Understanding and Improving Communication in Healthcare

Inauguraldissertation
zur
Erlangung der Würde
einer Doktorin der Philosophie
vorgelegt der
Fakultät für Psychologie
der Universität Basel

von

Victoria Siegrist, M. Sc.

aus Vordemwald, Schweiz

Basel, Mai 2018

Originaldokument gespeichert auf dem Dokumentenserver der Universität Basel
edoc.unibas.ch

UNI
BASEL

Genehmigt von der Fakultät für Psychologie

auf Antrag von

Prof. Dr. Rui Mata
Prof. Dr. med. Roland Bingisser

Basel, den _____

_____
Prof. Dr. Alexander Grob

Dieses Werk ist lizenziert unter einer Creative Commons - Namensnennung - Nicht kommerziell - Keine Bearbeitungen 4.0 International Lizenz (CC BY-NC-ND 4.0)

UNI
BASEL

This dissertation framework is based on three manuscripts:

History taking:

Frey Renggli, J.*, Eken, C.*, Siegrist, V., Nieves Ortega, R., Nickel, C. H., Rosin, C., Hertwig, R., & Bingisser, R. (2018). Usability of a web-based software tool for history taking in the emergency department. Manuscript submitted for publication.

Discharge information:

Siegrist, V., Langewitz, W., Mata, R., Maiori, D., Hertwig, R., & Bingisser, R. (2018). Discharge communication using the book metaphor: An advance organiser reducing the impact of health literacy on recall. Manuscript submitted for publication.

Siegrist, V., Mata, R., Langewitz, W., Hertwig, R., & Bingisser, R. (2018). Improving discharge communication in the emergency department by information structuring: A cluster randomized clinical trial. Working paper.

Not included in this dissertation:

Siegrist, V., Eken, C., Nickel, C., Mata, R., Hertwig, R., & Bingisser, R. (2018). End-of-life decisions in emergency patients: Prevalence, outcome, and physician effect. *QJM: An International Journal of Medicine*. In press.

Declaration

I, Victoria Siegrist (born March 27, 1988 in Basel, Switzerland) hereby declare the following:

(i) This dissertation is based on three manuscripts. I contributed to these manuscripts substantially in the following way:

Frey Renggli*, Eken*, Siegrist, Nieves Ortega, Nickel, Rosin, Hertwig, & Bingisser (2018): Primarily responsible for the experimental paradigm. Jointly responsible for data collection and writing of the manuscript.

Siegrist, Langewitz, Mata, Maiori, Hertwig, & Bingisser (2018): Jointly responsible for the idea. Primarily responsible for data collection, analysis and writing of the manuscript.

Siegrist, Mata, Langewitz, Hertwig, & Bingisser (2018): Jointly responsible for the idea and the experimental paradigm. Primarily responsible for data collection, analysis and writing of the manuscript.

(ii) I only used the resources indicated.

(iii) I marked all the citations.

Victoria Siegrist

Basel, May 2018

Acknowledgements

I would like to acknowledge and sincerely thank my supervisors, Rui Mata and Roland Bingisser, for their support and their valuable inputs throughout the years of my dissertation. You gave me the opportunity to grow my knowledge and skill set as a researcher, and to always push my limits a little further. The interdisciplinary work between psychology and healthcare taught me far more than I could have wished for. I would also like to thank my co-supervisor Ralph Hertwig for the collaboration. It was a pleasure learning from you and the members of ARC. Spending time at the Max Planck Institute for Human Development as a visiting researcher allowed me not only to get valuable feedback on my dissertation but also to find companionship and friendship in Berlin. I am also indebted to my co-supervisor Wolf Langewitz for his constant encouragement and the opportunity to join him in several communication trainings. Furthermore, I would like to thank Rainer Greifeneder for being the chair of my committee, Christian Nickel for his thoughts and inputs on my work, and Laura Wiles for editing the manuscripts.

