

# Over-personalized attribution of medication errors and Chinese nurses' needs for a just culture: a qualitative study

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## Research Article

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## **Title page**

### **Over-personalized attribution of medication errors and Chinese nurses' needs for a just culture: a qualitative study**

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## **Abstract**

**Background:** Medication errors remain a pervasive threat to patient safety worldwide, yet frontline nurse' own explanations of why these errors occur and what they need from the system are rarely explored. While quantitative studies have identified various risk factors, they seldom capture how nurses themselves interpret their errors or what they perceive as essential for a supportive medication safety culture. This qualitative study therefore aimed to explore nurses' perspectives on the causes of medication errors and their perceived needs for a medication safety culture.

**Methods:** This study used a descriptive qualitative design. Nineteen in-depth semi-structured interviews were conducted among nurses at two tertiary hospitals in Hunan Province, China during March 2025- January 2026. Data were analyzed using thematic analysis.

**Results:** The study results revealed two overarching themes with multiple sub-themes: causes of medication errors and construction needs of medication safety culture. A striking paradox was that nurses strongly self-attributed errors to their own carelessness while simultaneously describing systemic flaws they actively dismissed as invalid excuses, a pattern we term 'over-personalized attribution', revealing a critical gap between their experiences and the organizational support they require.

**Conclusions:** Nurses attributed medication errors to themselves while dismissing systemic factors they had identified- a pattern we term "over-personalized attribution"- and articulated four needs for a supportive safety culture: supportive climate, system-focused attribution, just accountability, and empowering learning. These findings suggest that patient safety depends not only on vigilant individuals, but on a system that shares the burden of responsibility and protects those who protect patients.

**Keywords:** medication error, medication safety culture, just culture, nurse, qualitative study

## 1. Background

Medication error (ME)<sup>[1]</sup> refers to “any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer.” MEs are a pervasive problem in healthcare systems worldwide. Direct observation studies have found that in adult inpatients, 89.5% of medication administrations involve at least one error<sup>[2]</sup>; among neonates, overall administration error rates have been reported as high as 68% per dose<sup>[3]</sup>. Expanding the lens from errors to actual harm, the World Health Organization<sup>[4]</sup> reports that medication-related harm accounts for up to half of all preventable patient harm in medical care. In England alone, an estimated 237 million MEs occur annually, costing the National Health Service nearly £100 million and contributing to over 1,700 deaths<sup>[5]</sup>. Despite this alarming burden, most hospitals still rely on voluntary reporting systems, which capture only a fraction of actual errors<sup>[3, 6]</sup> -suggesting that the true scale of MEs is substantially higher than official records indicate. Understanding why these errors occur and how they can be prevented is therefore a pressing patient safety priority.

MEs can occur at any stage of the medication use process and present in various forms, including omission, wrong dose, wrong time, wrong patient, wrong drug, and wrong route<sup>[7, 8]</sup>. Nurses, as the primary professionals responsible for medication administration, play a critical role in error prevention<sup>[9]</sup>. However, most existing studies have adopted quantitative approaches that identify risk factors for MEs -such as similarity in drug appearance, name or packaging, unclear prescription, lack of drug information, and heavy workload<sup>[2, 6, 8]</sup> -yet they rarely capture how these factors interact in clinical settings or how nurses themselves understand the errors they experience.

Patient safety culture is widely recognized as a critical determinant of care quality, encompassing organizational values, beliefs and norms aimed at preventing harm across all clinical activities<sup>[10]</sup>. Medication safety culture, as a core sub-domain of patient safety culture, focuses specifically on the safe use of medicines throughout the medication process. Central to both is the ‘Just Culture’ principle, which

differentiates between human error, at-risk behaviour and reckless behaviour, and prioritizes system-level improvement over individual blame <sup>[9, 11]</sup>. Quantitative tools such as the Safety Attitudes Questionnaire and the Hospital Survey on Patient Safety Culture have been widely used to assess safety culture<sup>[12, 13]</sup>, and global evidence reveals persistent weaknesses in two domains that are directly relevant to medication safety: ‘non-punitive response to error’ and ‘staffing’<sup>[14, 15]</sup>, as they influence nurses’ willingness to report errors and their ability to administer medications safely. However, most existing studies have focused on describing these scores and identifying influencing factors, rather than exploring nurses’ own experiences of the safety climate after MEs, their expectations of managers, or the practical and psychological support they truly need.

