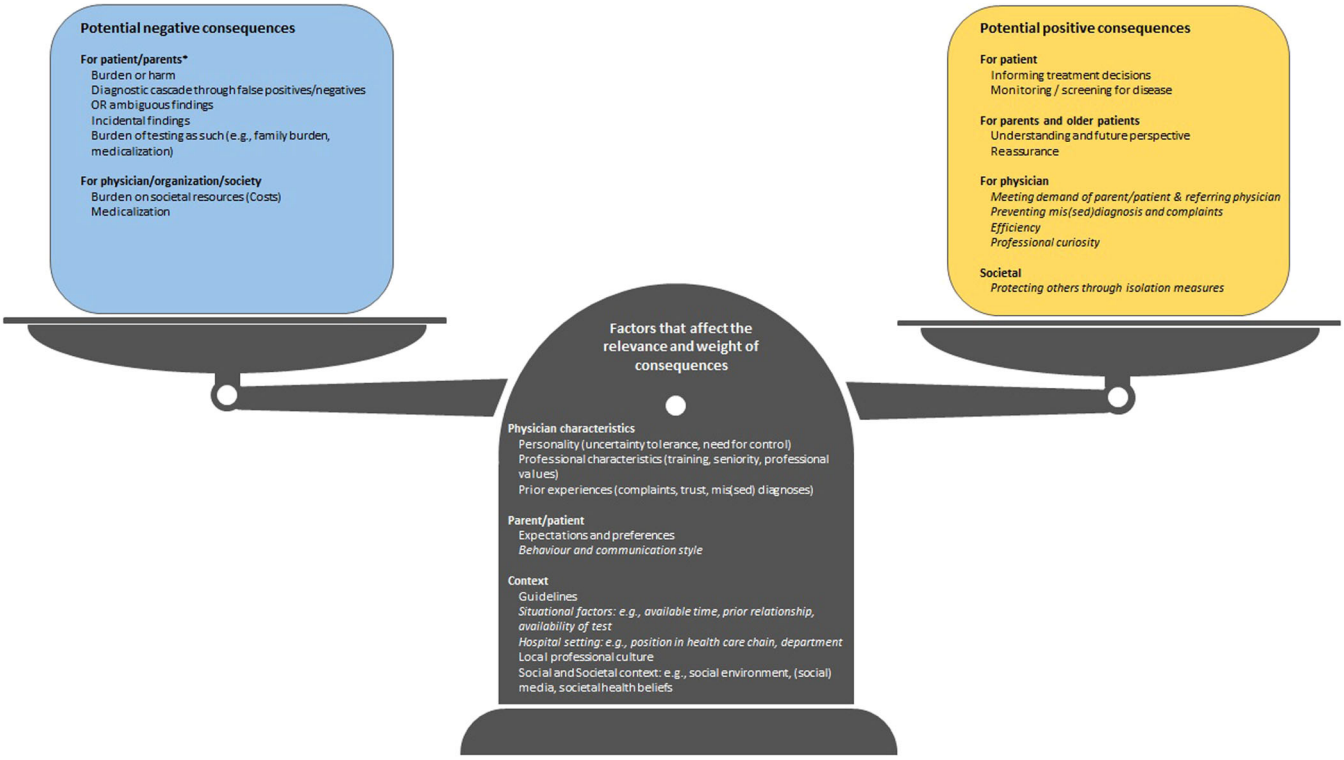

FIGURE 2 Perceived potential negative and positive consequences of testing, and factors that affect their weight. Italicized factors and consequences are *not* described in the results section. Quotes supporting italicized factors and consequences can be found in Supporting Information: Table 4. *Parent is used to describe any legal substitute decision-maker.

stature), *or parents, patients and colleagues*. Pediatricians mentioned examples including constipation, medically unexplained symptoms and fears of specific diseases like borreliosis or cerebral aneurysm.

When weighing the positive and negative consequences of testing (*the deliberation phase*) pediatricians considered the interests of *various stakeholders* (Figure 2). Besides the patient, testing could have positive and negative consequences for parents, pediatricians and/or their organization or society. Yet, their most important concern was whether diagnostic testing would be in the child's best interest.

