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The Effects of an ISOBAR-Structured Patient Handover Conversation Between Rescue Services and Emergency Department Staff: The COPTER Trial

Matthias Nuernberger MD, MSc[1], Sebastian Lang MD[2], Tabea Maass[1], Thomas Lehmann PhD[4], Stefan Brodoehl MD[3], Jan-Christoph Lewejohann MD[1]

[1]*Department of Emergency Medicine, Jena University Hospital, Friedrich Schiller University, Jena, Germany*
[2]*Department for Anesthesiology and Intensive Care Medicine, Jena University Hospital, Friedrich Schiller University, Jena, Germany*
[3]*Department of Neurology, Jena University Hospital, Friedrich Schiller University, Jena, Germany*
[4]*Centre for Clinical Studies (ZKS), Jena University Hospital, Friedrich Schiller University, Jena, Germany*

Correspondence

Matthias Nuernberger, MD, MSc, Department of Emergency Medicine, University Hospital Jena, Am Klinikum 1, 07747 Jena, Germany.
Email: matthias.nuernberger@med.uni-jena.de

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Abstract

Objectives: Communication errors are the main cause of adverse events in emergency medicine, underscoring the importance of patient handover conversations. This study aims to assess the impact of implementing the ISOBAR handover protocol for patient transfer between emergency medical services and emergency department (ED) personnel.

Methods: We conducted a single-center implementation trial to evaluate the ISOBAR handover protocol efficacy in a German university hospital ED. We observed and analyzed 651 handover conversations involving adult patients, comparing those using the ISOBAR protocol to those following standard procedure without the protocol. Direct observation of handover processes was employed during alternating interventional periods across 6 trial phases. Primary outcome measure was the "Key Information Transfer Efficiency" score (KITE), a higher score indicating a more efficient patient handover conversation. Secondary outcome measure was the retention of key information by ED personnel, indicating successfully conveyed information.

Results: The KITE score was significantly higher in the ISOBAR group (difference 0.12, 95% CI 0.02-0.22), showing a notable increase from baseline without ISOBAR to the final trial phase using ISOBAR (difference 0.16, 95% CI 0.02-0.34). Key information retention increased significantly: +18% for physicians (95% CI 9-28) and +19% (95% CI 10-28) for nurses. The number of

abstract continues

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Abstract (continued)

questions asked after handover decreased by 29% (95% CI 5.81-41.46). The adherence to ISOBAR had no notable effect on outcome measures.

Conclusion: The implementation of ISOBAR can enhance information transfer during handover. However, adherence to ISOBAR was not crucial, highlighting the importance of focusing on quality of communication during patient handover.

Keywords: *communication, patient safety, ISOBAR, patient handoff, patient handover, sign out, implementation research*

1 INTRODUCTION

1.1 Background

Communication errors are the main cause of adverse events in medical treatment, with 70% attributable to poor information transfer.[1–6] Most of these errors occur during patient handover,[7–9] a critical issue in emergency departments (EDs). This risk can be mitigated through improvements in the handover process.[10] Implementing standardized protocols that incorporate human factors is essential.[11] An effective handover relies on the clear communication of relevant information within an appropriate setting.[12]

1.2 Importance

Communication frameworks like ISOBAR are designed to enhance the efficiency of information transfer.[13,14] Adherence helps both sides of the conversation to remember transmitted information and ultimately enhances patient safety.[12] Handover protocols are already widely implemented in the United States. Organizations like the *Joint Commission*[5] and especially the *American College of Emergency Physicians*, in cooperation with the *Emergency Medicine Patient Safety Foundation*, have underscored the importance of structured handover communication through initiatives like the "*Safer Sign Out*" program.[15] In German EDs, however, the adoption of handover protocols remains limited. This reluctance is mainly attributed to insufficient evidence supporting the protocols' benefits and a lack of incentives for their implementation. Yet, positive effects have been demonstrated across various health care settings.[16] Starmer et al[10,12,17] have shown that the I-PASS handover framework can reduce adverse events and enhance communication quality during inpatient treatment. This evidence predominantly pertains to the U.S. health care system. To date, there exists no such evidence for the German context. Specifically, the initial and crucial patient handover from emergency medical services (EMS) to ED staff remains an under-researched area in Germany.

