Medication safety in pediatric care
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Chapter 3

Contributory factors leading to medication errors in pediatric patients: a qualitative study

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Marian Smeulers
Petra van Rijn-Bikker
Hester Vermeulen

Submitted.
ABSTRACT

Introduction
Keeping patients safe is a priority for hospitals worldwide and the medication process has been identified as a key area of risk. Despite a growing knowledge on medication safety, effective interventions to prevent medication errors are still limited. To move forward in the field of medication safety, we conducted a qualitative study with the aim to explore the contributory factors that may lead to medication errors as experienced by doctors, nurses and pharmacists, in an academic pediatric hospital.

Methods
We collected our data from focus group discussions. These discussions were coded by three researchers, who therefore read the transcripts independently in an iterative way, keeping the research question in mind. After completing the initial coding, the researchers sorted the emerged codes into similar contextual categories. Finally, the categories were developed further into interpretative main themes.

Results
Four main themes emerged: “lack of coherent teamwork”, “suboptimal working process”, “inability to work safely” and “culture”. Culture appeared to be a central element, linking the three themes. Especially organisational issues were considered to contribute to unsafe patient care. The participants expressed feelings of frustration, confusion and uncertainty, but also resignation was present.

Conclusion
Our results highlight the need for interventions on organizational level. Essential is creating an organizational culture that gives priority to medication safety and is supported by leadership as well as by the healthcare professionals.
INTRODUCTION

Keeping patients safe is a priority for hospitals worldwide. Because medication errors (MEs) are common and are associated with outcomes such as patient harm, additional length of stay, readmissions and increased costs, the medication process has been identified as a key area of risk [1-7]. The medication process in pediatric care is considered more hazardous due to issues such as the constant need for adaptations based on age and weight, the lack of appropriate formulations and dosages, and the dependency on caregivers [8-10]. Several types of MEs have been described, such as omissions, dosing errors and wrong time of administration, which occur mostly during the prescribing and administering stage of the medication process [5,11-15]. Although knowledge about medication safety is growing, effective interventions to prevent MEs are still limited [16].

To improve medication safety, in-depth understanding of the factors contributing to MEs is essential. Known factors that contribute to MEs are slips and lapses, inadequate communication, high workload and lack of knowledge [17-19]. Specific factors for prescribing errors are lack of training and experience, fatigue, stress and reluctance to question senior colleagues [19]. Specific causes during the administration process are problems with distribution and storage, ward-based equipment, patient-related factors and interruptions [17,18].

Despite this knowledge about the various contributory factors, previous studies have not fully addressed the interdisciplinary character of the medication process, nor have they provided in-depth understanding of why the contributing factors exist. However, if we could enrich this knowledge, more effective interventions could be developed and implemented, thus preventing the unfavourable outcomes for patients and organizations. We therefore conducted a qualitative study in an academic pediatric hospital to deepen the understanding of the contributory factors that may lead to MEs as experienced by the key professionals: doctors, nurses and pharmacists.

METHODS

Design

We used a descriptive phenomenological approach that emphasizes understanding the reality through the experiences of the participants [20]. Focus groups were chosen as they allow the participants to build upon the responses of other group members and thereby explore different views on the subject [21]. The design and execution of the study comply with the COnsolidated criteria for REporting Qualitative research (COREQ) recommendations [22].
Setting
The study took place at Emma Children’s Hospital, which is part of the Academic Medical Center and affiliated with the University of Amsterdam. In this pediatric hospital, children from birth to the age of 18 years are treated on three general pediatric wards, an oncology ward, a pediatric intensive care unit (PICU) and a neonatology intensive care unit (NICU). On these wards, all medication is prescribed in computerized physician order entry systems (CPOE). The CPOE used on the non-intensive care wards is called Medicator, while Patient Data Management System (PDMS) is used on the intensive care units. The nurse transfers a copy of the prescription to a patient’s medication chart and signs this chart after each administration. It is standard practice to double-check all intravenous medications and a limited group of high-risk medications. Frequently used medications are stored in a locked area on each ward, from which medications are administered to the patients. The hospital formulary is available online. A pharmacist checks the prescriptions for children on a daily basis, and the pediatrician is contacted in case of irregularities or questions about dose or deviating matters. Pharmacists are available for advice, but do not participate in ward rounds. When a ME occurs, it is reported in a computerized incident reporting system with the option to report anonymously. Ward-based safety teams, which consist of pediatricians and nurses, are responsible for systematically collecting and reviewing these incidents. They report the findings to the ward leaders. All healthcare professionals are strongly encouraged to report incidents and they are assured that the purpose of incident reporting is not to assign blame, but to ultimately prevent unsafe situations. The leaders of the hospital and wards are healthcare professionals, representing a strategy known as “professional in the lead”, which aims to connect the worlds of healthcare professionals and managers. Since 2012, the Academic Medical Center is held by the Joint Commission International accreditation certificate.