> 'Well, it is not about me, it is about the patient. I am the patient's advocate. […] I am not the one who has to undergo the test and neither are the parents. The child has to, and bears the consequences. […] A simple lab test can be very traumatic for children, so I don't take that lightly. If parents and I share the same goal, and parents feel that, this hardly ever results in disagreement.' (Interview 10)

3.3.1 | Negative consequences (Figure 2)

Pediatricians uniformly stated that the most important downside of testing was *burden or harm* to the child. The majority pointed out that in comparison with adult medicine, test burden played a more prominent role in decision-making. The challenges and limitations involved in testing children, such as the need for anesthesia when performing an MRI, also led to a more thorough evaluation and deliberation compared with adult medicine, where routine testing was said to happen more frequently.

> 'And I do think that as a pediatrician, you are even more selective in what you do and don't do compared to physicians in adult medicine. Because an intervention can easily be uncomfortable for a child, has to be performed under anesthesia et cetera. So you think twice instead of just saying: "please lie down, draw blood, all done."' Interview 11

Other reported negative consequences of testing were a *diagnostic cascade* provoked by false negative, false positive or ambiguous results, or *incidental findings* causing worry.

> 'With MRIs there are incidental findings and then you need to perform an ultrasound, followed by a CT scan, and so forth. Before you know it, half a year has passed full of tests the child had to endure. And in the end it has only resulted in unrest.' Interview 13

Additionally, some pediatricians emphasized several negative consequences related to the testing itself, for example, the *practical burden* to the family, or confirming parents' belief there must be an

underlying disease if the pediatrician thinks testing is warranted (*medicalization*).

Apart from possible negative consequences for the patient, pediatricians experienced potential negative consequences for themselves, the organization and/or society. Most felt responsible for an *affordable social healthcare system*.

> 'Many people want to get an MRI, which costs loads of money. We have to pay for the health care system together, and I think it is my responsibility to prevent us from spending money on things that are unnecessary and might even be harmful.' Interview 1

Some additionally mentioned they did not want to drive societal *medicalization* of normal variation. Yet, pediatricians would only consider the cost and use of scarce techniques when they questioned the added value of testing.

> 'When I consider testing, costs are never an argument to refrain from performing them. However, you frequently get patients where you do something to reduce their worry or your own, or their parents'. In these instances, I do find costs relevant. In these cases scarce resources and economic arguments do play a more important role than if you have a very ill child in front of you, and you really need diagnostic testing.' Interview 13

3.3.2 | Positive consequences (Figure 2)

Pediatricians mentioned that diagnostic testing could benefit the patient in several ways, for example, by informing *treatment decisions*, *facilitating disease monitoring* or *providing an explanation for complaints*.

> A: '[…] Well, if you can treat it, then you can make a difference for the patient. By performing that test, the patient's quest [to find a medical explanation for the symptoms] will end, which may lead to acceptance. […]. With untreatable diseases or syndromes it can be helpful that they know the origin, as it provides clarity about the future.' Interview 1

An important perceived positive effect of testing was *reassurance of parents*, which could decrease the likelihood of parents' 'doctor shopping', which may harm the child. More generally, testing could help reduce parents' (specific) anxiety by excluding a disease or could lead to a diagnostic label, thereby also facilitating acceptance of nonmedical treatments. Pediatricians argued that testing at parental request could thus indirectly benefit the child.

> 'A 9 year old girl presents because of abdominal pain since 1 year, and nothing really helps. And mother's main question is, whether the pain is caused by lactose intolerance. Since mother is lactose intolerant herself. Then we can very easily perform a lactose test in the outpatient setting. They only have to stay for a short while, and you get the result really fast. And in this case I thought: it is such a specific question mother has, and she will otherwise avoid giving milk to the poor child, so I can rule that out.' Interview 2

3.4 | Factors that affect the relevance and weight of consequences (Figure 2)

All pediatricians observed variations in their assessment of medical situations and the projected negative and positive consequences of testing because multiple factors influenced the trade-off. We distinguished three categories of factors: physician characteristics, parent and patient characteristics and contextual factors.

3.5 | Physician characteristics

All pediatricians reported broad variation in diagnostic testing decisions between pediatricians in their practice. They attributed this to *personality differences*, most importantly regarding uncertainty management, need for control and perfectionism. Moreover, the *local culture and experiences during pediatric specialist training* had a lasting influence on physicians' professional values and behavior.

> 'One reason why I am more conservative regarding tests, might be that in the first hospital where I worked as a junior, I was trained to really look and listen very carefully to your patients. First use your clinical assessment and only after that step you start thinking about whether you need testing. And why you would need it, or wouldn't.' Interview 2

In addition, most indicated that being more *senior* in general led to less reliance on diagnostic testing, but also to a better understanding of when testing was required.