1.3 Goals

Our aim with this study was to provide evidence for the effectiveness of a structured patient handover in a German ED. To achieve this, we conducted a single-center implementation trial to evaluate the effectiveness of information transfer during handover from EMS to ED staff using ISOBAR. We hypothesized that the use of ISOBAR would result in shorter handovers with fewer words but more relevant information that could subsequently be better remembered by ED staff.

2 METHODS

2.1 Design and Setting

This is a single-center implementation trial in the ED of a German university hospital, which handles an average of 38,000 patients per year. The study took place from April 2023 to May 2024. The study was approved by the responsible ethics committee in September 2022 (Registration: 2022-2727-MV). It was preregistered in the German Clinical Trials Register on February 23, 2022 (ID: DRKS00031223). Trial duration was 13 months (April 2023–May 2024), see Figure 1. To report our findings, we used the Consolidated Standards of Reporting Trials (CONSORT) checklist.[18] Our implementation science approach was in compliance with StaRI[19] specifications. We conducted a pilot trial (n = 54) to test feasibility, train personnel, and determine sample size.

2.1 Selection of Subjects

All cases of adult patients admitted to the ED by EMS were eligible for inclusion. EMS personnel participated in the study through patient handovers. In Germany, EMS personnel are similar to paramedics in other regions. ED staff (specialized nurses, resident physicians, and attending physicians) participated in the study through patient handovers and subsequent interviews. Inclusion criteria were a minimum age of 18 years, presentation by the EMS, and Emergency Severity Index triage category 2 or higher. Exclusion criterion was severe pain on admission (Numerical Rating Scale NRS $\geq$ 8).

A total of 651 patient cases were included. Allocation was based on a time-sequenced design with 6 consecutive time periods that defined 6 groups (Fig 1). Inclusion took place daily between 9 am and 9 pm during a 2-hour block (Supplementary).

The Bottom Line

Communication errors during patient handover are a major cause of adverse events in emergency medicine. There is limited evidence on the impact of implementing structured protocols, such as ISOBAR, on communication between emergency medical services and emergency department (ED) staff.

This study compared 651 handovers with and without ISOBAR in a German university hospital ED. Results showed that the implementation can improve communication efficiency, leading to higher information retention among ED staff. However, strict adherence to ISOBAR did not significantly impact outcomes.

Therefore, this study emphasizes that, although structured protocols are essential, a conducive communication culture is equally important for interdisciplinary exchange.

2.3 Intervention

In our study, the intervention involved the unannounced implementation of the ISOBAR framework for patient handover between EMS and ED staff across 6 time periods (Fig 1). Each period represents a trial group. There was no formal handover protocol prior to the intervention, which is represented by the *Baseline* group. No formal training was provided throughout the study; changes in handover practice were induced solely through visual aids and verbal prompts to assess the adoption and sustainability of ISOBAR without formal training.

During *Baseline*, handovers followed standard practices without intervention. *Intervention 1* introduced ISOBAR via a departmental directive. The intervention was de novo: no preliminary training or specific instructions on ISOBAR were given to EMS or ED personnel. Staff were guided by a large schematic poster in the handover area, and the study team reminded the EMS of the use of ISOBAR at the start of the handover. In *Postintervention 1*, we removed the poster and discontinued reminding. In *Intervention 2*, we reinstated the original poster, added 2 more in the EMS area, and resumed

