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Registered nurses' experiences of near misses in ambulance care – A critical incident technique study

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ABSTRACT

Background: In hospitals, potentially harmful near misses occur daily exposing patients to adverse events and safety risks. The same applies to ambulance care, but it is unclear what the risks are and why near misses arise.
Aim: To explore registered nurses' experiences and behaviours associated with near misses where patient safety in the ambulance service was jeopardized.
Methods: Based on critical incident technique, a retrospective and descriptive design with individual qualitative interviews was used. Ten men and five women from the Swedish ambulance service participated.
Results: Seventy-three critical incidents of near misses constituted four main areas: *Drug management; Human-technology interactions; Assessment and care* and *Patient protection actions*. Incidents were found in drug management with incorrect drug mixing and dosage. In human-technology interactions, near misses were found in handling of electrocardiography, mechanical chest compression devices and other equipment. Misjudgement and delayed treatment were found in patient assessments and care measures while patient protection actions failed in transport safety, hygiene and local area knowledge.
Conclusions: Experiencing near misses led to stress, guilt and shame. The typical behaviour in response to near misses was to immediately correct the action. Occasionally, however, the near miss was not discovered until later without causing any harm.

1. Background

Alarming reports all over the world state that avoidable harmful incidents cause injuries, i.e. adverse events, and leave patients exposed to safety risks. Patient safety, meaning "the reduction of risk of unnecessary harm associated with healthcare to an acceptable minimum," [1,p.19] is thus threatened. Errors, i.e. failures to carry out a planned action as intended or application of an incorrect plan, are frequent [1,2]. Between 8 and 12 percent of patients in Europe are subject to some adverse events during hospitalization, contributing extensively to morbidity and mortality. Medical errors are a major issue in healthcare and the cost is high. In the European Union alone, 95,000 lives are lost per annum [2].

To date, research on patient safety issues such as errors and adverse events are predominantly done in hospital settings. However, some studies have been performed in the context of ambulance services [3–9]. This is especially important given the high risk of adverse events identified in this setting [6,7]. Threats to patient safety in ambulance services include areas such as medication, clinical judgment, communication, transports, and intubation [10]. Moreover, errors in the ambulance personnel's decision-making process have been identified [4,11,12].

In Sweden, Advanced Life Support (ALS) ambulances are staffed by at least one registered nurse (RN), often with specialist training in prehospital emergency care (ambulance nurses). The RNs have the overall responsibility for care and treatment, including patient assessment, decision-making and evaluating medical conditions [13]. No research has explicitly been done on studying "near misses" among RNs in the ambulance services, and hence, little is known about how they detect and prevent patient safety risks.

Fortunately, clinicians often detect a risk before it develops into a harmful incident and stops at a near miss event, defined by the World Health Organization (WHO) as "a serious error or mishap that has the potential to cause an adverse event but fails to do so because of chance or because it is intercepted" [14,p.8]. However, a problem is that near misses are not always reported, which could be looked upon as missed

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learning opportunities and may go unnoticed in daily clinical practice [15].

Three studies on near misses have been found in the ambulance services setting, all with a dual focus on near misses and adverse events [5,8,12]. Research that focuses explicitly on near misses in the ambulance services is, to our knowledge, completely lacking. Thus, knowledge about near misses leading up to adverse events, errors and patient suffering, is needed.

2. Aim

The aim of this study was to explore registered nurses' experiences and behaviours associated with near misses where patient safety in the ambulance service was jeopardized.

3. Methods

A retrospective, explorative and descriptive design with individual interviews was used, based on the critical incident technique (CIT) with five steps. The first step is to identify and establish the general aim. The second step is to develop plans and specifications to gather critical events in accordance with the focus of the study. The third step is to collect data and the fourth is to analyse the data and to develop a set of categories and subcategories. The last step is to interpret and report the data [16]. The methodological reporting of this study follows the COREQ standard [17].