I would like to thank my colleagues at the University Hospital of Basel and at the Department of Psychology. Although each of you made a difference in my work and personal life, I am especially thankful for the friendship and constant support of Ceylan Eken, Alexandra Malinovska, and Mascha Bethke. I am also thankful for the support of my research assistants and interns: Marianne Benz, Leona Knüsel, Dominik Maiori, Valentina Steffen, Doreen Eckardt, Laura Fässler, Anna Becker, David Bachmann, Galya Iseli and Isabelle Keller. I could not have wished for more motivation and engagement from you. Each of you made me learn so much about myself, my working style and the importance of a good team. Additionally, I want to thank all the physicians, patients, students and other volunteers that took part in my studies.

Special thanks go to Stephan Furger, who has supported me in every respect and has grounded me throughout my dissertation. This dissertation would not have been possible

without you and our beloved Aimee. I would like to thank my parents and my family, who always believed in me and never made me lose sight of the big picture. Furthermore, I would like to thank all my friends and my godchild Liliana Giglia for their support and patience when working days were long and weekends were short.

Abstract

Physician–patient communication plays a crucial role in healthcare as it is directly linked to patients' well-being and outcomes. The focus of this dissertation is on communication in healthcare. More specifically, it comprises three manuscripts on understanding and improving physician–patient communication at the beginning (i.e., history-taking) and at the end of an emergency department consultation (i.e., discharge communication).

Manuscript one evaluates the usability of a web-based software for medical history-taking. We found excellent usability for emergency patients not in need of immediate medical care. However, the gathered medical history was not able to substitute medical history-taking by physicians but rather to provide ancillary information.

Manuscript two investigates in a laboratory setting the effect of three different information-structuring measures (i.e., advance organiser, structure, post organiser) on proxy-patients' recall of discharge information, and their satisfaction with the physician. We show that pre-existing medical knowledge had a positive effect on participants' recall, and that structured discharge communication complemented by an advance organiser (i.e., the so-called book metaphor) was beneficial in individuals with lower pre-existing medical knowledge. Additionally, in the information-structuring conditions, proxy-patients perceived information as more structured, and they recommended the physician to family and friends more strongly in comparison to a natural conversation condition.

Manuscript three studies the effects of communication training for physicians in information structuring compared to communication training in responding to emotions in the real-life setting of an emergency department. In this cluster randomized clinical trial, we show that explicit structure of discharge information was beneficial for patients' recall and adherence to recommendations without a trade-off on patients' satisfaction.

In sum, this dissertation sheds light on effective communication between patients and physicians by investigating verbal and electronic communication aids.

Introduction

"The single biggest problem in communication is the illusion that it has taken place."

— George Bernard Shaw

This quote by George Bernard Shaw, who received the Nobel Prize in Literature in 1926, illustrates a problem that is as relevant today as it was during Shaw's lifetime. Although the phenomenon of ineffective communication is pervasive, it has major consequences in healthcare in particular: Physician–patient communication has a high impact on patients' satisfaction, adherence to recommendations and, ultimately, health outcomes (Street, 2013). This makes effective communication a vital component of quality in healthcare (Ong, de Haes, Hoos, & Lammes, 1995).

The relevance of physician–patient communication is especially pronounced in the challenging setting of an emergency department (ED) (Eisenberg et al., 2005). On the one hand, patients present to the ED with acute complaints and without the possibility of continuous treatment by their ED physician. On the other hand, physicians face challenges such as time constraints and lack of prior knowledge about the patient (Samuels-Kalow, Stack, & Porter, 2012). These challenges emphasize the need for effective physician–patient communication in the particularly demanding environment of an ED (Taylor, Wolfe, & Cameron, 2002).

Eisenberg and colleagues examined communication at an ED and identified four distinct processes (Eisenberg et al., 2005): (1) triage: at the beginning of the consultation, when physicians gather information on patients' medical histories; (2) testing and evaluation: after an initial assessment, when physicians further test and evaluate patients' complaints; (3) handoffs: in the process of the work-up, when physicians give a report to colleagues and seek reassurance; (4) admitting: at the end of the consultation, when physicians provide information to their patients for a successful transition from ED to further work-up.

The communication processes “triage” and “admitting” are essential in physician–patient communication because information gathering and information provision were found to have a major impact on the direction and quality of care (Rhodes, Vieth, He, Miller, & Howes, 2004). The main goal of the communication process “triage” is history-taking whereas the objective of “admitting” is patient discharge. Both processes are crucial for patient treatment: Effective history-taking influences the provision of high-quality care (Tam et al., 2005) whereas successful discharge communication enables patients to manage their disease after discharge from the ED (Engel et al., 2012). Thus, this dissertation focuses on history-taking and discharge communication.