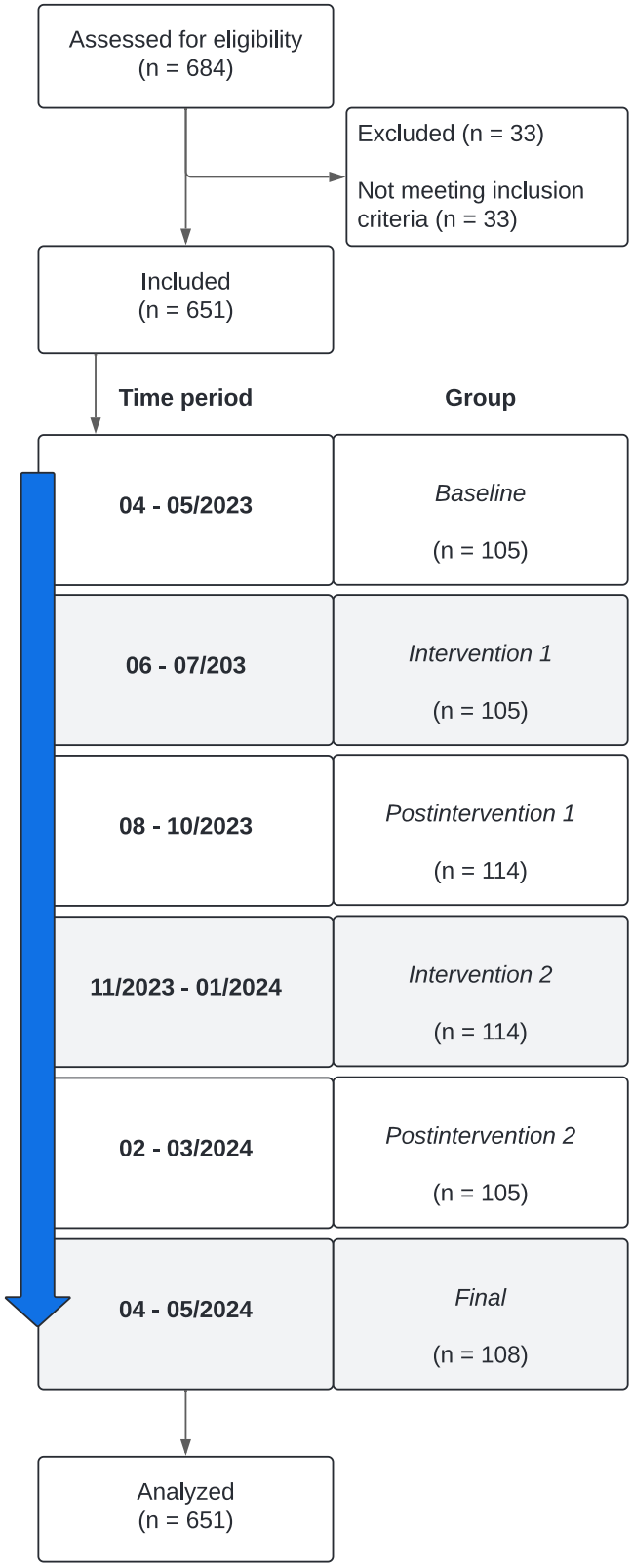

FIGURE 1. Flowchart of study procedure: time period on the left, attached study group, and number of included handovers on the right. Including CONSORT flowchart.

verbal reminders. For *Postintervention 2*, we removed all modifications and stopped reminding again. In *Final*, we reintroduced all posters along with a large digital ISOBAR display in the handover area, and we resumed verbal reminders.

2.4 Measures

Two research assistants and the principal investigator monitored each patient handover in the ED included in the study. Because of privacy protection regulations, we could not record the handover. The research assistants used standardized collection forms (Supplementary Figures S1 and S2) to collect data: key information provided, the sequence of that information, total word count, handover duration, questions raised, and adherence to the ISOBAR framework. We used stopwatches to measure the duration of the handover and hand counters to track the number of words spoken. Key information refers to information that is relevant to a patient's treatment; see Figure 2 for a listing. We assessed adherence to ISOBAR based on the correct sequence of information. The research assistants interviewed the ED personnel involved 15 minutes after the handover using a standardized collection form (Supplementary Figure S3) to assess their retention of the conveyed information. Our research coordinator checked and digitized the data in a secure REDCap database.[20] The research assistants underwent rigorous training, practicing the use of the hand counter until they achieved consistent recording accuracy of over 95%.