To address this gap, a qualitative approach is essential to capture nurses’ real experiences of MEs, to understand how they explain the causes of these errors, and to identify their unmet needs for a medication safety culture.

## **2. Methods**

### **2.1 Design**

This study used a descriptive qualitative design. The research adhered to the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines<sup>[16]</sup>.

### **2.2 Study Setting and recruitment**

This study was conducted between March 2025 and January 2026 at two tertiary hospitals in Hunan Province, China. A maximum variation sampling strategy was employed to achieve sample heterogeneity. With the assistance of head nurses, the first author purposefully recruited potential participants from the adverse event reporting system maintained by the nursing department, seeking variation in clinical units, years of experience, and types of medication events. Recruitment was conducted via telephone or WeChat. Of those approached, 2 nurses declined to participate due to a scheduling conflict.

### **2.3 Inclusion and Exclusion criteria**

Inclusion criteria were: (a) being a registered nurse; (b) having reported an

adverse event attributed to a ME within the preceding 12 months; and (c) providing informed consent. Exclusion criteria were: (a) not being on active duty during the study, and (b) unwillingness to provide a complete narrative account of the event during the interview. A total of 22 nurses were initially recruited and interviewed. Three were subsequently excluded because, upon in-depth exploration, their reported incidents did not meet the study's definition of a ME. The final sample therefore comprised 19 participants.

#### 2.4 Data collection

Semi-structured interviews were employed as the primary data collection method, as this approach is well-suited to exploring participants' subjective experiences and the meanings they attach to sensitive clinical events such as MEs. An interview guide was developed based on the study's research questions and a review of the literature on MEs and safety culture. The guide was initially piloted with two nurses who had experienced MEs. As the pilot interview yielded rich data and the questions required only minor wording adjustments, these two interviews were retained in the final sample. The final interview guide consisted of four open-ended questions: (1) Could you describe the context in which this adverse event occurred? (2) From your perspective, what factors contributed to this event? (3) Looking back, do you think you could have acted differently in that situation? If not, what made it difficult or impossible to do so? (4) What suggestions do you have for improving medication safety culture in your unit or hospital?

All interviews were conducted by the first author, a female registered nurse with seven years of clinical experience and formal training in qualitative research. Interviews were conducted in a private room within the participants' workplace or via WeChat video call, according to each participant's preference. Only the researcher and the participant were present during each interview. The interviews lasted between 45 and 90 minutes, with an average duration of 62 minutes. Throughout the interviews, the researcher used probing and clarification techniques to explore participants' responses in greater depth, while remaining sensitive to their emotional state. Data collection continued until information saturation was reached, determined when no

new insights emerged from three consecutive interviews and the relationships between categories were clearly established.

## 2.5 Data analysis

All interviews were audio-recorded with participants' informed consent and transcribed verbatim within 48 hours. The transcribed interviews yielded 237 pages (A4), totaling approximately 173,000 words.

We analyzed the data using Braun and Clarke's six-phase thematic analysis framework<sup>[17]</sup>. First, we familiarized ourselves with the data by reading the transcripts and listening to the audio recordings multiple times. Second, we generated initial codes by systematically working through the entire dataset. Third, we sorted these codes into potential themes and sub-themes. Fourth, all authors independently reviewed and refined the themes to ensure they were grounded in the study's purpose and faithfully represented the data. Throughout this process, we adopted an iterative, inductive approach to semantic analysis, continuing until theoretical saturation was reached. Fifth, the authors collaboratively named and described the final themes and sub-themes. Finally, we produced the written report, integrating illustrative quotes from participants.