Personal characteristics of the researchers
Two researchers performed the data collection (JM and HV). Both researchers are registered nurses and clinical epidemiologists, with a longstanding experience in tertiary healthcare. The participants were aware that this study was part of the PhD research of the first author. The researchers had no formal hierarchical relationship with the participants that may inhibit frank discussion. The coding was supported by a registered nurse and physiotherapist, both with academic degrees and experience in qualitative research (CvO and MS).
Focus groups
The focus groups consisted of six to ten professionals, according to the recommendations [23]. We invited nurses (all with a bachelor’s degree), pediatricians, residents and pharmacists to participate in the focus groups. In total 52 participants participated in six different focus group meetings. Heterogeneity was present regarding age, postgraduate experience and working hours per week. An overview of participant characteristics is presented in Table 1.

Table 1. Characteristics of the participants

<table>
<thead>
<tr>
<th>Focus group</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration, minutes</td>
<td>50</td>
<td>55</td>
<td>51</td>
<td>39</td>
<td>42</td>
<td>49</td>
</tr>
<tr>
<td>Profession</td>
<td>nurses</td>
<td>nurses</td>
<td>nurses</td>
<td>pediatricians</td>
<td>residents</td>
<td>pharmacists</td>
</tr>
<tr>
<td>Participants, n</td>
<td>10</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Female, n</td>
<td>9</td>
<td>6</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Age in years, median (min-max)</td>
<td>31 (24-63)</td>
<td>34 (23-56)</td>
<td>40 (22-59)</td>
<td>47 (28-60)</td>
<td>31 (26-34)</td>
<td>39 (31-50)</td>
</tr>
</tbody>
</table>

Postgraduate experience

<table>
<thead>
<tr>
<th></th>
<th>* 0 – 5 years.</th>
<th>* 5 – 10 years.</th>
<th>* &gt; 10 years.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

Working hours per week

<table>
<thead>
<tr>
<th></th>
<th>* 24 – 32 hours</th>
<th>* 32 – 40 hours</th>
<th>Member of safety committee, n</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>6</td>
<td>-</td>
</tr>
</tbody>
</table>

The focus groups were monodisciplinary to create a safe climate and to encourage the participants to speak freely. The participants were selected purposively based on (a) years of experience, (b) education level, (c) function, (d) membership of the ward safety committee and (e) availability during the moments the planned meetings of the focus groups. After consulting the managers or supervisors, one researcher (JM) approached potential participants by email, explaining the aim and practical details of the focus groups. The focus groups meetings were held during regular working hours, and were therefore limited to 60 minutes to minimize disruption of the clinical work. Apart from the participants, only the first and last authors (JM and HV) were present during the focus group meetings, which took place in a meeting room at the hospital. Both researchers were familiar with focus group discussions. The first author (JM) was the leader of the focus group discussions. The last author (HV) made field notes, asked for clarification when necessary, and summarized the discussions. Prior to the
discussion the participants’ demographic characteristics were assessed. The focus group
discussion was guided by open-ended questions and participants were encouraged to
bring forward any relevant information. The list of questions is presented in Table 2.
The next day, the researchers (JM and HV) discussed the field notes, such as striking
topics that emerged, the atmosphere in the group during the discussion and the role of
the researchers. We used these experiences in the subsequent focus group discussions,
but we did not change the list of questions. The discussions at the focus groups were
performed in Dutch. The focus groups were audio taped and transcribed verbatim by a
research assistant (SW). We collected the data between February and June 2014.