3.1. Setting and sample

This study was conducted in one ambulance service organization in mid-Sweden, in a region of 8190 square kilometres with 368,971 inhabitants (45 inhabitants/sq km). The regional organization with 8 ambulance stations had 13 ALS ambulances around the clock and 5 daytime ALS ambulances. Approximately 40,000 ambulance assignments were carried out in 2017 [18,19].

Purposive sampling was used [20]. The selection was based on the participants' experiences of near misses, regardless of the length of experience as RN or work within ambulance services. The purpose of this selection was to capture a breadth and variety of near misses and in the handling of these events. Fifteen RNs were asked for participation via e-mail, telephone or personal contact with one of the authors. A total of ten men and five women participated (Table 1). The participants' ages ranged between 34 and 51 years [mean 42, Mdn 43], work experience as RN ranged between 1 and 20 years [mean 5, Mdn 4], and experience in the ambulance service ranged between 1 and 35 years [mean 11, Mdn 5]. One third (33%) were in addition trained as emergency medical technicians (EMTs).

Table 1
Demographics of study participants (n = 15).

No.	Sex	Age	Specialist care education[1]	Experience as RN	Experience in AS[2]	Trained EMT[3]
1	♂	45	Ambulance	5	12	Yes
2	♂	37	Intensive	8	2	No
3	♂	34	Emergency	1	5	No
4	♂	43	Anaesthesia and Ambulance	5	14	Yes
5	♂	39	None	4	4	No
6	♂	46	None	1	19	Yes
7	♂	51	None	6	35	No
8	♂	49	Ambulance	1	18	No
9	♂	48	None	2	4	No
10	♀	46	Ambulance	20	24	Yes
11	♀	42	Ambulance	4	7	No
12	♂	44	Ambulance	2	5	No
13	♀	39	None	6	4	No
14	♀	36	None	4	3	Yes
15	♀	35	Ambulance	3	4	No

[1] University College education for 1–1.5 years.
[2] Years in the Ambulance Services.
[3] Emergency Medical Technician.

3.2. Data collection

Data was collected through face-to-face interviews in Swedish, performed between August 2017 and October 2017. All participants were off duty and chose to be interviewed at the workplace. The interviews were audio recorded, with consent, and later transcribed verbatim. Before the interviews, participants were briefed about the CIT method and that a critical incident was defined as a major event of great importance to the participant. The interviews had a distinct starting point in the participant's memory aiming at their subjective experience in an inductive process of identifying critical incidents and behaviours. The interviews started with an open request: "Please, describe an incident at work when the safety of the patient was jeopardized." This request was followed by open, in-depth follow-up questions such as "How do you mean?" and "Please, explain more." The interviews lasted between 15 and 30 min. There was no time limit for when the near miss events should have taken place. Flanagan recommends gathering incidents until redundancy appears [16] and in this study, redundancy began to appear after ten interviews.

3.3. Data analysis

Flanagan argues that the researchers' experiences are assets [15]. However, the researchers' experiences cannot be treated uncritically in the analysis, without being subjected to appropriate criteria for rigor and maintain a vigilance of non-bias by being aware of their pre-understanding [21]. In this study, the researchers' personal assumptions, professional background, and previous experiences were discussed and reflected on during the data analysis. For example, the researchers' extensive experience in ambulance care was under critical review. This process was ongoing between the lead researchers as well as with other researchers and Master's students who gave comments on analysis and writing.

The data analysis is an inductive process that aims to classify critical incidents and to identify critical behaviours on a descriptive level. The levels of analysis go from quotes to subcategories, on to categories and finally to main areas. Subcategories, categories and main areas are usually abstract [22]. In this study, the authors used a content analysis process at manifest level (Table 2).

The interviews were anonymized during the transcription and then read through several times to become familiar with the text. The incidents were sequentially compared across interviews in order to integrate or refine categories. This includes grouping related subcategories which resulted in the creation of categories and main areas. This process was critically performed by the authors until consensus was established. The incidents varied between one and six per informant. No new category of critical incidents was found in the last six interviews during the analysis.