## 2.6 Ethical considerations

This study was conducted in full compliance with the ethical principles outlined in the Declaration of Helsinki and received approval from the institutional review board from Xiangya Hospital of Central South University(Prot. 2025091337). The information sheets and informed consent confirmed that their anonymity would be preserved through the removal of any information that might reveal their identity and the use of pseudonyms or numbers instead of their original names.

## 2.7 Rigor and reflexivity

We acknowledged that the interviewer's positionality as a registered nurse with 7 years of clinical experience shaped the inquiry as she served as the primary instrument of data collection. Her clinical background facilitated rapport and trust with participants, enabling deeper disclosure. However, it also inclined her to emphasize systemic factors over individual accountability, particularly when

participants described distressing medication events. In such moments, her clinical empathy sometimes led to a subconscious avoidance of probing personal responsibility an effort to protect participants' emotional comfort. At the same time, when participants actively dismissed systemic factors they had just described, the interviewer noted this contradiction without challenging it, allowing the pattern to emerge inductively rather than steering the conversation in any predetermined direction. This reflective observation contributed to the inductive identification of what we later termed 'over-personalized attribution.'

To mitigate these influences, several strategies were employed throughout the study. During interviews, the term "medication event" was used consistently to lower defensiveness. While listening empathetically, the interviewer remained conscious of avoiding over-accommodation in questioning. Throughout data analysis, reflective memos were maintained to document emotional responses and decisional turning points. Additionally, two researchers with nursing management backgrounds joined coding discussions, providing external perspective to challenge and enrich interpretation, thereby strengthening the study's reflexivity and rigor.

To further enhance credibility, preliminary themes were presented to participants to confirm that our interpretations accurately reflected their experiences. Data that contradicted emerging patterns were also continuously examined to refine the thematic structure. In one selected case, we also employed data triangulation by interviewing the three nurses (N11,N12,N13) involved in the preparation, checking, and administration stages of the same medication event, which allowed us to cross-check narratives and gain a more comprehensive understanding of how the error unfolded across different points in the medication process.

### **3. Results**

#### **3.1 Characteristics of participants**

A total of 19 nurses (18 female, 1male) participated in the study. The mean age of the participants was  $32.8 \pm 4.2$  years. Sample characteristics are presented in Table 1.

Table 1 Participants characteristics(N=19)

| Parameter                                | Frequencies |
|------------------------------------------|-------------|
| Age                                      |             |
| <30                                      | 4           |
| 30-40                                    | 13          |
| >40                                      | 2           |
| Department                               |             |
| Medical department                       | 9           |
| Surgical department                      | 5           |
| Traditional Chinese medicine department  | 3           |
| Operating room                           | 1           |
| Intensive care unit                      | 1           |
| Number of years of experience            |             |
| 1-5                                      | 3           |
| 6-10                                     | 6           |
| >10                                      | 10          |
| Types of MEs                             |             |
| Wrong dose                               | 7           |
| Wrong drug                               | 6           |
| Identity verification error              | 2           |
| Wrong time                               | 1           |
| Wrong route                              | 1           |
| Omission                                 | 1           |
| Error following incorrect prescription 1 | 1           |

### 3.2 Theme1:Causes of MEs

#### 3.2.1 Over-personalized attribution

All participants attributed the cause of MEs to themselves without any hesitation when recounting their experienced events, citing their own carelessness and imprudence.

“Now that I think back on it, it was really just a personal mistake... I don’t think any normal person would have misread that medication. It was purely an individual error (nervously picking at his fingers).”

(N17, Wrong dose)

This pattern of self-attribution persisted even when some nurses acknowledged contextual difficulties. Nine participants noted frequent interruptions and distractions during the administration process, yet immediately dismissed these as valid explanations.

