

Original Article

German critical incident reporting system database of prehospital emergency medicine: Analysis of reported communication and medication errors between 2005–2015

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BACKGROUND: Communication failure in prehospital emergency medicine can affect patient safety as it does in other areas of medicine as well. We analyzed the database of the critical incident reporting system for prehospital emergency medicine in Germany retrospectively regarding communication errors.

METHODS: Experts of prehospital emergency medicine and risk management screened the database for verbal communication failure, non-verbal communication failure and missing communication at all.

RESULTS: Between 2005 and 2015, 845 reports were analyzed, of which 247 reports were considered to be related to communication failure. An arbitrary classification resulted in six different kinds: 1) no acknowledgement of a suggestion; 2) medication error; 3) miscommunication with dispatcher; 4) utterance heard/understood improperly; 5) missing information transfer between two persons; and 6) other communication failure.

CONCLUSION: Communication deficits can lead to critical incidents in prehospital emergency medicine and are a very important aspect in patient safety.

KEY WORDS: Critical incident reporting system; Prehospital emergency medicine; Communication error; Medication error

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INTRODUCTION

Errors in medicine are frequent, and while some errors remain without harm to the patient (so-called near-misses), others result in significant morbidity and mortality. Development of causes for errors in medicine has been the subject of recent research worldwide. Often errors occur due to a badly designed system or

organizational mistakes. Human error remains a leading cause for errors in medicine when compared to causes like equipment or technical failure. In addition to the individual tragedy that is associated with each harmful incident, huge costs in the health care system are due to medical errors. Therefore, medical errors remain a challenge despite development of safer technology,

training, and organizational improvements.

Emergency medicine is "a practice prone to error", as Croskerry and Sinclair described.^[1]

Especially in the prehospital setting, providers are confronted with difficulties such as working with rotating and therefore often different teams. Decisions have to be made in time-critical situations, under great pressure, within situations that are unforeseeable and can shift quickly. Therefore, errors are prone to occur in this area of medical care and efforts have to be made to minimize the risk for resulting adverse events and harm. Different mechanisms can lead to human error in prehospital medicine such as staffing, training, technical equipment, and communication. Communication is a key element in teamwork and especially important in high-risk settings. Poor communication frequently contributes to the occurrence of medical errors in intensive care.^[2] In prehospital medicine, many different levels of communication are possible and many caregivers are involved including laymen, the dispatcher, the EMS team, and the emergency department staff. Communication takes place any time humans interact as it is impossible not to communicate, verbally or non-verbally. Communication failure has been identified as an important source of errors, although insight into the nature of these errors is limited. Insight is necessary to design preventive strategies. To our knowledge, there has been no study so far with the focus on communication failure in prehospital emergency medicine. The aim of this study was to identify the root causes of communication failure in prehospital emergency medicine by analyzing the database of the critical incident reporting system (CIRS) for prehospital emergency medicine in Germany (www.cirs-notfallmedizin.de).

METHODS

The webdesign, software, and data acquisition of the database "cirs-notfallmedizin.de" has been described earlier.^[3] This CIRS is an open-access platform in the German language using a questionnaire and open-ended questions to describe critical incidents. It is available with free access via the internet and used by many different providers all over Germany, Austria and Switzerland. It comprises both errors that lead to a significant bad outcome as well as those with only potential bad outcome.

All incidents reported between October 2005 and July 2015 were screened by a PhD-candidate to identify any possible communication failure that might have

contributed to the reported incident. Every incident was a written report. The inclusion during this first screening was deliberately broad and generous in order to also include possible borderline cases. All identified incidents were then checked in detail by a group of four senior emergency medicine physicians highly experienced in prehospital emergency medicine and risk management. The experts defined a communication failure as: 1) any verbal communication failure; 2) missing verbal communication although necessary; 3) any non-verbal communication failure (e.g. written communication); and 4) individual common sense judgement whether communication aspects contributed to the incident.

If at least two experts independently judged communication failure to be a factor contributing to the incident, it was classified as "communication error".

One team member then analyzed the remaining reports and developed an arbitrary classification of different communication errors.

RESULTS

Between October 2005 and July 2015, 845 reports were sent via our website. Totally 320 reports were extracted as possibly related to communication failure by the first screening process performed through the PhD-candidate. Of these, the experts identified 247 incident reports where at least two reviewers judged that communication failure contributed to the incident (Figure 1).

All communication aspects in these 247 incidents were analyzed and arbitrarily classified as follows (Table 1):

Category 1: One of the team members expresses a suggestion or piece of advice during possible patient mismanagement. None of the other team members acknowledges this or pays attention although they heard and/or understood the statement, no inquiry what the other team member thought was going wrong.