3.4. Ethical considerations

An advisory statement specifying no objections to the study was provided by the Swedish Regional Ethical Review Board of Uppsala (2017/185). Written informed consent was obtained from all participants. Information was given before interviews, explaining the study's aim and making clear that participants could decline to be interviewed or withdraw from participation at any time. The research was carried out in accordance with the World Medical Association Declaration of Helsinki [23]. The head of the regional ambulance service approved the study.

Table 2
Example from the analysis process.

Quotes	Subcategory	Category	Main area
I was new as ambulance nurse and felt so unsure that I always gave a little less drug than the guidelines said. It is stressful when you feel uncertain and the situation is stressful.	Uncertainty of drug effects Unsure handling of drugs	Incorrect drug management	Drug management
I usually only pull up two milliliters but my colleague pulled up four milliliters so I gave everything. The patient was not affected.	Incorrect drug mixing Wrong drug is given		
I've received the wrong drug from my colleague but still I did not reflect the mistake until I just gave it. It was an extremely stressful situation.	Incorrect drug dose is given		

Table 3
Subcategories (numbers of critical incidents), categories and main areas.

Subcategory	Category	Main area
Uncertainty of drug effects (4)	Incorrect drug management (36)	Drug management
Incorrect drug mixing (11)		
Content in guidelines are forgotten (8)		
Wrong drugs are picked up (6)		
Passed expiration date is discovered (1)		
Incorrect drug dose is given (3)		
Unsure handling of drugs (2)		
Wrong drug is given (1)		
ECG equipment out of order (6)	Technical errors and human shortcomings (15)	Human-technology interactions
Improper use of ECG equipment (3)		
Mechanical chest compression device out of order (2)		
Communication and positioning equipment out of order (4)		
Missed measurement of vital parameters (1)	Incorrect assessment and care (11)	Assessment and care
Communication difficulties with the patient (1)		
Incorrect referrals (2)		
Treatment is delayed (1)		
No compliance with care guidelines (1)		
Uncertainty about intraosseous needle placement (1)		
Uncertainty about laryngeal mask placement (1)		
Interrupted assessment (1)		
Missed team communication (1)		
Missed patient information (1)		
Patients are not attached to scoop stretchers (2)	Inadequate security measures (11)	Patient protection actions
Patients are not strapped (3)		
Patients are not immobilized (2)		
Maps are not used to locate address (2)		
Contaminated intravenous needle is used (1)		
The skin is not disinfected (1)		

4. Results

The participants describe 73 critical incidents of near misses. The results are presented with the four main areas *Drug management; Human-technology interactions; Assessment and care* and *Patient protection actions*, which are based on the categories and subcategories listed in Table 3.

The reasons behind the near misses are a lack of knowledge, experience and time, factors that manifest themselves in stressful and complex situations. Deliberate deviations from guidelines are made for priority and practical reasons. In addition, there is pure negligence.

4.1. Drug management

RNs in the ambulance service are allowed to administer drugs and provide medical treatment without a physician's direct order, provided that laws and guidelines are followed. However, the RNs describe that there is sometimes a lack of knowledge about drug management and the content of the guidelines. Near misses in drug management involves all aspects of how the administration of drugs is handled. One RN describes an incident that could have led to an adverse advent but she manages to avoid it happening: *"I switched the drug in the ambulance, it could have been a disaster for the patient, but it wasn't. No one saw me."* Another RN describes a different type of near miss: *"I pulled more drug than I usually do, gave everything, the patient got tired. No harm though, or…?"*

The RNs describe problems related to switching or taking the wrong drug and scenarios where they feel uncertainty about not being able to master situations involving new drugs. One situation involves insecurity about how to administer an unfamiliar drug, probably with undesirable consequences for the patient.

> *I was new as ambulance nurse and felt so unsure that I always gave a little less drug than the guidelines said. It is stressful when you feel uncertain and the situation is stressful.*

Problems related to incorrect drug management are stressful and closely approach becoming adverse events. The primary response to these near misses is emotional, describing shame, embarrassment and guilt. The first action taken is to hide the mistake. However, in the aftermath, it becomes important to build mutual trust in the team.