“In clinical work, there are often interruptions, you can’t focus entirely on just one treatment... But just because someone interrupts me doesn’t mean I should make a mistake- I don’t think that’s a valid excuse.”

(N2, Identity verification error)

Other participants’ account further illustrated how deeply internalized this self-blame was. One nurse attributed the error entirely to her own calculation, while mentioning the lack of training only as an afterthought, never as a contributing cause:

“It was my own miscalculation error. None of the other nurses have ever made this mistake, only me... They all got training, but I joined later and didn’t receive it.”

(N16, Wrong dose )

### 3.2.2 Safety compromise under heavy workload

Heavy workload was the second most common cause of MEs. Nearly all participants described their work environment as relentlessly “busy.” Under such pressure, they reported cutting corners, losing mental focus, and even making basic memory mistakes- each of which compromised patient safety in different ways. Ten participants described skipping the double-checking step altogether, driven by the urgency to finish before the shift ended.

“At noon, a big batch of meds came in, and I don’t even know how I ended up grabbing that bottle of amino acids ... It was so hectic with all those meds coming in, I didn’t have time to track her (another nurse) down to verify, so I just used her PDA. All I could think was getting it done and to the patient.”

(N11, Wrong drug)

Even when nurses formally followed the verification steps, the sheer exhaustion from prolonged high-intensity work could render their clinical judgment ineffective. One participant recalled feeling “mentally drained”- she went through the motions of the protocol but lost sight of the patient’ s real condition.

“That day I was on the night shift ... I was just exhausted, I guess- checked his glucose, then gave the pre-meal insulin out of habit...I was so focused on following the verification protocol that it didn’t even register- he wasn’t supposed to get insulin, he had surgery coming up.”

(N4, Error following incorrect prescription)

Heavy workload could also affect basic memory. Five participants said that under intense time pressure, their sense of certainty sometimes overrode what they had actually done:

“Around 11 a.m. the pharmacy delivery arrived. I went to grab them myself- only took seven at the time ... I knew the order was for eight. I really thought I'd grabbed eight, and I prepared eight.”

(N8, Wrong dose)

### 3.2.3 The safety paradox of PDA use

A number of participants said the PDA- a technology designed to enhance medication safety- could actually backfire. They pointed to three problems: over-reliance, misleading signals, and inherent technical limitations. Ten participants described how their heavy dependence on the PDA meant that when the device malfunctioned, they found it difficult to detect MEs.

“I used a coworker’s PDA, but it wasn’t working, so I went back to swap it for another. That one wasn’t working either, so I just ended up not scanning. The patient didn’t respond either- and that's when I gave the wrong med.”

(N9, Identity verification error)

Even when the PDA worked properly, it fostered a false sense of certainty regarding undone tasks. The absence of an electronic signature on the screen, while

technically correct, led nurses to erroneously conclude that a medication had not been given, overlooking the possibility that the documentation step had simply been missed. Nurses sometimes trusted that a task hadn't been done just because the screen showed no signature.

“The patient hit the call light and said he hadn't gotten his bedtime insulin yet...I checked the PDA- no signature there either- and the infusion sheet didn't have one... After I got back to the nurses' station, my coworker told me she'd already given it to him around 8 p.m.”

(N5, Wrong dose)

Beyond these issues, four participants pointed out a fundamental blind spot. The PDA can only match the patient's wristband with the label on the medication. It cannot tell whether that label actually matches the drug in the bottle, or whether the medication has been prepared correctly.

“But the thing is, during the preparation process, the PDA isn't smart enough to tell you whether you've drawn up the right med or not.”

(N8, Wrong dose)

### 3.2.4 Defects at the prescription source

Eight participants traced MEs back to the prescription stage. Problems with order quality, timing, and clarity created risks that nurses had to manage downstream. Three participants pointed to insufficient quality control in prescribing, noting that newly arrived doctors, especially visiting physicians and postgraduate trainees, frequently lacked adequate training on standardized order entry.