Table 2. Interview questions and topics

<table>
<thead>
<tr>
<th>Question</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who witnessed or was involved in a medication error recently? Can you tell us what happened?</td>
<td>Insight, knowledge, openness to discuss error.</td>
</tr>
<tr>
<td>Can you explain how this medication occurred?</td>
<td>Communication, interruptions, information technology, patient group, workload.</td>
</tr>
<tr>
<td>What aspects contributed to the medication error in your opinion?</td>
<td>Insight in safety, organization knowledge.</td>
</tr>
<tr>
<td>What aspects prevented patient harm in your opinion?</td>
<td>Insight in safety, knowledge of prevention strategies.</td>
</tr>
<tr>
<td>What happened after the medication error was discovered?</td>
<td>Attitude, emotions, feedback, support, teamwork.</td>
</tr>
<tr>
<td>How did you (and your colleagues) feel?</td>
<td>Attitude, emotions, support.</td>
</tr>
<tr>
<td>Are there specific situations in which medication errors are likely to occur?</td>
<td>Insight, knowledge.</td>
</tr>
<tr>
<td>We know medication errors are a problem on many wards in many hospitals. Why do you think this problem is so hard to solve?</td>
<td>Awareness, emotions, knowledge.</td>
</tr>
<tr>
<td>Is there anything else you would like to tell us in relation to medication errors?</td>
<td>Complexity, pediatric patient group, availability of medications, calculation skills.</td>
</tr>
</tbody>
</table>

Analysis

We analyzed the data according to the guidelines described by Pope et al. [24]. One
researcher checked all transcripts (JM). After this, the first focus group with nurses and
the first focus group with pediatricians were coded independently by two researchers
(JM and MS or CvO). This process involved the identification of recurring issues in the
transcripts. Therefore the three researchers read the transcripts independently in an
iterative way, keeping the research question in mind. The results of the three researchers
were compared and discussed until consensus on the coding was reached. Notes were made during these consensus meetings. The transcripts of all six focus groups were coded with the finalized list of codes by the first researcher (JM) and reviewed by one of the others (MS, CvO or HV). After completing the initial coding, the researchers sorted the emerged codes into similar contextual categories. Finally, the categories were developed further into interpretative main themes. The text fragments were sorted and analyzed according to the identified categories and main themes by the first researcher (JM). This process was discussed with the other researchers for consistency of findings and discrepancies were resolved. An overview of codes, categories and main themes is presented in Table 3. The results are illustrated with quotations of the participants. We also describe the emotions, expressed verbally and non-verbally by the participants in relation to the themes. The data analysis was facilitated by MAXQda software, version 11.