4.2. Human-technology interactions

Near misses occur when technology and medical equipment in the ambulance does not work, or when the technology cannot be managed. This causes frustration and risks affecting patient care and outcome. For example, when the electrocardiogram (ECG) equipment stops working and the ECG cannot be sent to the receiving department to identify signs of acute myocardial infarction: *"We were in a shadow and unable to send an ECG. Then I had to read the ECG to see if it was a critically ill*

patient. I don't have that experience".

Technical devices are not always working, which is stressful for the RNs. This technological dependence makes it difficult to carry out a thorough assessment at times when the RN becomes surprised when the technical support suddenly fails.

> *Once we were with a patient with a cardiac arrest and were supposed to use Lucas (a mechanical chest compression system) and Lucas did not work, it was stressful but we did manual chest compressions instead. But this change of mind-set is difficult.*

Technical errors are stressful, regardless if these could have been prevented or not. Human deficiencies in relation to technology become apparent through lack of knowledge and attitudes that risk causing near misses. The primary response to these near misses is a change of action based on the unexpected event.

4.3. Assessment and care

RNs describe it as difficult to determine whether the patient's condition is critical or not, especially when there are communication problems due to language barriers, drug intoxication, dementia, or if the patient is a child. In such cases, the RNs experience that their competence is lacking, which risks leading to near misses and adverse events. This lack of competence could lead also to delayed treatment and negatively affect patient outcome.

> *Sometimes it is difficult to interview the patient, it could be language problems or anxious parents. It is easy to miss a thing or two when you are disrupted all the time. I missed to measure blood sugar once, but it went well for patient anyway! But I was embarrassed in front of the emergency department personnel.*

The RNs take risks in managing care but at the same time they feel that others in the ambulance team are taking greater risks than themselves. Patient safety risks are perceived, for example, in situations where the patient is left at home without consulting a physician to check if this is appropriate.

> *Once I decided to leave the patient at home. Later I heard my colleagues went to the same address. I talked to them and the patient was sick but not harmed. I need to follow the guidelines better. They can help you, I know.*

Near misses occur in the performance of health care measures. One RN describes an event in which a child had a cardiac arrest and how the RN became unsure how to place the intraosseous needle. He asked the colleagues out loud if the placement was correct and received a positive response. However, once the needle was in place the RN realized that it was wrongly placed and responded immediately by placing a new needle in the right place. Afterwards the RN was afraid of being exposed and accused for wrongdoing.

Another RN describes when he arrived to the scene of a cardiac arrest and the colleagues wanted help with the laryngeal mask. The RN cleaned the airway and placed the mask in the patient's throat: *"When I had inserted the laryngeal mask, I discovered it was in the wrong direction. I took it away and tried again, in the right direction".* The RN describes anxiety upon realizing this. Family members at the scene did not seem to see or understand what happened. However, the RN was worried: *"Hope no one saw me!"*

The reasons behind near misses in patient assessment and performing health care measures are multifactorial and lead to guilt and shame. The key causes are stress, unstructured and interrupted assessments, inability to get the patient's story, and deviations from guidelines. The primary response to incorrect execution of a care measure is to immediately correct the action. Deficiencies in the patient assessment are usually detected when the patient is handed over or when the assignment is completed.

4.4. Patient protection actions

Near misses occur when RNs fail in their patient protective actions, and not being proactive against adverse events. Hygiene routines are not followed, even though the RNs are aware of the importance of hygiene to protect the patient. One participant explains: "*You put away the needle on a surface that is not clean and then insert. And you are not always using cleaning cloth."*

One RN describes an incident when the patient almost falls off the stretcher because the staff did not focus on the patient. They managed to get hold of the patient before he fell and the situation worked out fine. However, the RN expresses concern.