History-taking

At the beginning of the encounter, ED physicians do not know patients’ histories or the seriousness of patients’ medical conditions (Dean, Oetzel, & Sklar, 2014). Therefore, effective history-taking (e.g., information on pre-existing diseases, medication, and allergies) is crucial for a suitable diagnostic work-up and therapeutic plan (Lindner, Slangman, Senkin, Mocker, & Searle, 2015). Although the use of computer technology in healthcare settings is on the rise, there has only been little progress in using this development for the collection of patients’ medical histories (Zakim, 2016).

Using computer technology in history-taking could bring several advantages: (1) The collection of data in a structured way, instead of the currently used free texts in electronic health records, provides detailed information that contributes to the accuracy and timeliness of clinical diagnoses (Fernando, Kalra, Morrison, Byrne, & Sheikh, 2012). (2) Presenting complaints of patients tend to be processed and filtered by the recording physician (Safwenberg, Terént, & Lind, 2007). Thus, the use of a software that enables patients to take their own history would have the advantage of bias reduction. (3) Patients with non-urgent triage categories experience long waiting times at the ED due to physicians’ time constraints. This time is usually perceived

as time wasted (Rhodes, Lauderdale, Stocking, Howes, & Roizen, 2001), and could be used by patients to fill in their medical histories in a web-based software.

A systematic review found mixed results in terms of benefits and risks when using computer technology to gather patients' medical histories (Fernando et al., 2012). Most studies focused on the amount and completeness of information gathered but ignored whether this additional information was useful. It remained unclear whether a web-based software to gather patients' medical histories would show the quality and usability necessary for usage in the context of an ED. Thus, *manuscript one* investigates the quality and usability of a web-based software for history taking.

Discharge communication

After ruling out life-threatening conditions, patient care is typically not integrated into the ED. Nevertheless, emergency physicians play a key role in facilitating continuity of care (Kripalani, Jackson, Schnipper, & Coleman, 2007; Villanueva, 2010). Therefore, Cooley and colleagues suggested that during discharge communication physicians should summarize the visit, teach patients how to safely care for themselves at home, address remaining questions or concerns, and help patients connect to the care providers where their medical needs may be best managed (Cooley, McAllister, Sherrieb, & Kuhlthau, 2009). Deficits in communication and information transition at discharge may adversely affect patient care (Kripalani, LeFevre, et al., 2007). However, patients' recall of key aspects of discharge information is generally described as poor (Crane, 1997; Engel et al., 2009; Kessels, 2003; Vashi & Rhodes, 2011).

To improve discharge communication, it should be (1) standardized, (2) adapted to the patient's knowledge and language, (3) include comprehension checks, and (4) involve patient reminders or help with follow-up appointments (Samuels-Kalow et al., 2012). One possibility to standardize communication is the provision of written information (Johnson & Sandford, 2005). However, this is not always possible when information needs to be tailored to a specific

patient, patient literacy is low, or diagnoses are varied or unclear—as it often occurs in the ED. Several studies have demonstrated that written ED discharge instructions often exceed patients' health literacy or reading levels (Powers, 1988; Williams, Counselman, & Caggiano, 1996). Therefore, a more feasible alternative is to ensure that the typical oral communication includes the main characteristics listed above.

One way to standardize oral communication is the use of information-structuring measures. Previous studies found positive effects on participants' recall if information was structured, in comparison to a condition where information was unstructured (Epstein, 1967; Traupmann, 1975). A technique to enhance communication skills in information structuring is the use of an advance organiser. The advance organiser outlines the structure of the content and is embedded into the conversation prior to learning with the aim of helping the learner to organize new incoming information (Livingston, Frankiewicz, & Williams, 1979). A meta-analysis on the effects of information structuring with an advance organiser showed a positive effect size of .4 on learning (Hattie, 2008). Based on these results, it is not surprising that communication training with the focus on information structuring with advance organisers is included in the curriculum of medical students at the University of Basel, Switzerland. To facilitate learning of this communication skill, the term "book metaphor" was established. The book metaphor transfers the structure of a book to the physician–patient communication. More specifically, the communication gets a title, a table of contents (i.e., advance organiser), title of chapters, and text (Kiessling & Langewitz, 2013).