“The doctors coming in, they're supposed to get training, but honestly, more than once they've forgotten to order meds that need to be dispensed as a full box... You can't expect nurses to catch everything. We can do our part, but this needs to be addressed at the source.”

(N3, Omission)

Others highlighted how the unpredictable timing of order entry created artificial peaks of workload. When doctors could write orders at any time, medications piled up at the same hour, forcing nurses to rush through preparation and administration, which

could lead to MEs. One nurse recalled:

“Before, doctors could write chemo orders anytime-a dozen patients all needing their shots at once, all rushing you at once. That's what made everything pile up.”

(N8, Wrong dose)

Still other participants pointed to ambiguous order phrasing- for example, failing to specify the strength of each tablet. As one nurse illustrated:

“The discharge summary said 150mg, twice a day, one and a half tablets each time... but it didn't specify that each tablet was 50mg.”

(N18, Wrong dose)

### 3.3 Theme 2: Construction needs of medication safety culture

#### 3.3.1 Creating a supportive safety climate

Nearly all participants expressed a strong need for a more supportive safety climate- one that would catch risks before they reached nurses, acknowledge their struggles, and offer psychological support when MEs happened. They pointed to specific needs: more distinctive packaging, smarter pharmacy processes, and clearer orders. One nurse was frustrated that nothing had changed despite their feedback:

“We really hope the manufacturer can make the packaging more varied. We actually brought this up to the pharmacy before, but they said it'd take years...So, it just ended up going nowhere- we just have to tell them apart on our own.”

(N12, Wrong drug)

Others called attention to the hidden toll of chronic fatigue caused by unreasonable shift schedules, hoping that their difficulties could be seen and addressed.

“That evening shift was really exhausting-our helping evening shifts are set up so you still have to work the next day's day shift, so you don't get great rest...By the time my own evening shift came around, I'd already done three helping evening shifts in a row. We'd love to optimize the scheduling, but for now, no one's figured out a good way to do it.”

(N19, Wrong drug)

Some also asked for clear guidance on how to respond when a ME did occur. One nurse recalled her panic and fear of blame, and called for transparent guidance:

“I was really panicking (an emphatic tone)!I didn’t tell the patient the truth...I was afraid he'd blame me...afraid the nurse manager would come down on me...I think during nursing meetings, the nurse manager needs to tell us: when a mistake happens, don’t be afraid, don’t resist owning up to it. Tell us what happens after we come clean-teach us how to handle something like that.”

(N2, Identity verification error)

A supportive safety climate, some participants stressed, must also extend to the nurse who made the error- the “second victim”- by offering psychological support and a sense of being seen, understood, and treated fairly.

“Emotionally and psychologically speaking, I think someone needs to be there for the person involved. If it didn’t cause any serious harm, then I really think someone should offer them (psychological) support-comfort them, reassure her: ‘Look, it’s okay. The patient's fine, and you’re going to be fine too’.”

(N14, Wrong route)

“The nurse manager handled it really well. After it happened, she was worried about adding to my stress, so she waited and talked to me privately three days later. She asked how I was doing, and said if I needed help...You know, like you’re not left to deal with it alone when something goes wrong-she’s there for you (voice breaking, crying)...”

(N16, Wrong dose)

### 3.3.2 Building a system-focused attribution culture

Many participants were frustrated that MEs were usually blamed on individuals rather than on system flaws. Four participants pointed out that blaming individuals rarely fixed anything. One nurse’s experience was telling. After her error, the unit gave her a personal penalty. The punishment was carried out, but the real problem stayed.

“After the case was discussed at the staff meeting, they decided I should write the morning meeting summaries for six months... Honestly, it didn’t feel like

much- I usually end up writing them anyway, so I'm pretty used to it... Now it's mostly just the nurse manager checking up on me every day. No other measures besides that."

(N10, Wrong drug)

Even when teams recognized the need for systemic fixes, those fixes often never happened.. Nurses were left feeling that all they could do was try harder on their own.