Table 3. From codes to main themes

<table>
<thead>
<tr>
<th>First level codes</th>
<th>Categories</th>
<th>Main themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• No insight</td>
<td>Tribes (mono disciplinary working)</td>
<td>Lack of coherent teamwork</td>
</tr>
<tr>
<td>• Communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No common meetings</td>
<td>Siloes (ward-based working)</td>
<td></td>
</tr>
<tr>
<td>• No common protocols</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Misunderstanding between disciplines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Handovers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• IC versus non-ICU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Patient groups</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Misunderstanding between wards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Individual preferences</td>
<td>Practice variation</td>
<td>Suboptimal work process</td>
</tr>
<tr>
<td>• Variation procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Absence of protocols</td>
<td>Lack of backup behavior</td>
<td></td>
</tr>
<tr>
<td>• Unclear responsibility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No insight total process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Shortage of manpower</td>
<td>High workload</td>
<td>Inability to work safely</td>
</tr>
<tr>
<td>• Too many things to do</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Unexpected workload</td>
<td>Inadequate information technology</td>
<td></td>
</tr>
<tr>
<td>• Different ICT systems</td>
<td>Limited knowledge and experience</td>
<td></td>
</tr>
<tr>
<td>• Limited features of ICT</td>
<td>To err is human</td>
<td></td>
</tr>
<tr>
<td>• Student or new employee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Unfamiliarity with medication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Unfamiliarity with patients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Information available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Pharmacist available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Less concentration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Human nature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Not to blame</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Inaccuracy</td>
<td>Lack of shared attitudes</td>
<td>Culture</td>
</tr>
<tr>
<td>• Irresponsible behavior</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Self confidence</td>
<td>Acceptance of unsafe behavior</td>
<td></td>
</tr>
<tr>
<td>• Indifference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Reluctance to seek assistance</td>
<td>Learning climate</td>
<td></td>
</tr>
<tr>
<td>• Feelings of no influence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No feedback</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No communication about errors</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Validation
Techniques for validation as described by Mays et al. guided the validation process in our study [25]. We documented all the stages of the study and its procedures to achieve transparency and coherence regarding the study data and the interpretations. Crosschecking the analyses among the researchers as described above increased validation of the data. After the analyses, a summary of the preliminary results was sent to the participants to verify the content and interpretation of our findings (member check). Several participants checked the results and confirmed that they were accurate with only a few textual corrections. The feedback was discussed among the researchers, after which the analyses were finalized. We asked two reviewers (BS and EV), who were not familiar with the study and without access to the original transcripts, to provide an assessment of the process and conclusions. They contributed to optimizing the description of the methodology and challenged us to choose quotes that illustrate the themes most accurately.

Ethical considerations
The Institutional Review Board of the Academic Medical Center determined that the protocol did not require medical ethical approval according to the Dutch Medical Ethics law. All participants provided informed consent for participation in the focus groups and audio taping the discussions. All data were analyzed and reported anonymously.

RESULTS
Four themes emerged from the analyses of the focus group discussions: “lack of coherent teamwork”, “suboptimal work process”, “inability to work safely” and “culture”. During the analysis it became clear that “culture” was a central subject, linking all three themes. The themes are described below, with quotations of the participants.

1. Lack of coherent teamwork
In all focus group discussions the participants reported that patient care should incorporate the expertise of healthcare professionals from multiple disciplines. However, it was recognized that patient care is fragmented in daily practice. We identified that care is organized in two ways: “monodisciplinary” and “ward-based”. The healthcare professionals appear to work within tribes (disciplines) and siloes (wards).

1.1. Tribes (monodisciplinary working)
Nurses and pharmacists particularly emphasized the lack of interdisciplinary teamwork. They experienced that other professionals have limited insight into their work processes
and believe this is a problem in relation to medication safety. We noticed feelings of disbelief, as if the participants do not understand why other disciplines are not familiar with their work process.

Regularly, I explain to the doctors how the prescriptions are processed in our administration. And most of the time they are really surprised. They have no idea; really they have got no clue!

(FG 1 nurses, R6)

All professionals mentioned that they make work instructions for their part of the medication process: doctors for prescribing, nurses for the administration and pharmacists for the preparation. These instructions are discussed in monodisciplinary meetings and described in monodisciplinary protocols, and there is no interdisciplinary information exchange or coordination.

That [aspect] is described in our protocols, but I don't know if it is also mentioned in their protocols or written down somewhere else.

(FG 6 pharmacists, R6)

1.2. Siloes (ward-based working)

Participants of all focus groups recognized that daily work is organized per individual ward, resulting in heterogeneity in work processes between the wards.

Last week a colleague from another ward came to help, and when preparing a new infusion with electrolytes, he said: “Have you gone mad! It is much safer to ….”

(FG 3 nurses, R8)

In the discussion this was justified by emphasizing the unique characteristics of the patients, leading to specific ward-based rules. However, it was acknowledged that the differing work processes cause problems when a patient is transferred to another ward, or for departments like the pharmacy that provide services to several wards. When this results in an actual ME, the healthcare professionals feel upset.