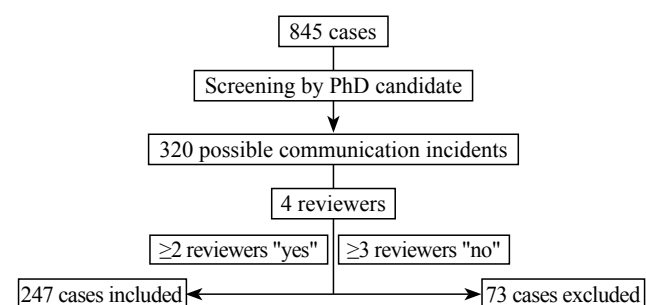


Figure 1. Communication failure contributes to the incidents.

Table 1. Examples of different communication failures related to categories

Variables	Number	Examples
Team member suggestion not acknowledged	n=109	Emergency physician does not consider advice from other team members (mostly paramedics) (n=83) Family doctor does not consider EMS advice (mostly paramedics) (n=7) Non-physicians (mostly paramedics) do not consider advice (n=3) Relative (physician) does not consider advice (n=1)
Medication error	n=66	No double check: wrong dose or drug (n=16) Wrong drug recognized: prevention of administration (n=15) Different drug concentrations in ampules lead to wrong dose application (n=11) Similar sounding drug is ordered (n=7) Drug administration through not labelled syringes (n=5) Drug and/or dose handed over falsely or incomplete (n=4) Wrong drug not recognized although double check is done (n=3) Wrong drug application of EMS of another district, where another medication looks similar to the required (n=2) Ambulance was equipped with wrong medication that lead to confusion (n=2) Several drug dosages prepared, wrong dose administered (n=1)
Communication failure with involvement of dispatcher	n=41	Communication failure with dispatcher and ambulance (n=15) Hospital rejects patient (n=13) EMS unable to locate the address (n=6) Unsuitable ambulance is dispatched (n=4) Wrong dispatch directions to EMS (n=3)
Acoustical problems	n=27	No communication about the patient condition at all (n=9) Misunderstanding of orders other than related to drugs (n=6) Lack of language skills in a non-native speaking emergency physician (n=3) Information orally given is not heard (n=3) Contradictory information about patient condition (n=2) Lack of language skills of patient or relatives (n=2) Confounding of patient data (n=1) Misunderstood information about patient condition (n=1)
Missing information transfer between two persons	n=22	Handover to EMS leads to misinformation (n=10) EMS handover to hospital leads to misinformation (n=7) Drug administration through paramedics without physician approval (n=2) Relatives hold back information (n=2) Handover at change of shift leads to misinformation (n=1)
Other	n=17	Delayed patient treatment (n=7) Drug company label on different drugs, but identification is made by label and not by name—therefore confusing (n=3) No familiar drugs stocked in ambulance (n=1) Family physician is asked to do a house call and rejects (n=1) Emergency physician rejects to escort the patient although indicated (n=1) No communication among EMS team about worsening of patient's condition (n=1) Preparation of (wrong) medication without prior order or communication (n=1) No communication equipment (n=1) No labelling of blood samples (n=1)

Category 2: Medication error (wrong dose or wrong drug).

Category 3: Miscommunication between dispatcher and ambulance or dispatcher and admitting hospital.

Category 4: An utterance of a team member is improperly heard/understood or not heard at all due to acoustical problems.

Category 5: No proper information transfer between two involved persons, e.g. during handovers. This may include first responders, laymen, paramedics, prehospital emergency physicians, dispatchers, or emergency department staff.

Category 6: Other kind of communication failure.

DISCUSSION

It is well known that communication deficits are among the most important causes for critical incidents in high reliability organizations, for example medicine.^[4] Information processing in emergency situations is specifically difficult, because there are several challenging issues: 1) time pressure; 2) team with multiple members involved; 3) high distraction probability; 4) several handovers possible; 5) high degree of non-verbal communication (action performing communication like performing procedures); and 6) limited resources for documentation.

Given these special conditions, it seems especially important to focus on possible communication failures and to identify these failures in a first step. One challenge in this study was to determine, which cases were due to communication error. Even with a definition of what a communication failure is, there will always be different views and perceptions on this topic, because ultimately anything can be attributed to verbal, written or other kind of communication. It is also difficult to judge non-verbal cues, impossible for example body language or voice tone although this is definitely an important aspect in communication. Therefore, four emergency medicine experts finally judged with common sense about inclusion or exclusion within the given limits. We put the focus on including incidents generously to be sure to analyze and think also about hidden or not as obvious communication aspects in incidents. We excluded only those incidents where at least 75% of the experts judged that communication failure did not contribute to the incidents.