> 'I remember vividly when I was younger, less experienced and knowledgeable, I needed more support from diagnostics, for example, to reduce the risk of missing something you are not familiar with. And as the years pass you need that less often.' Interview 18

When prompted about (the *effects of) missing a diagnosis* or complaints filed by parents, around half had an instant recall of such situations, which influenced their current behavior.

'And honestly, in some situations I don't take any risk. For example, having missed a meningitis as a junior doctor has left a mark. My risk tolerance is still very low in that specific situation. It has been 20 years, but with me a child still has a higher chance to get a lumbar puncture than with other pediatricians.' Interview 1

3.5.1 | Parent/patient characteristics

Parents' characteristics and assessment of their children's symptoms reportedly influenced preferences and expectations. These in turn affected the magnitude of positive and negative consequences the pediatricians expected from testing (Figure 2). If parents feared a serious disease while the pediatrician did not, pediatricians would go to great lengths in *exploring the cause of parental concern* (Figure 1). Because parental worry could cause the child to undergo a diagnostic test, pediatricians stressed their professional responsibility as the *patient's advocate to avoid unnecessary burden of testing* (Figure 2). Pediatricians reported involving parents in their assessment of the situation and their considerations regarding testing, including limitations of the desired tests and watchful waiting.

'It is often a good thing to involve patients in your considerations. People often come into your office saying: "I want an ultrasound, I want this, I want that…" While at the end of the consultation they themselves propose how to move forward, and they do not mention their initial demand for testing anymore.' Interview 4

'[if my judgment differs from that of the parents, who think of a (serious) disease underlying their child's symptoms] I primarily explain how I see the problem, what the yield of further investigations would be, the advantages of watchful waiting and what the burden [of diagnostic testing] is. Simply explaining why I make certain choices. And [in our hospital] we often have a bit more time per patient, so you can take time to discuss this together. Most of the times they seek reassurance. If you just ask what they are afraid of, parents often answer: "well, cancer!" And then it turns out that the test they request cannot rule that in or out. But by then they are already very set on that test.' Interview 13

If parents could not be dissuaded and reassured, pediatricians would *consult with other pediatricians*, to both crosscheck their assessment and convince parents (Figure 1).

'Consulting the pediatric neurologist helps me gain some confidence, because I am always a bit insecure about my neurological examination. It also helps parents if they see the expert on the brain and nerves do a neurological examination and not find anything alarming. Yes, then that settles it.' Interview 3

They reported that this approach was usually successful, except when parents or the patient had specific anxieties, often associated with a positive family history or a traumatic experience.

'I once saw a girl whose father had died of a brain tumor. And of course she had a headache and we could not move on [to nonmedical therapy]. And when I said: "we will perform that MRI", a big weight fell off their shoulders. And of course the result was normal. I do not think we could have achieved that any other way.' Interview 9

Pediatricians almost uniformly reported that there were tests they would never perform purely at parental request, such as biopsies. For widely available tests, such as simple laboratory tests, some pediatricians would more easily yield to parents' wishes. Yet, in such cases they would negotiate a limited work-up at the outset to avoid consecutive testing. Others would still strive to avoid testing because of the potential harm inflicted on the child. If the desired test had limited availability or would be a great burden to the child or society, such as an MRI, pediatricians would invest a considerable amount of time and effort to avoid it.

'[I handle parental requests for hemoglobin test and MRI differently..] If I have to draw blood just for hemoglobin, I find that quite a burden for the child. But suppose I want to take blood for thyroid function and they are curious about the hemoglobin, then I spend half a sentence on this and simply ask them why, before just ordering it. I will not spend 10 min on discussing this. If they would have asked for an MRI, I would have.' Interview 14

3.5.2 | Contextual factors

Guidelines

Most pediatricians felt that guidelines could facilitate their decision-making overall by providing guidance and evidence summaries. However, many also perceived them as defensive or that they insufficiently consider the prior probability of individual patients.

'But I think that the current guidelines for general pediatrics are very defensive. I regularly feel it is hard to find your way in working with them. You cannot ignore them, because they exist. So if you do not follow them, you have a problem.' Interview 13

Some felt restricted by the guidelines and felt forced to perform unreasonable diagnostic tests (Figure 1), because of the legal implications of undesired outcomes if they would not adhere to the guidelines. Pediatricians mentioned that with increasing experience they applied guidelines more liberally, because they had witnessed the natural course of disease episodes.