This patient was transferred from the PICU, and we did not have written information. So medication was stopped and started according to - well, how we are accustomed to doing it. Later we found out this was not correct, and the child was readmitted to the PICU. Terrible!

(FG 3 nurses, R8)
Feelings of frustration were expressed when the heterogeneity created additional, unnecessary work.

*At time of arrival on the ward, the medication of the child is most of the time not clear, no overview, so there is a lot to sort out, which is not very convenient. To be honest: very annoying!*

(FG 5 residents, R4)

2. Suboptimal work processes

The participants indicated that the medication process itself is error prone due to the complexity and the interdependencies between the disciplines involved. In addition they mentioned that the lack of ready-to-administer medications for pediatric patients further increases the complexity, but this is felt as inevitable. They also recognized that the medication process is characterized by inefficiency due to the way the work processes are organized. We defined two reported topics: “practice variation” and “lack of backup behavior”. Although the participants expressed a strong desire to improve, they felt incapable of doing so. Nurses and pharmacists felt they spend a lot of time fixing malfunctioning processes, mostly with ad-hoc measures.

2.1. Practice variation

The issue of practice variation emerged in all focus group discussions. It was agreed that this variation is the result of lack of coherent teamwork. In addition, the lack of clear procedures was mentioned in all focus group discussions.

*When the results of the antibiotic level are deviating, sometimes I get a phone call, but sometimes not. I really do not understand why not; we should always be warned if a result is odd.*

(FG 5 residents, R3)

Practice variation was explained in the broader context of the organizational characteristics, i.e. the hospital is described as an informal organization in which individual preferences about how work is organized and care is provided are accepted. Although this aspect is appreciated, it was agreed that it also causes undesirable variation of work practices. Participants often felt confused and unsecure.

*It does happen that a surgeon, during the procedure, decides what to prescribe. Most of the time this is not documented or…. well, maybe in the nursing files, I think…… It seems to me a personal preference. Then it easily goes wrong.*

(FG 4 pediatricians, R4 and R8)
2.2. Lack of backup behavior

Pediatricians and residents recognized that in daily practice the specialization in care leads to fragmentation and inefficiency of the care provided. They struggle with tasks and responsibilities in relation to other medical specialists and they feel reluctant to make decisions on medication when the patient is taking care of by a medical specialist.

*We, pediatricians, should be the coordinators of care, but half of the patients are in the care of a different specialist and sometimes multiple specialists. I am not going to change their prescriptions! So should I contact the neurologist for the anti-epileptic drugs and the cardiologist for the … and so on and so on? (FG 5 residents, R4)*

The participants feel as if the primarily responsible specialist is not able to anticipate the needs of pediatricians and residents to safeguard medication safety (backup behavior). Pediatricians and residents recognize their own lack of knowledge and experience, but this is not always acknowledged in the work processes.

*The anesthetic medication, postoperative. It does not make sense, we make those prescriptions. We do not have the experience and still we accept the responsibility. We are forced to make those prescriptions, without having the expertise. That does not feel “senang”!* (FG 4 pediatricians, R9 and R10)

3. Inability to work safely

Several issues were mentioned that created situations in which the participants feel it is simply impossible to work safely. “High workload”, “inadequate information technology” and “limited knowledge and experience” were considered a threat to patient safety. But there was also debate about the human nature, which is not perfect (“to err is human”).

3.1. High workload

Participants identified workload as an important factor that compromises patient safety. Residents and nurses in particular stated they could do better if more time was available, e.g. for performing checks.

*If I would have plenty of time, then I could think thoroughly about the dosages of medication, check the protocols. But that is not the reality; there are always so many tasks that have to be done at the same time.* (FG 5 residents, R3)
Despite the fact that they are aware of risks, they feel the workload forces them into situations in which they cannot work according to the established medication safety practices.

I know, it is not an excuse, but we are often so busy! And then you know the next shift is arriving any minute, so the documentation has to be finished and there is still a lot on your list that has to be done. No way, I am going to check the medications; there is simply not enough time.