2.5 Outcomes

The primary outcome measure was the "Key Information Transfer Efficiency" (KITE) score. The secondary outcome measure evaluated the retention of key information by ED personnel 15 minutes after the handover. Here, remembered key information refers to all relevant details conveyed by EMS during the handover that can afterward be recalled by the interviewed ED personnel.

2.5.1 *KITE score*

Information regarding KITE development and calculation can be found in the Supplementary. KITE is calculated using word count, duration, and number of key information items conveyed. A longer duration and higher word count typically reduce KITE, whereas a greater number of conveyed key information items increases it.

2.6 Staff Interview

Fifteen minutes after the patient handover, the study team interviewed ED personnel involved in the handover using a standardized collection form (Supplementary Figure S3). We selected a latency of 15 minutes as the optimal duration for the mapping of the declarative short-term memory, which is of particular importance for the everyday processing of information of this nature.[21] During the interviews, we asked the personnel to recall key information conveyed in the handover. We also requested a subjective rating of the handover, rated on a grading scale from 1 (very good) to 6 (insufficient). Additionally, we asked participants to assess the perceived complexity of the case (low, medium, or high).

2.6 Influencing Factors

To control for influencing factors, the principal investigator documented the number of occupied beds in the ED (range: 0-20), the presence of noise during patient handover (yes/no), instances of understaffing among medical personnel (yes/no), and any interruptions occurring during the patient handover (yes/no). These variables were aggregated into a composite measure and used as a surrogate parameter for the current workload.

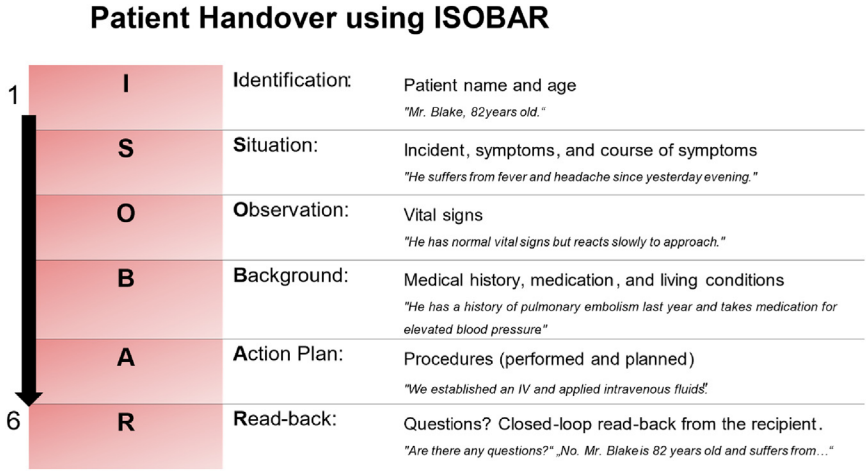

FIGURE 2. ISOBAR protocol for patient transfer communication. Each letter of the acronym refers to key information. Example in italics illustrates intended content.

2.7 Data Analysis

We determined the sample size a priori after the pilot trial. We conducted no interim analyses. We used nonparametric methods for group comparison, including Mann-Whitney-U and Kruskal-Wallis tests. See Supplementary for a detailed description.

All statistical analyses were performed using SPSS Statistics version 29.0.0 (IBM). Figures were created using Prism version 10.2.1 (GraphPad Software, LLC.). We used an alpha level of 0.05 to determine significance.

3 RESULTS

3.1 Group Characteristics and Comparisons

All 6 trial groups were compared individually. No significant differences were found in workload, professional experience, or case complexity, $P > .05$. Afterwards, we combined *Baseline*, *Postintervention 1*, and *Postintervention 2*, hence called *No-intervention*. We combined *Intervention 1*, *Intervention 2*, and *Final*, hence called *Intervention*. There was no difference between these 2 groups in workload, professional experience, or subjective case complexity either, $p > .05$.