"After our incident, the unit discussed whether to switch to unit-dose packaging for oral meds- dispensing daily doses based on daily orders. But the issue is, doctors would have to write orders every single day. And if a patient needs to be discharged in a hurry, the unit-dose meds wouldn't even make it to the unit until at least 2 p.m. In the end, it never got implemented... So, we're still doing prednisone the old way- just trying our best to confirm the patient actually took it."

(N6, Wrong time)

Experiences like these made many nurses want a different kind of response- one that looked at systemic improvement instead of endlessly criticizing individuals.

"I hope there can be some objective, or at least fair, analysis. For me, what I really want is proper training and guidance on how to improve going forward, not just having them keep rehashing my mistake over and over again..."

(N14, Wrong route)

### 3.3.3 Establishing a just accountability mechanism

Non-punitive actions are often stressed in medication safety culture to encourage error reporting. However, participants in this study expressed more nuanced views. What they really asked for was a just accountability mechanism- one with predictable consequences, a focus on the error rather than the person, and room for nurses to keep their dignity while taking responsibility. Some nurses compared the emotional weight of different forms of accountability. A clear financial penalty, four participants noted, felt easier to bear than vague, ongoing criticism.

"I honestly think fining me is easier than criticizing me- the emotional toll is just so heavy! If you punish me, I get it, I made a mistake, I deserve it. But the inner

turmoil- that's what really gets to you.”

(N2, Identity verification error)

Others also distinguished between accepting consequences and being subjected to endless blame. They were willing to take responsibility for their actions, but they did not want the same mistake to be repeatedly held against them in public.

“I can accept punishment-but I don’t want to be blamed... Yes, I made a mistake, but it’s not like I did it on purpose. I’m willing to deal with the consequences of what I did- just don’t keep bringing it up over and over, don’t keep calling me out in front of everyone.”

(N14, Wrong route)

The social dimension of accountability also emerged repeatedly. Three nurses had once been open to sharing their errors so that others could learn, but the response from colleagues made them withdraw.

“I used to be open to sharing too- I thought if I made a mistake and talked about it, everyone else could learn from it and avoid it later. But over time I realized most people just see it as something to gossip about. So now I’d rather keep it to myself.”

(N19, Wrong drug)

### 3.3.4 Constructing an empowering learning support system

Many participants envisioned a learning support system that actually helped them feel more capable- able to handle medication safety on their own with the right knowledge, confidence, and resources. Five participants argued that learning should happen before a new drug or protocol reached the unit, not after. They wanted to feel prepared, not caught off guard.

“For example, when a new med comes into the hospital, there should be training first, the whole unit gets trained... At the very least, we need to know how they (the doctors) plan to use it.”

(N15, Wrong dose)

Passive lectures, many noted, didn’t stick. What worked was having to teach someone else- because preparing to explain forced you to really understand the

material.

“In our unit, they have everyone do knowledge sharing on new knowledge- because when you're the one responsible for presenting, you have to really dig into the material, and it sticks with you. You're actively involved, and in the end, it informs how you actually work- way more effective that way.”

(N17, wrong dose)

Three participants also valued learning from actual errors- their own or others' - as long as the discussion was constructive rather than humiliating. Storytelling, they said, made the lessons more memorable than abstract rules. One nurse appreciated a hospital-wide initiative that used real incidents:

“I think our hospital's ‘Case of the Quarter’ initiative is really good, it gets people reflecting through storytelling... These are real cases that actually happened in our hospital, and they really grab people's attention and make them think.”

(N18, wrong dose)

#### **4. Discussion**

This qualitative study explored how nurses explain the causes of MEs and what they perceive as essential for a supportive medication safety culture. Two overarching themes emerged: nurses' strong tendency toward self-attribution of errors- despite concurrently identifying multiple systemic contributors (heavy workload, PDA paradox, prescription defects)- and their four articulated needs for a safety culture that is supportive, system-focused, just, and empowering. Notably, nurses readily described systemic flaws yet actively dismissed them as invalid excuses- a pattern we term "over-personalized attribution" -highlighting a critical gap between their current experiences and the organizational support they need to prevent and manage MEs.