> 'The consideration for or against a head CT in case of mild traumatic head injury is always difficult. During the past years, I have started relying on my own experience. If you follow the protocol, you have to perform a CT quite often. And I don't think the advantage outweighs the disadvantage, because from my own experience I know that it will not yield anything even when the protocol says I need to perform it. And that is why I stopped doing it.' Interview 15

Moreover, they felt more confident that it was acceptable to establish a diagnosis at a later time point if symptoms evolved. Also, pediatricians would sometimes *consult with colleagues* regarding the best course of action or support for intended deviation from guidelines (Figure 1).

Local culture and societal/social context

Because pediatric staff worked closely together and discussed their diagnostic decisions openly, pediatricians believed they influence each other's decisions and create a *local culture of care*.

> 'You may work in a group in which it is very common to perform diagnostic testing or that has a very low testing threshold. And if you then deviate from that and miss a diagnosis, I think your colleagues will say: "See, you should have kept to our standard"'. Interview 1

Societal and social influences entered the deliberation through several channels: through parental fears of specific diseases that were inspired or augmented by *relatives, friends or other healthcare providers*. Also, *social media and online resources* were mentioned as causes of parents' fear or expectations. On the other hand, some pediatricians perceived that online resources could adequately inform parents and thus decrease their desire for testing. Many pediatricians described broader societal developments to drive the demand for testing, such as *suspecting pathology in physiological variation*, a *lower tolerance of uncertainty or apparent inaction* (wait and see).

> 'People are less willing to accept it when you propose to wait. Because in adult medicine you can arrange things yourself, e.g., a total body scan. If your physician does not refer you, you take care of it yourself. So I do think things are changing. People are less prepared to wait, because they are impatient. Everything has to be done fast and immediately. And maybe there is a certain fear that [a disease] is missed, for which you would have needed treatment.' Interview 3

4 | DISCUSSION

Through our study we obtained an overview of pediatricians' considerations regarding diagnostic test decisions in a high-resource, publicly funded healthcare system. Our participants described that in many situations the positive and negative consequences of testing were closely balanced ('grey area'). Stakeholder interests and multiple other contextual factors together determine how they weighed these consequences. They prioritised the child's interest over that of other stakeholders. Pediatricians perceived the test-related burden to be higher in children compared with adults and believed that avoiding unjustified burden caused them to be more restrictive and deliberate in test ordering, when compared with other medical disciplines.

This overall critical view of even simple diagnostic procedures such as laboratory testing might be more pronounced than in adults, in whom the harms of such procedures are regarded as more trivial and inconsequential.[29] Pediatricians' perception that the burden of frequent and relatively simple diagnostic procedures is higher for children, is supported by previous findings.[43,44] Arguably, the importance of direct test-related harms in children primed pediatricians to also critically consider other negative consequences of testing and drivers of testing. For example, pediatricians sought to avoid other negative downstream consequences, such as treatment due to misleading or false test results. Such cascade effects have previously been reported as arguments against excessive testing in adult medicine.[12,14,45–48] Pediatricians in our study also found that some guidelines promote unnecessary tests, which correspond to findings from a recent European survey.[49] These concerns regarding guidelines are similar to those described in adult medicine, where low-yield testing,[14,50] conflict of (intellectual) interest of panel members[51] and over-diagnosis have been described.[52–54] Even if pediatricians felt that guidelines recommended low-value testing, they would nevertheless test because of feared legal implications, which is an undesired consequence of complaint and legal structures, intended to strengthen the patient's position.[55] Enhanced methodological support in guideline development,[56] explicit value judgment on efficient test use and embracing an acceptable miss-rate in guidelines may reduce the use of low-value testing.

Pediatricians' consideration of negative test-related consequences and their role as expert and child's advocate reportedly determined the thoroughness of their considerations, their willingness to accept uncertainty and their engagement in in-depth communication with parents. A thorough and comprehensive consideration of potential downstream consequences of testing can improve decision-making. It might however not protect against the overestimation of benefits of testing and underestimation of harms

by patients and physicians.[57,58] This mainly seems due to insufficient knowledge regarding pretest probability and test characteristics, which might be difficult to solve. Equally challenging is the management of the psychological mechanisms and biases that drive ineffective or inefficient testing.[59–61]

To avoid test burden disproportionate to diagnostic information gain, pediatricians expressed a willingness to accept some level of uncertainty, especially if the professional local norms were supportive. Group decisions[62] and guidance by seniors[63–66] might be important to translate this tolerance of uncertainty into prudent testing, and counterbalance general tendencies in medicine to conduct diagnostic testing to eliminate uncertainty and avoid missed diagnoses.[67–70] This is desirable, because excluding ever smaller risks leads to high testing rates to find a needle in a haystack, with its associated cost and burden.[38]