ISOBAR adherence was 51% in *Intervention* and 37% in *Postintervention 1* and *Postintervention 2*. ISOBAR adherence was analyzed as a controlling variable. Questions during and after the handover, as well as the rating provided by ED personnel, were analyzed as impact variables.

3.2 Primary Outcome Measure: KITE

Intervention (mean [SD], 95% CI; median: 8.51 [0.65], 8.44-8.58; 8.56) achieved significantly higher results in KITE compared with *No-Intervention* (8.39 [0.61], 8.32-8.46; 8.42), mean difference 0.12, 95% CI 0.02-0.22, $P < .01$, *rrb* = 0.116.

Handover word count and duration differed significantly as well, with *Intervention* showing a lower mean word count (198 vs 189, mean dif. 8.86, $P < .05$) and duration (101 vs 96 seconds, mean difference 4.46, $P < .05$). Conveyed key information however did not differ (7.87 vs. 7.96, mean difference 0.1, $P > .05$), see Figure 3 and Supplementary Table S2.

Final (8.45 [0.62], 8.33-8.58; 8.48) achieved a significantly higher KITE score than *Baseline* 8.29 [0.67], 8.16-8.43; 8.30), mean difference 0.16, 95% CI 0.02-0.34, $P < .05$, *rrb* = 0.151.

Mean handover word count (203 vs 202, $P > .05$) and duration (106 vs 100 seconds, $P > .05$) did not differ between the groups, yet there was a significant difference in conveyed key information (7.78 vs 8.18, $P < .05$).

The KITE score was compared across all trial groups. The analysis revealed a significant increase in the KITE score from *Baseline* (*M* 8.29, *SD* 0.67) to *Intervention 1* (*M* 8.61, *SD* 0.67), *d* = −0.26, 95% CI −0.67 to 0.16, $P_{bonf} < .001$, resulting in a significant difference between all 6 groups, $P < .001$, *partial* η^2 = 0.023. KITE declined to 8.49 in *Postintervention 1*, 8.47 in *Intervention 2,* and 8.37 in *Postintervention 2*, before rising again in *Final* (*M* 8.45, *SD* 0.62), see Figure 4.

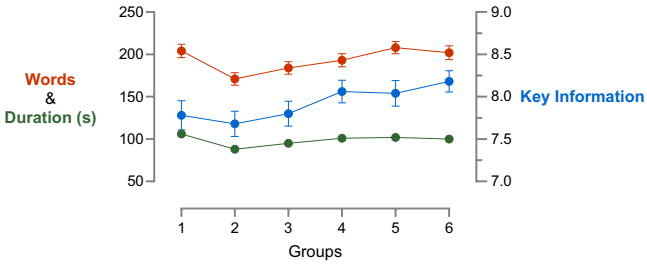

FIGURE 3. Words (orange), Duration (green, in seconds), and conveyed Key Information (blue, Y-axis on the right) in patient handover conversations across the course of the study (M ± SEM). X-axis shows the 6 groups (ie, time-clusters) of the study. SEM of duration was small and is not shown. M, mean; SEM, standard error of mean; 1, Baseline; 2, Intervention 1; 3, Postintervention 1; 4, Intervention 2; 5, Postintervention 2; 6, Final.

3.3 Secondary Outcome Measure: Key Information Retention

For ED physicians, the mean for remembered key information was significantly higher in *Intervention* (mean [SD], 95% CI: 7.71 [1.78], 7.47-7.95) compared with *No-Intervention* (7.37 [1.85], 7.14-7.60), $P < .05$, *rrb* = 0.11. Nurses remembered significantly more in *Intervention* (7.81 [1.74], 7.57-8.04) than in *No-Intervention* (7.27 [1.81], 7.04-7.50), $P < .001$, *rrb* = 0.175.