The goal of the study was to retrospectively analyze prehospital emergency medicine incidents reported to the nationwide CIR-System with regard to communication

deficits. We suspect that a lot of issues identified here are applicable to many other EMS systems in different countries as well. Risk management is increasingly important in medicine and also prehospital emergency medicine. The implementation of a local CIRS can offer new insights in local safety issues and should be part of a risk management program. In addition to gathering more and often redundant information through CIRS, we should work with known information and available data in reducing or eliminating risks.

We found that 27.5% of all reported incidents were related to communication deficits. Although this number does not necessarily reflect the composition of incidents, quite a high number of communication issues are at least perceived by EMS staff and subsequently reported. This corresponds to a study by Vioque et al,^[5] which showed that 26% of fatal incidents were related to communication errors. At the same time, communication deficits are rarely addressed in studies related to patient safety in prehospital medicine.^[6]

It is striking that in many reports team members, mostly paramedics, complain that advice was not followed by other team members, mostly physicians. Given the fact that many emergency physicians in Germany do not have adequate training and sometimes rarely work in EMS, the advice of the paramedic might have been valuable.^[7,8]

On the other hand, we also should keep the possibility in mind that paramedics whose advice was sometimes harshly disregarded under emergency conditions, were frustrated. This frustration is reflected in the two reports, where paramedics injected medication without physician approval – although it should be the most normal thing to talk to each other in such context. These two reports of medication application without physician approval do need distinct discussion. A young emergency physician tried to intubate a polytraumatized patient without muscle relaxation and apparently too little sedation, because he was afraid of full relaxation and a possible cannot intubate/ventilate situation. The paramedic secretly injected 100 mg succinylcholine to facilitate the intubation after the second unsuccessful attempt. With full relaxation, the intubation was easy and successful. Although this action is highly disputable and objectively fulfils a criminal act, it was the right medical thing to do. In another case, a paramedic injected without further communication 8 g glucose in a comatose patient, although the blood sugar was not measured yet. At the end, the patient had a cerebrovascular accident without a hypoglycaemia. Again, since a physician was available,

it was a criminal act itself to inject a medication without communication and might have been harmful in this situation. On the other hand, both actions are comprehensible from the medical point of view. They simply reflect, that there is lacking trust in the physician's competence in combination with fear to discuss different treatment options. One of the most striking findings of the database is that lack of emergency physician training often leads to incidents. Especially in circumstances when paramedics realize difficulties in airway management, during CPR or resuscitation, they seem to suggest actions that at least need to be seriously being considered or discussed by the emergency physician.

Examples include intubation without relaxation, no intubation without indication, esophageal intubation, CPR-cycles 5:1, refusal of a helicopter although indicated, inappropriate pain management in children, to name a few. The examples all have one feature in common: the paramedics would like to discuss their suggestions and would like to be taken seriously. Instead, their suggestions and questions are not being considered at all without an explanation, neither during nor after the action in the field.

On the other hand, the paramedics can use CIRS as a method to complain about physicians, although the medical decision was well comprehensible in that particular situation. Even if in retrospect the decision seems wrong, it is often impossible to judge by analyzing the CIRS reports whether the disregard was correct or incorrect. Hierarchic aspects probably play a significant role and can complicate communication in prehospital emergency medicine. Disregarding advice leads to frustration, which can have a negative effect on future situations if not discussed after finishing the case. Team discussion and debriefing are part of training scenarios and current guidelines recommend this. The high number of category 1 reports shows that team members do have the need to communicate about decisions in order to understand the thought process of the other. If in contrast the decision maker should have taken the advice, but did not, immediate or subsequent communication about the thought process will help to foster emergency medicine knowledge and team work. We consider an explanation to the team for certain decisions as well as a short discussion about the case afterwards is important to improve team work. This has been postulated in similar situations.^[9,10] Also, cross-professional training might improve interdisciplinary communication gaps and misunderstanding.^[11]

Handovers are known for possible ineffective

transfer of knowledge from one care provider to the other and carry a high risk for medical error.^[12-14] In prehospital emergency medicine, information transfer occurs among providers with different experience and knowledge. Furthermore, it takes place in different situations that vary between being chaotic and multitasking as well as calm and organized. There is little doubt that correct transfer of information at any given time is important for patient safety. Communication breakdown considerably fosters poor outcomes.^[15] Standards for information transition in emergency medicine are currently rare, but should be established as other literature also suggests.^[16,17]

Lacking or wrong labelling of medication can lead to medication error with sometimes disastrous results. Many prevention strategies have been suggested, e.g. standardized drug concentrations or uniform drug labels.^[18,19] These recommendations, even if implemented in some areas, do not prevent medication errors completely. The double check or four-eye-principle means that two persons have to confirm the correct drug and dose prior to drug administration in addition to other safety methods. In our database several reports show that this simple closed-loop communication is not always performed. Yet, the reports also show that it can prevent wrong drug administration if done correctly. Closed-looped communication prior to drug administration should be part of the education program.