> *I know how to attach the scoop stretcher but sometimes I ignore it. I don't know why, maybe it's stressful, if the patient vomits you must wiggle the scoop. The scoop can go back and forth, and so can the patient. Imagine if we were going to crash then… No patient has been harmed. Yet! I think I feel overstrained.*

RNs describe situations when they do not check the exact address and map coordinates for the address before leaving the ambulance station, which sometimes leads to driving in the wrong direction or taking a detour, and hence extending the time to reach the patient. The RNs seem aware of patient safety risks that may arise, but despite this a proactive approach is replaced with a reactive approach.

> *It happens quite often that the GPS hangs and then it becomes difficult to find the address to the patient. I know we will look at the map but sometimes it is missing. But it could be bad for the patient if it took longer times for us to arrive. Sometimes the mobile got out of whack. You just must fix it on your own. Sometimes I use my own mobile phone.*

The reasons for negligence behind near misses in patient protection actions are a mixture of deliberate choices, change of focus, team culture, practical reasons, and time shortages. The primary response to the near misses is reactive and a proactive approach is lacking.

5. Discussion

Near misses can be seen as the first step towards patient injury and harm. However, near misses can also be seen as an inevitable part of care and an educational opportunity for the individual RN. Based on 73 critical incidents, this study identified four main areas of near misses in ambulance care where patient safety was jeopardized. Near misses mostly became visible in stressful and complex situations where the RNs reacted and acted upon the detection of a near miss. However, some near misses remained undiscovered until someone outside the ambulance team drew attention to potential patient safety risks.

5.1. Drug management

A problematic aspect of ambulance care is drug management. This finding was no surprise *per se*, since previous research show that patient safety risks often involve medication errors [3,5,8,9,12,15]. However, what is perhaps more surprising is that the RNs seemed to be insecure about drug doses and mixing of drugs. One explanation to unknowingly give an incorrect drug can be explained by stress combined with too extensive guidelines for drug administration. A negative impact of stress has previously been found among paramedics [24] during simulated high-stress scenarios causing reduced clinical performance [24]. Experienced RNs sometimes deliberately chose to administer higher doses of analgesics when this was perceived to be in the patient's best interest, and thereby disregarding the guidelines for drug management. However, such deliberate choices causing near misses cannot be seen in our results. A possible interpretation of the RNs' lack of compliance may be that the guidelines have shortcomings. This corresponds to a study where the main obstacle of using EMS guidelines and protocols was found to be the format, due to the exclusion of context

knowledge in the development process [25].

5.2. Human-technology interactions

The results showed consequences of failing technology, such as delay of assessment and treatment. This finding is in line with previous research, showing that malfunctioning of equipment can cause harm to the patient [3,8]. Research also shows that incompatibilities between equipment in different ambulance units are likely sources of adverse events [12]. Furthermore, our results indicate that failure in support systems force RNs to make decisions they may not be qualified for, which causes a loss of control and feelings of inadequacy. This finding raises questions about the RNs' competence, i.e. to which degree they "can use the knowledge, skills, and judgment associated with the profession to perform effectively in a domain of possible encounters defining the scope of professional practice." [26,p.166]

The RNs' interactions with technology also raises questions regarding both professional knowledge and competence in assessment, as well as technical skills to operate medical technical equipment. One example was the interpretation of the ECG where one might argue that the RNs' competence should include the ability to recognize suspicion of acute myocardial infarction. Competencies and knowledge like these have been identified in research as desirable by professionals [27] and EMS managers [28] in the Swedish ambulance care services.

5.3. Assessment and care

The decision-making process was difficult and errors in the assessment of patients constituted a threat to patient safety. The results confirm previous research showing that RNs in ambulance care perceive patient assessment as demanding [3,25,29]. The RNs described a sense of inadequate assessments, and sometimes they ignored guidelines or omitted crucial examinations. Similar results are found in previous studies [3,25,29]. Some RNs felt that the cause of insufficient assessments could be due to stress or unstructured examinations. Near misses occurred especially in the case of stressful situations. This is interesting given that RNs who work in the ambulance service are supposed to be skilled to handle stressful situations. However, stress in the prehospital setting can cause medical errors and jeopardize patient safety which has been shown in previous studies [29,30]. The risk of adverse events is higher when ambulance personnel provide care for patients with a life-threatening condition and when deviations from the standard of care are made [3], a risk that can be assumed to be greater in a stressful situation.