Participants in our study consistently blamed their own carelessness or inattention, often apologizing for even mentioning contextual difficulties. This pattern is not unique; previous research has shown that nurses readily admit responsibility while also identifying external contributors such as workload or interruptions<sup>[18, 19]</sup>. However, what this study adds is the observation of an active dismissal of systemic

factors from the causal framework. In our interviews, nurses described heavy workloads, poor lighting, and unfamiliar medications, yet repeatedly asserted that these “do not count” as reasons for their mistakes- phenomenon we term “over-personalized attribution.” This pattern may reflect a internalized culture of individual blame, which has been shown to reduce error reporting and heighten fear of repercussions among healthcare professionals<sup>[20-22]</sup>.

This active dismissal is driven by several interrelated mechanisms operating at different levels. The contradiction, seeing system flaws while blaming oneself, unfolds at the organizational, interpersonal, and professional levels. At the organizational level, nurses internalize the logic that errors are personal failures when organizational responses focus on who caused the error rather than why the system failed<sup>[7, 20, 23]</sup>. At the interpersonal level, citing systemic factors such as workload or interruptions is often perceived- by colleagues, managers, and even nurses themselves- as “making excuses,” carrying significant professional risks, including blame, disciplinary action, damage to their professional reputation, or fear of reprimand and punishment<sup>[24]</sup>. At the professional identity level, nurses who make errors often experience profound guilt and remorse precisely because they perceive themselves as the final gatekeeper in the medication administration process<sup>[18, 25]</sup>. Even when the system fails, they hold themselves personally accountable for catching those failures- a finding consistent with the enduring emotional and moral aftermath of errors described in the literature<sup>[18, 21]</sup>. This pattern underscores the need to move beyond individual blame and toward system-level accountability- a principle that lies at the heart of a just culture.

This principle is precisely what nurses in our study were asking for: a culture where errors are analyzed objectively and accountability is exercised fairly. Prior literature has consistently demonstrated that a just culture, by shifting the focus from individual blame to systemic improvement, can effectively enhance patient safety <sup>[26, 27]</sup>. What our participants’ accounts add to this picture is a clearer understanding of why such a culture matters to them on a personal level. They were not rejecting accountability itself, but rather the arbitrary and humiliating ways in which it was

often exercised. A clear financial penalty, several nurses noted, felt easier to bear than vague, ongoing criticism- “the inner turmoil,” as one nurse put it, “is what really gets to you.” This distinction is critical: nurses are willing to take responsibility, but they want accountability to be predictable, proportionate, and focused on the error rather than the person. These expectations align with the core principles of just culture, which distinguishes between human error, at-risk behaviour, and reckless behaviour, and responds to each accordingly<sup>[28]</sup>. A just culture is not about being “soft” on errors- it is about being smart about them, ensuring that the response to errors promotes learning rather than silence, and system improvement rather than individual defensiveness- a principle that aligns with the view that adverse events should become opportunities for systemic improvement rather than occasions for individual punishment <sup>[28, 29]</sup>.

Some participants identified the PDA as a contributing factor to MEs- a technology designed to enhance safety, yet which paradoxically introduced new risks through over-reliance, misleading signals, and inherent technical limitations. Taft et al.<sup>[30]</sup> identified “hidden medication administration technology(MAT) limitations” and “inaccurate beliefs about MAT functionality” as persistent hazards, noting that nurses develop overreliance on technology precisely because they do not fully understand what it can and cannot do. Our findings mirror this pattern: nurses assumed the system had “caught everything,” inadvertently reducing their vigilance, while the device’s fundamental inability to detect errors originating before the scanning step remained invisible to them. This mismatch between perceived and actual functionality creates a vulnerability that persists even when the device works correctly. This paradox extends beyond the PDA to the broader digitalization of healthcare: digital technologies have been found to limit nursing autonomy, reduce opportunities for critical thinking and problem- solving, and at times transform caregivers into machine operators<sup>[31, 32]</sup>. Addressing this paradox requires moving beyond the assumption that simply deploying technology will improve safety. organizations must develop clear protocols for technology failure, train nurses not only in how to use the PDA but also in its limitations, and involve frontline nurses in the design and evaluation of these