There are reports where the hospital simply rejects patients and information to the EMS was conducted via the dispatcher. Although German law prohibits an EMS-rejection by a hospital, it seems to be a problem in real life. Nevertheless, in cases of shortness of hospital capacity for whatever reason, a communication between the hospital provider and the EMS provider would make sense to evaluate each case with respect to the most sensible individual approach for the patient.

Some reports reflect a situation where said words are simply not heard, or are inaccurately heard or misunderstood. It is obvious that this simple lack of information transfer should be ensured. Again, trained closed-loop communication could eliminate this kind of incident.

Communication failure with the dispatch center is mostly due to wrong comprehension of statements. Closed loop communication seems especially important for dispatch center workers.

Despite the four-eye-principle and correct labelling, incidents can occur during drug administration. If drugs

sound similar (e.g. Pantozol =Pantoprazol and Pantolax =Succinylcholine), even two persons might mistake them during stress and it is imaginable that similar looking labels produce the same effect. One prevention strategy is to thoroughly look through the medication list and check medication on similar labels and similar pronunciation, and organize medication in groups of effect, e.g. narcotics together in one box.

Obviously, a lot of harm could be prevented if we were able to eliminate or at least reduce the number of the reported communication deficits. Due to the large amount of data in a CIRS database and multiple options to start dealing with active risk management, it is important to prioritize incidents and start the analysis with consideration of certain aspects, for example, communication deficits.

Communication in a team, especially under pressure, is not mandatory during medical education, neither in medical school nor during the paramedic training. An important step to limit communication breakdown in prehospital medicine with long-term effect is to implement communication training in medical education. Facing the severe incidents described in our database, and we suspect that they are present in many if not most countries of the world, we should seriously consider putting effort in long lasting communication training for EMS providers, as postulated by others as well.^[2,15,16,20] Message related problems might be improved by content standardization. To reduce failure of interpersonal relation as often happened in those incidents of category 1, communication training covering interpersonal situational aspects are a sensible option.

Based on our data, we recommend the following to improve team work:

1. Explanation of decisions in the team, either during the work process or afterwards in a debriefing session.
2. Organized structured information transfer and handovers, training of closed-loop-communication.
3. Uniform and easy recognizable drug labels. Always labelling of syringes. Four-eye-principle and closed-loop-communication prior to drug administration.
4. Closed-loop-communication especially under loud, chaotic or multitasking conditions or if one of the communicators does not speak the native language.
5. Pronunciation and labelling of different drugs should be distinctive.
6. Communication techniques should be part of the training of both paramedics and physicians.
7. Emergency medicine should focus on education and research on communication aspects.

We believe, although hard data are missing, that the described communication failures do occasionally but with regular recurrence contribute to bad outcomes. The proposed communication improvements need to be confirmed by studies; we can only suspect that patient safety will be improved.

Limitations

Although we established a strategy to identify and classify a communication error before the study, there was disagreement in certain cases. To eliminate subjective judgement at least to some degree, we only considered an incidence to be related to communication failure if two independent experts judged so. As every action, labelling, or word could ultimately be considered as communication, every incident is in some way related to communication errors. With our method we used common sense in determining with simple majority on what a communication failure is. Further studies are necessary that also focus on hard criteria, how a communication failure in prehospital emergency medicine can be defined.

The results are limited by limitations of CIRS itself, as neither the total nor the relative number of documented communication failures reflects real numbers. CIRS can only cover those incidents that are perceived by the staff in the first place, and reported by staff in the second place. For example, we only found two cases where a lack of language skills by a patient lead to an adverse event. This might not reflect the frequency with which such events are encountered in daily practice. Many people in Germany including EMS providers and physicians are non-native speakers, similar to other countries. With this view, each reported and identified communication failure needs to be considered as potentially harmful for a number of patients in different regions.

In conclusion, communication deficits can lead to critical incidents in prehospital emergency medicine and are a very important aspect in patient safety. Communication training does not cover much during training in emergency medicine and should be implemented, for paramedics and physicians, since it plays a crucial role in good team work. Especially during times of stress and time pressure, communication skills are important for optimal outcome. Given the fact that the disregarded advice from paramedics to physicians seems to be a major issue for the team work, once focus in education should be on teaching mutual respect for each other and team debriefing should

routinely be performed after each activity in the field. Standardized handovers between different care givers, especially from the prehospital to the innerhospital staff, should be implemented. Routine double check with the four eyes principle can reduce medication error.

In summary, communication deficits have not been studied a lot in emergency medicine. A better communication strategy and teaching communication skills will have enormous effect in increasing patient safety. There is still a plenty of opportunities in research projects in this area.

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Contributors: Hohenstein C proposed the study and wrote the first draft. All authors read and approved the final version of the paper.

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