Pediatricians observed that parents struggled with uncertainty and linked this to parental requests for testing in situations with a low probability of disease. Respondents further explained parents' testing demands through factors similar to those in adult medicine, that is, a general enthusiasm for testing, overestimation of the benefits alongside underestimation of the harm, consumerism and medicalization of physiological phenomena.[26,57,71] Pediatricians employed patient-centered communication to explore parental concerns and only tested if they saw no other way to reassure parents. Previous literature suggests that such elaborate exchange is necessary to prevent clinician misconceptions about patients' concerns and preferences,[72,73] and that it may reduce ineffective testing.[74–76] Regarding the reassuring effect of testing in situations with a low probability of serious disease in adult medicine, a review described that testing had no positive effect on anxiety, symptoms or illness concern. Testing also proved to be an inefficient way of reducing the frequency of subsequent primary care visits.[77] Although the overall favorable effect of testing on reassurance is thus questionable, it may be valuable in anxious subgroups[78] and create a short-term sense of relief that is valued by patients.[79] Our respondents' strategy to limit testing for parental reassurance to those parents who fear specific diseases might therefore be efficient. Physicians can further enhance the reassuring value of testing when there is a low probability of disease by providing parents with alternative explanations for their child's symptoms but also by explaining the aims of specific tests.[80–82] Watchful waiting, which was deployed by many of our respondents, can successfully reduce low-value testing while maintaining patient satisfaction,[64,82,83] and might be most effective when framed as active surveillance.[84] In summary, pediatricians described many strategies to limit testing for reassurance and increase its reassuring value. Shared decision-making is gaining ground in the Netherlands and should be complemented with other effective strategies to limit low-value testing. These strategies are supported by evidence and are apparently already in use by pediatricians, but are not yet covered during formal pediatric education.

Even if physicians are highly motivated to avoid low-value tests, this requires them to spend considerable time and effort—scarce resources in themselves—to educate and convince patients.[29] They may moreover fear negative effects when they decide against testing, affecting the patient-provider relationship or personal repercussions in the case of adverse outcomes.[85] These fears have been found to lead them to concede to requests,[19,50,86,87] in line with pediatricians' reports in our study.

To effectively deal with drivers and requests for low-value tests, support and compensation is needed for the negative effects which physicians both anticipated and experienced.[29] From research on behavioral interventions, we know that a multifaceted approach involving education of patients/parents can be effective,[22] and it should not be solely left up to physicians to resist the pressure to test.[86]

5 | STRENGTHS AND LIMITATIONS

A limitation of this study is the potential gap between reported and actual considerations, motives and behavior. Vignette studies and observational studies are more suited to assess the impact of certain factors on decision-making, for example, by analyses of practice variation or through surveys. Effects of interventions such as education, feedback or use of role models on test ordering behavior can indirectly shed light on the underlying behavioral mechanism behind testing. The strength of qualitative studies like ours is that they can generate information on the broad spectrum of physicians' arguments underlying their diagnostic decisions. This can help design interventions and create circumstances to improve their testing behavior. Deliberations and decisions regarding testing are context specific, because financial, judicial, organizational and social factors influence the anticipated consequences that are considered in decision-making. This limits generalizability of our findings to different geographical settings.

6 | CONCLUSION

We obtained an overview of pediatricians' considerations of test decisions involving children, which largely correspond with those observed in adult medicine. The comparatively strong focus on prevention of the possible harm of diagnostic testing in children elicits a critical appraisal of the added value of testing and drivers of low-value testing. Through patient-centered communication pediatricians reported to engage parents. They reportedly applied several communication strategies, such as exploration of underlying concerns, education on harms and benefits, alternative explanations or watchful waiting. These approaches are promising and could be applied in other medical disciplines. Yet, they are not an integral part of residency programs. If patient visits and patient test demand increase, the effort and time to discuss requests for low-value diagnostic testing increases concomitantly. Critically revising guidelines that force physicians to perform testing with questionable value may reduce low-value testing.

AUTHOR CONTRIBUTIONS

F. Ropers and M. Hillen conceptualized the study, all authors helped in the design of the study. F. Ropers and S. Rietveld collected the data under supervision of M. Hillen, and together with M. Hillen carried out the main analyses. All authors helped in the interpretation of the analyses and discussion of the results. The article was drafted by F. Ropers, and revised critically by all authors. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS APPROVAL

The Leiden University Medical Center's Medical Ethics Review Board waived the need for ethico-legal adjudication and approved the study [N20.083].

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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