(FG 1 nurses, R1)

Pharmacists did not report safety risks in the direct patient care, but they expressed a strong desire to support physicians and nurses, e.g. in protocol development, and feel unable to put this into practice due to shortage of time. Feelings of frustration and acceptance were both present.

Of course we want to cooperate, for example in the development of medication protocols for the wards. It is not that we do not want to; we just do not have the manpower.

(FG 6 pharmacists, R4)

3.2. Inadequate information technology

Although the hospital has implemented Computerized Physician Order Entry (CPOE), the participants all believe that they do not benefit as much as might be expected from this technology. The limited functionality of the CPOE is considered a barrier instead of a facilitator to a safe medication process.

If you start looking in Medicator, you get an enormous list of medications, most of them not relevant. But you have to go through them first to pick the right prescription, while you are on a busy consultation shift. Well, then I think “hop, hop, click”, and hopefully it will end up right.

(FG 4 pediatricians, R5)

In addition, a recurrent item that emerged from all focus group discussions was the presence of different ICT systems that are used in the medication process: Medicator on the non-intensive care wards and PDMS on the intensive care units. In particular, the residents found this very confusing as they work on all wards and therefore have to familiarize themselves with all the different systems. All participants recognized this situation as very unsafe.
In PDMS the prescription is a daily dose, while in Medicator we prescribe the dose for a single gift. Very tricky!
(FG 5 residents, R2)

The healthcare professionals feel unsecure; although they work according to the protocols and guidelines, they are not sure the process will go as planned.

Prescriptions are only written down in Medicator, also when they are stopped or changed. We do not have any possibility to check, we just get the printouts. These are numbered, so based on those numbers you have to figure out what you are supposed to do. I simply start guessing: maybe this is what they want? It is like playing cards.
(FG 1 nurses, R7)

2.3. Limited knowledge and/or experience
Knowledge and experience were discussed in all focus group discussions. Doctors and nurses acknowledged their pharmaceutical knowledge is limited. They also mentioned national guidelines and local protocols are sufficiently accessible and pharmacists are available for consultation. These sources are used, but only when the professionals feel the need to do so.

We had this incident with Digoxin; it was changed from oral to intravenous, I think because the child went for an operation. But the dosage was not changed, you know, and intravenous is a different dosage. That was lack of knowledge, simply not knowing.
(FG 4 pediatricians, R4)

In addition, the pharmacist mentioned the absence of knowledge about medication, especially for children.

In pediatrics, a lot is still not clear. Dosages for example, especially for children younger than one year, the infants. There is very little evidence available.
(FG 6 pharmacists, R7)

The lack of experience was mentioned by all participants, and was considered a safety risk because experience is believed to be an important barrier to MEs.

Last week I saw this prescription, and I thought “Huh? That dosage is strange for a child of only a few kilograms”. And indeed the dosage was far too high, and I noticed because I know this medication.
(FG 5 residents, R1)
2.4. Resignation to “to err is human”
The participants believe that, generally speaking, it is impossible for a human being to work flawlessly all the time. A ME might occur even when it is clear what has to be done and the working conditions are perfect, simply because to err is human.

> On our ward we had this incident with a wrong infusion rate. We double checked it and also the next shift did not notice. So stupid, we simply did not recognize the mistake, as if we were blind for it! Those things happen.
> (FG 3 nurses, R7)

3. Culture
Organizational culture can be defined as the shared perceptions, beliefs and attitudes about patient safety. In the focus group discussions several elements of the organizational culture were brought forward that compromise patient safety. In addition to the aforementioned teamwork problem, which is an important aspect of culture, we identified three additional issues: “lack of shared attitude”, “acceptance of unsafe behavior” and “learning climate”.

3.1. Lack of shared attitude
The participants recognized differences in the use of medication protocols, advice seeking behavior and accuracy. A shared attitude toward medication safety seems to be absent and personal differences in attitude and behavior are considered normal.

> Not every doctor keeps his records in Medicator up-to-date. But that is what we agreed upon, I think it is even mandatory. I know, but some of them refuse to do it, and they keep writing it down in the patient’s notes.
> (FG 3 residents, R4 and R5)

The participants also acknowledged that not all healthcare professionals are doing their utmost to achieve safe practices.