systems to ensure that technology supports rather than supplants clinical judgment<sup>[30, 31]</sup>.

What makes these findings worth pausing over is not simply that nurses blame themselves. It is that they blame themselves even when they can describe, in detail, the system failures that contributed to their errors. They have learned to treat their own vigilance as the only reliable safeguard, and when that safeguard fails, they accept the fault as their own. The very commitment that makes them good nurses- the willingness to be the last line of defence- also makes them the easiest place to lay blame. A just culture does not take that commitment for granted. It repays it by ensuring that nurses are not left to carry, alone, the weight of failures that belong to the system.

This study has several limitations that should be acknowledged. First, all participants were recruited from two tertiary hospitals in China, and the findings may not be transferable to other healthcare settings with different organizational cultures, staffing levels, or technology infrastructures. Second, the study relied on retrospective self-reports of MEs, which are subject to recall bias and social desirability bias. Third, although the sample included nurses from diverse clinical settings, the perspectives of other key stakeholders- such as physicians, pharmacists, and hospital managers- were not captured. Their views on MEs causation and safety culture might have provided a more complete picture. Finally, as with all qualitative research, the findings are context-bound and should be interpreted with caution; they are not intended to be statistically generalizable but rather to offer theoretical insights that may be transferable to similar settings.

## **5. Conclusion**

This qualitative study explored how nurses understand the causes of MEs and what they perceive as essential for a medication safety culture. Two main findings emerged. First, nurses consistently attributed errors to themselves while dismissing systemic factors they themselves had identified- a pattern we term “over-personalized attribution.” Second, they articulated four needs for a safety culture: a supportive

climate, system-focused attribution, just accountability, and empowering learning. The concept of over-personalized attribution captures a central paradox of this study: nurses are not unaware of systemic failures, yet they actively exclude them from their causal accounts. This pattern reflects not a lack of insight, but a deeply internalized professional identity as the final gatekeeper of patient safety. The same commitment that makes nurses diligent also makes them vulnerable- they carry alone the weight that should be shared by the system. Building a just culture, therefore, is not simply about implementing policies or technologies; it is about fundamentally reshaping how organizations respond when nurses make errors. Nurses are willing to take responsibility, but they should not be expected to shoulder the entire burden of systemic failures. Patient safety depends not only on vigilant individuals, but on a system that protects those who protect patients.

## List of abbreviations

| Abbreviation | Full form                            |
|--------------|--------------------------------------|
| ME           | Medication error                     |
| MAT          | Medication administration technology |

## Declarations

### Ethics approval and consent to participate

This study was approved by the institutional review board from Xiangya Hospital of Central South University(Prot. 2025091337). The information sheets and informed consent confirmed that their anonymity would be preserved through the removal of any information that might reveal their identity and the use of pseudonyms or numbers instead of their original names.

### Consent for publication

Not applicable.

### Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

### Competing interests

The authors declare no competing interests.

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### Authors' contributions

Wanli LIU, Jing ZHOU, Jianhui ZHOU: Made substantial contributions to conception and design, acquisition of data, and analysis and interpretation of data. Wanli LIU, Jing ZHOU: Drafted the manuscript and revised it critically for important intellectual content. Xuefang AN, Yinmei DENG, Yanhong SU: Reviewed and edited the manuscript. All authors approved the final version and agree to be accountable for all

aspects of the work.

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