Physicians showed a significant increase in remembered key information between *Baseline* (6.84 [2.08], 6.37-7.30) and *Final* (8.10 [1.60], 7.69-8.50), $P < .001$, *rrb* = 0.38; mean change: 1.26, +18.42%, 95% CI +9.21-27.63%. For nurses, there also was a significant increase between *Baseline* (6.54 [1.70], 6.17-6.92) and *Final* (7.79 [1.83], 7.31-8.28), $P < .001$, *rrb* = 0.40; mean change: 1.25, +19.11%, 95% CI +9.94-28.29.

Throughout all trial phases, physicians' remembered key information consistently increased from 6.84 (*SD* 2.08) at *Baseline* to 8.10 (*SD* 1.60) in *Final*, *partial* η^2 = 0.041,

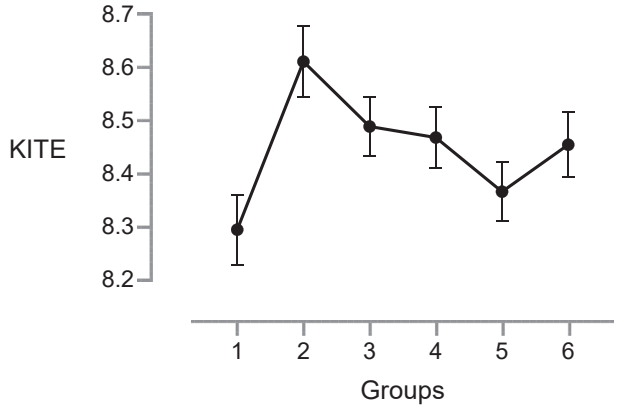

FIGURE 4. KITE (Mean ± 95% CI) for all 6 groups across the whole trial duration. KITE, Key – Information – Transfer - Efficiency; 1, Baseline; 2, Intervention 1; 3, Postintervention 1; 4, Intervention 2; 5, Postintervention 2; 6, Final.

d = −0.70, 95% CI_{bonf} −1.21 to −0.20, P_{bonf} <.001, see Figure 5. Nurses' remembered key information also increased significantly from 6.54 (*SD* 1.70) at *Baseline* to 7.57 (*SD* 1.67) in *Intervention 1*, d = −0.59, 95% CI_{bonf} −1.06 to −0.11, P_{bonf} <.001. This was followed by a moderate further increase to 7.79 (*SD* 1.833) in *Final* d = −0.72, 95% CI_{bonf} −1.23 to −0.21, P_{bonf} <.001, see Figure 6.

3.4 ISOBAR Adherence

There was no statistically significant difference between handovers with ISOBAR adherence and those without in terms of KITE and remembered key information, P >.05. The interaction between group and ISOBAR adherence did not show a significant effect, P >.05.

3.5 Intervention Impact: Questions and Rating

The mean number of questions during or after the handover was significantly less in *Intervention* compared with *No-Intervention* (2.54 vs 2.06, P <.001). They were also significantly less frequent in *Final* (3.10 vs. 2.37, −29%, 5.81-41.46%, P <.05) compared with *Baseline*, see Figure 7. The mean rating for the handover by physicians (2.17 vs 1.93, P <.01) and nurses (*M* 2.03 vs 1.86, P <.01) was significantly better (ie, lower) in *Intervention*.

The mean rating for the handover by physicians was significantly different between *Final* and *Baseline*, with *Final* receiving better (ie, lower) grades (2.29 vs 1.79, P <.001).

4 LIMITATIONS

The time-sequenced design approach used in this study leads to unavoidable performance and participant biases (eg, Hawthorne effect).[22] As blinding was not possible, this could not be evaded completely. We controlled for these effects by standardizing all procedures, anonymizing all participants, a long study duration implying intermediate data collection rate, and a pilot phase to absorb most of the initial fluctuations. Nevertheless, we cannot rule out a small residual effect on the generalizability of our results. We assume that time-dependent confounders (eg, seasons) had no major influence, as the time periods were matched between the groups.