> I know, I know, we agreed to check all medications at the end of our shift, but you know it is hard to follow all the rules and often I am tired and just want to go home.
> (FG 1 nurses, R10)

3.2. Acceptance of unsafe situations
We noticed some degree of acceptance, as if the participants have accepted hazardous situations as normal daily practice.
The post-operative medication handover is always unclear, but it has been this way for a long time. That is the way it is.
(FG 4 pediatricians, R3)

Most of these participants had little trouble naming factors that they believe contribute to MEs. Many also noted that these factors apply to themselves. However, when discussing these contributing factors, there was often a good deal of reluctance for participants to take responsibility for their own or other’s behavior that result in a ME.

I know I sometimes leave out the double check. Although I intend to always … and recently I made a medication error. But that was in a situation… I mean, there were only two of us and at that moment I really could not disturb my colleague.
(FG 2 nurses, R6)

3.3. Learning climate
An important aspect of safety culture is the ability of an organization to identify errors and use them to implement safety measures. The participants understand improvements strategies, like feedback and incident reporting, but they do not seem to expect much improvement from using them.

We report medication errors, we sometimes analyze and discuss them as well, and then we continue as we always did. We do not learn from the errors we make.
(FG 6 pharmacist, R5)

The healthcare professionals mentioned they report MEs, but they seem to doubt whether this information is used to create improvements, resulting in feelings of frustration.

It has been discussed so many, many times, but it does not change. Very frustrating!
(FG 3 nurses, R9)

DISCUSSION
Based on the focus group discussions with pediatricians, residents, nurses and pharmacists we deepened the understanding of unsafe medication practices by conducting a qualitative analysis of the contributory factors that may lead to MEs. Four main themes emerged: “lack of coherent teamwork”, “suboptimal work process”, “inability to work safely” and “culture”. Culture appeared to be a central element, that
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links all three themes. The participants expressed feelings of not only frustration, confusion and uncertainty, but also of resignation.

Our finding that lack of coherent teamwork is perceived as a contributory factor to unsafe medical practices is supported by several studies [26-28]. Indeed, teamwork is considered critically important in a dynamic hospital environment. Teams make fewer mistakes than individuals, especially when all team members understand their responsibilities, and those of other team members [29,30]. Unfortunately, teamwork and cooperation are not automatic and specific efforts are needed to “eliminate working on islands” [31,32]. In a social network analysis it became apparent that information sharing and advice seeking across professions was limited [31]. This conclusion was confirmed by qualitative research showing that doctors, nurses and pharmacists largely work alongside each other rather than with each other [32]. Therefore, healthcare organizations need to create an organization culture that emphasizes teamwork at various levels: across professions to eliminate tribes, and across wards and departments to break down siloes [33].

The lack of coherent teamwork resulted in differing work processes within disciplines and wards, without coordination between them. During all focus group discussions, it became clear that the participants experienced this situation as suboptimal. An organization-wide focus on process improvement may be of interest to address this problem. Evidence has shown that process-based organizations have a moderate but significant positive effect on efficiency in hospitals [34,35]. For example, Lean Six Sigma is a well-known method to redesign processes and has been successful in improving medication safety [36-38]. However, to actually achieve these positive effects, it is of major importance to motivate participation of all disciplines and create an adequate organizational culture [35,39].

The responses of the participants revealed they felt unable to work safely. This was perceived as a result of the aforementioned suboptimal work processes. Workload was an important issue in the focus groups with the residents, nurses and pharmacists. This is consistent with previous studies that identified high perceived workload as an error-provoking condition in the prescribing and administration stage of the medication process [17-19]. However, a systematic review on workload in pharmacists’ practice showed a lack of robust evidence indicating threats to patient safety caused by a high workload [40]. This is consistent with our findings that pharmacists feel constrained in supporting doctors and nurses in medication management, but do not report direct patient safety concerns caused by their workload. In addition, the participants felt unable to work safely due to lack of knowledge, although they emphasized that pharmaceutical information is available. This is in line with several publications that report lack of pharmacological knowledge as an important contributory factor to MEs [17-19].
The medication process becomes even more complex in pediatric care. Knowledge on the operational mechanism of medication in children is limited, pediatric patients require a constant need for adaptations based on age and weight [8], while appropriate formulations and dosage forms for children are often not available [9,10]. Consequently, additional steps in the medication process like calculations, crushing or splitting of tablets are necessary, resulting in additional potential MEs [41,42]. Surprisingly, those specific pediatric issues were hardly mentioned in the focus group discussions.