5.4. Patient protection actions

The results showed a lack of proactive approach to avoid near misses and adverse events. The reason for this was negligence and inattention caused by a mixture of deliberate choices, change of focus, team culture, practical reasons, and time shortages. Similar to our findings were those found in a study of adverse events during ambulance stretcher operations, however mainly caused by user errors and not necessarily by negligence only [31]. In line with a previous study [15], the most common scenario for the RNs' responses to the near misses were to recognise and correct an error with no reporting of the event.

The result showed also that RNs do not always comply with guidelines aimed for patient safety protection. Research indicates that there is generally poor compliance with EMS guidelines in the ambulance care services, sometimes depending on protocols that are not suited for the care setting, and a lack of communication and implementation strategies [25].

6. Limitations

This study has some limitations. First, the interviewer was an educational coordinator in the organization where the interviews were conducted. This may have caused informants to feel obliged to participate and uncomfortable in the interview situation, and thereby threatening credibility. However, the interviewer was aware of this risk and made efforts to emphasize voluntary participation and the researcher's role.

Another limitation could be a negative impact on the study's credibility due to the authors' pre-understanding. However, this risk was handled by the authors throughout the research process. Before the interviews, the first author reflected on her understanding of the opportunities and problems that may exist with her own experiences as an ambulance nurse. This reflection continued between the authors during the data analysis, discussing how the researchers pre-understanding was both a prerequisite and a risk in ensuring dependability and confirmability.

A third limitation could be the active approach from the interviewer to personally ask RNs if they wanted to participate in the study. This may unintentionally have resulted in a biased selection of dedicated professionals, which may have affected the credibility and transferability of the study.

As there was no time limit for when the near misses should have taken place, such events in the past may have been misrepresented as a result of memory images that the participant has partially forgotten or reinterpreted. On the other hand, if the participant remembers the event it is probably of great importance for her/him and, hence, strengthens credibility as more events could be included.

In order to strengthen confirmability and credibility, the results were supported with quotations, representing the participants' reality. To increase confirmability, the interviewer asked the participants for detailed descriptions of near misses and explained Flanagan's [16] definition of a critical event before the interviews.

7. Conclusion

Experiencing near misses meant stress, guilt and shame. The typical behaviour to near misses was to immediately correct the action but occasionally the miss was not discovered until later without causing any immediate adverse event. The reasons behind near misses were internal and external; internally by lacking knowledge, negligence and deliberate choices, and externally by deficiencies in guidelines and team culture. In the aftermath, it became important to start a collegial dialogue and to build mutual trust in the team.

When the unpredictable ambulance care setting is combined with stressful situations, patient safety seems to have lower priority, which paradoxically may pose a greater risk than the patient's initial health problem. However, this priority should be seen in the light of complex challenges in ambulance care. To meet this complexity, it is reasonable to require knowledge and awareness of contextual near misses and the role of teamwork and feedback for the promotion of a proactive approach to patient safety. Such approach, combined with feedback, can motivate ambulance staff to learn and develop teamwork focused on patient safety, which could reduce the frequency of patient harm and suffering.

Further research should be directed especially on organizational prerequisites, team culture and stress in order to focus on proactive measures for patient safety in ambulance care. It seems important to study the causes of near misses in ambulance care, how these are managed and how near misses can be reduced.

Ethical statement

An advisory statement specifying no objections to the study was provided by the Swedish Regional Ethical Review Board of Uppsala (2017/185).

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Declaration of competing interest

The authors declare that there is no conflict of interest. The authors alone are responsible for the content and writing of the paper.

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