The use of the KITE score, a not yet externally validated marker for handover efficiency, as the primary outcome measure is another limitation. Assessing the efficiency of human verbal communication presents inherent challenges. Although there are established concepts in nonmedical sectors[23] and to some extent in certain medical areas,[24] there is, to our knowledge, no specific tool for assessing patient handovers

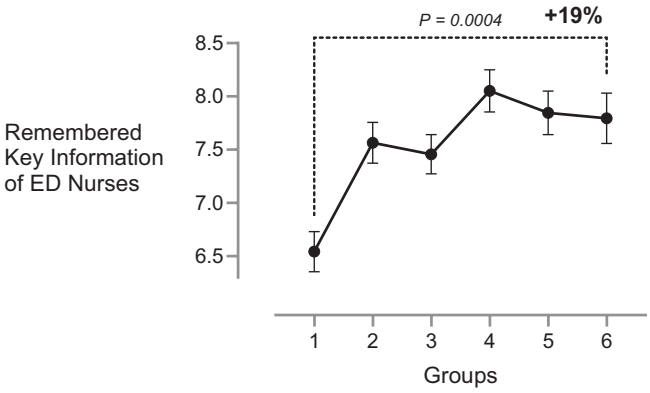

FIGURE 6. Remembered key information of the ED nurse 15 minutes after patient handover (Mean ± 95% CI) for all 6 groups across the whole trial duration. For clarity, only the comparison between Baseline and Final is shown. 1, Baseline; 2, Intervention 1; 3, Postintervention 1; 4, Intervention 2; 5, Postintervention 2; 6, Final.

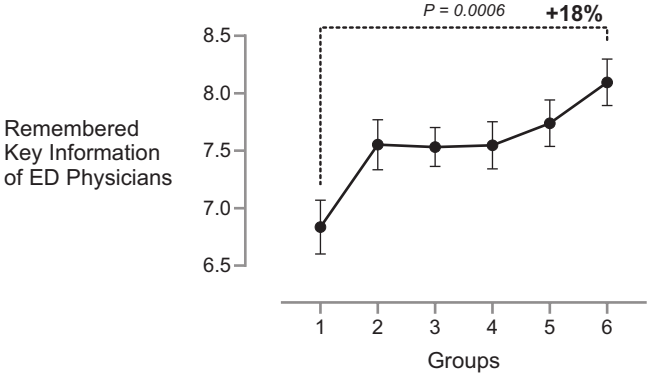

FIGURE 5. Remembered key information of the ED physician 15 minutes after patient handover (Mean ± 95% CI) for all 6 groups across the whole trial duration. For clarity, only the comparison between Baseline and Final is shown. 1, Baseline; 2, Intervention 1; 3, Postintervention 1; 4, Intervention 2; 5, Postintervention 2; 6, Final

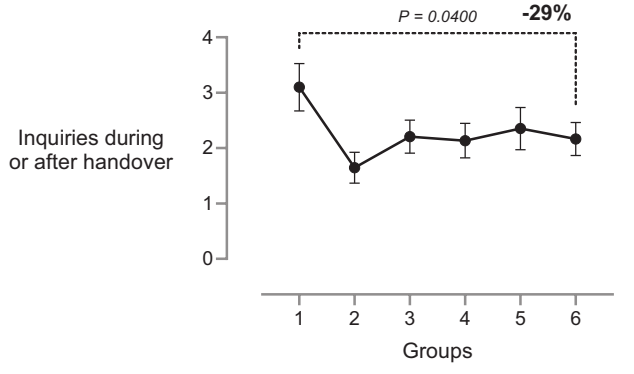

FIGURE 7. Inquiries (questions) during or after patient handover (Mean ± 95% CI) for all 6 groups across the whole trial duration. For clarity, only the comparison between Baseline and Final is shown. 1, Baseline; 2, Intervention 1; 3, Postintervention 1; 4, Intervention 2; 5, Postintervention 2; 6, Final.

in the ED. However, this is considered necessary.[17] An indirect assessment based, for example, on adverse events would not have been able to answer our research question. Therefore, we developed the KITE score (Supplementary). Future studies should relate KITE results to outcome measures to further validate its reproducibility. Its relevance for daily practice can currently be derived from direct effects such as information retention. This study links these effects with the results of the KITE score.