The contributory factors leading to MEs, summarized in the aforementioned main themes boil down to one central theme: culture. Organizational culture can be defined as the shared perceptions, beliefs and attitudes about patient safety. These are considered valid by the healthcare professionals and are therefore a strong incentive for their behavior. Our results indicate that the healthcare professionals are aware of unsafe situations, but they seem to accept this as a characteristic of the organization. The existing hospital culture motto “professional in the lead” results in limited centralized and hierarchical leadership, which the participants of the focus groups believed was the right philosophy. They acknowledged that this created a lot of freedom in decision making and developing new ideas, which was highly appreciated. However, our results show that the disadvantages were recognized as well: variation and lack of coherent teamwork, leading to suboptimal work processes and the inability to work safely. Organizations should pay attention to this contradiction during the implementation of a safety program by combining top-down activities, such as creating a clear vision and resource support, with bottom-up activities to value local initiatives by the healthcare professionals [43]. A strong statement from the leaders that MEs are unacceptable and always must be discussed in order to learn from them, might contribute to a safe culture.

**Methodological considerations**

We used focus groups to collect data. A limitation of this approach is that the participants might be reluctant to discuss errors they made or witnessed. However, we emphasized confidentiality and anonymity, and thus collected information that appeared to be open and honest. The accuracy of our study may have been affected by the researchers’ influence and pre-existing opinions. Being aware of this phenomenon, we performed several steps during the research process to ensure validity and credibility. After each focus group, the leader of the discussion made field notes and documented personal accounts, questions and emotions. The field notes were used to reflect on the role and influence of the researchers and subjectivities. In addition, during the analysis we continually used the original transcripts to identify and reflect on our own opinions and subjective interpretations. Finally, we performed a member check and the participants confirmed our interpretations.
Implication for practice
Healthcare professionals play a crucial role in the prevention of MEs in order to provide safe patient care. Hospital management must help them by creating optimal conditions. Priority should be given to issues known to contribute to better safety outcomes, like adequate staffing [44-46] and information technology [47,48]. The existing ward-based safety teams should organize interdisciplinary safety meetings to give the key players insight into the total medication process and the role of each healthcare professional in this process. These meetings can also be used to analyze MEs, provide feedback and discuss solutions. In addition, leadership walk arounds must be organized, as they have been proven to be effective in creating a positive safety culture [49,50]. These walk arounds enable clinical leaders to discuss safety issues with the frontline healthcare professionals and demonstrate commitment. The walk arounds should emphasize the total medication process and not be limited to a single ward or discipline. It is worthwhile to pay attention to the principles that characterize High Reliability Organizations. These organizations with a culture highly sensitive to safety have proven successful in various hazardous industries and are thought to be effective in hospitals as well [51].

Although our study was performed at only one academic pediatric hospital, the key messages may be transferable to hospitals with similar contexts. To facilitate the reader we have provided a thick description of the setting and participants. The organizations with many similarities will likely recognize the results from this study.

CONCLUSION
This study explored contributory factors that may lead to medication errors in pediatric care. Four main themes emerged: “lack of coherent teamwork”, “suboptimal work process”, “inability to work safely” and “culture”. Culture appeared to be a central element, linking all three themes.

Our results highlight the need for interventions on the organizational level, with a focus on interdisciplinary teamwork and re-design of the medication process. An essential aspect is to create an organizational culture that gives priority to medication safety and is supported by both healthcare management and healthcare professionals.

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