Self-assessment was used to acquire remembered key information. Although we also tested other methods, self-assessment proved to be the most practical in the ED. In the pilot study, the self-assessed data did not differ significantly from queried data.

Key information was not weighted in our study. As there is no standardized method for weighing this information and predicting its relevance is impractical, we did not carry out a ranking.

5 DISCUSSION

In this study, the implementation of the ISOBAR protocol improved the quality of communication during patient handover between EMS and ED staff. The outcome measures showed significant improvements, which were emphasized in the intervention groups and increased continuously until the end of the study. When translating these results into clinical importance, the effect on involved personnel must be considered: The ED team remembered around 20% more key information at the end of the study. The ED team perceived patient handovers during the study as continuously improving, and the number of inquiries declined by around 30% at the end of the trial. We can, therefore, assume a positive impact on working conditions and patient care, but this was not directly investigated in our study. However, other studies have linked the use of various structured communication protocols, such as I-PASS, to improved patient safety and outcomes.[25–28]

We know that structured communication can enhance information exchange by increasing the amount of information remembered afterward.[11] The ISOBAR protocol's acronym structure, which determines the sequence of information, should be crucial in this regard. All information is organized into chunks, aiding declarative short-term memory retention, especially in high-stress situations. Other handover protocols, such as I-PASS or SBAR, pursue the same goal, even if the order of the information is slightly different. However, adherence to the ISOBAR sequence did not affect our outcome measures. This means that strict adherence to the protocol was not decisive for the positive effect of our intervention. The presence of the study team (ie, Hawthorne effect)[22] and the interview of the staff after the handover cannot be the sole cause either, as the effect was particularly evident in the intervention groups. It stands to reason that the combination of a specified handover protocol and increased awareness of high-quality communication is responsible for the positive effects. We expected a side effect of the intervention by emphasizing quality in patient handover from the start but assumed a small effect compared with the impact of adherence to the handover protocol. However, our results suggest that it is the other way around. The ISOBAR protocol as such could then be interchangeable with other protocols such as I-PASS or SBAR. This would be consistent with other studies showing the effectiveness of structured communication using different communication frameworks.[16,17] We assume that a structured way of communicating is an essential part of the recipe, even if strict adherence to this or that protocol is not achieved. However, the other essential component is the awareness of high-quality handover communication within the team.

The fact that the ISOBAR protocol was implemented without prior instruction does not contradict this consideration because the first intervention group showed a large improvement in all outcome measures. Thus, the lack of prior instruction does not appear to have impacted our results, suggesting that a conscious effort to improve handover quality by EMS personnel is likely.

In summary, in our study, ISOBAR-structured handover communication improved information transfer in our ED. Fifteen minutes after patient handover, ED personnel could remember nearly 20% more relevant information at the end of the trial. However, strictly adhering to the ISOBAR acronym was not essential, highlighting the importance of focusing on quality of communication during patient handover. The handover protocol and its specific sequence of information should not be the sole focus of improvement efforts in interdisciplinary communication. Instead, the same attention should be paid to the culture of communication.

AUTHOR CONTRIBUTIONS

Study concept and design: MN, SL, TM, SB, and JL. Acquisition of data: MN, SL, and TM. Analysis and interpretation of the data: MN, TM, SB, TL, and JL. Drafting: MN. Revision: MN, SL, TM, SB, TL, and JL. Statistical expertise: MN, SB, and TL. Acquisition of funding: MN.

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CONFLICT OF INTEREST

All authors have affirmed they have no conflicts of interest to declare.

CLINICAL TRIAL REGISTRATION

German Clinical Trials Register, ID: DRKS00031223

ORCID

Matthias Nuernberger MD, MSc https://orcid.org/0000-0002-9030-3325

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SUPPLEMENTARY MATERIALS

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