Recent studies investigated the effects of information structuring with the book metaphor in the context of discharge communication and found positive effects on information retrieval and satisfaction (Ackermann et al., 2016; Langewitz et al., 2015). What remained unclear was whether information structuring per se or used with the book metaphor would lead to improved recall in comparison to a natural conversational style. Therefore, *manuscript two* examines the

benefits of different information-structuring measures on recall and satisfaction in comparison to a physician's natural conversational style.

Manuscript one

History-taking with a web-based software: Investigation in the real life setting of an ED

Frey Renggli, J.*, Eken, C.*, Siegrist, V., Nieves Ortega, R., Nickel, C. H., Rosin, C., Hertwig, R., & Bingisser, R. (2018). Usability of a web-based software tool for history taking in the emergency department. Manuscript submitted for publication.

The goal of the first manuscript of this dissertation is to investigate the quality and usability (defined by effectiveness, efficiency, and satisfaction (International Organization for Standardization, 2016)) of a web-based software for medical history-taking.

A systematic review of the benefits and risks of structuring patients' histories in the electronic health record found insufficient evidence for the benefits of structuring with electronic applications (Fernando et al., 2012). On the one hand, more detailed records were obtained but on the other hand it remained unclear whether the additional information would be useful.

To shed more light on the usability of a web-based software for history-taking, we conducted a study with patients, that were not in need of immediate medical attention at the ED of the University Hospital of Basel (UHBS), Switzerland. The software under investigation (Sublimd; www.sublimd.ch) is able to take patients' medical histories for 150 different complaints by having a pool of over 3,000 corresponding questions. It dynamically adapts the selection of its questions reasoned by the patient's answers and obtains detailed patient histories consisting of the presenting symptoms, medications, allergies, personal and family histories, as well as systematic history of symptoms. After information gathering, the software automatically generates a written report of patients' medical histories. For our study, the commercially available Sublimd software was aligned with the medical algorithms from medStandards (www.medstandards.ch), a decision support tool for physicians owned by the UHBS.

Our study consisted of three distinct study phases, each of one week's duration: (1) baseline, (2) run-in, and (3) intervention. In the baseline week, patients' and physicians' satisfaction with the "conventional history-taking", and patient care was obtained. In the run-in week, patients recorded their history on a tablet guided by the questions of the web-based software. In this week, only senior physicians had access to patients' self-administered medical histories, and they rated the quality of patient- versus junior-physician-generated medical histories. Additionally, senior physicians were asked to select history categories with missing information and to rate how strongly the lack of this information would affect patients' successful care. In the intervention week, patients still recorded their history on a tablet but, in contrast to the run-in week, junior physicians now had access to the patient-generated history before taking their own medical histories. Results from baseline and intervention on patient and physician satisfaction with history-taking and patient care were compared.

Our results show that senior physicians rated the medical histories as more complete when junior physicians had access to the patient-administered medical history. Nevertheless, the medical histories of the current version of the software were less accurate in the domains of "history of present illness" and "medication" in comparison to junior physicians' histories. Patients' and physicians' satisfaction with the physician–patient interaction and patient care were equally high when comparing ratings from the baseline and intervention.

Working with computers is thought to uncover more sensitive information, and to provide more adaptability in terms of language barriers (Bachman, 2003). In line with these findings, some patients disclosed sensitive information to the software but not to the physician. Additionally, the choice of two languages (i.e., German and English) for completing the history was valued by several patients.

In sum, our results suggest that the investigated web-based software has an excellent usability in emergency patients who are not in need of immediate medical attention.

Nevertheless, it should be used to gather ancillary information rather than substituting medical history-taking by physicians.

Manuscript two

Information structuring in discharge communication: Investigation under laboratory conditions

Siegrist, V., Langewitz, W., Mata, R., Maiori, D., Hertwig, R., & Bingisser, R. (2018). Discharge communication using the book metaphor: An advance organiser reducing the impact of health literacy on recall. Manuscript submitted for publication.

The second manuscript investigates the effects of information structuring and its interaction with pre-existing medical knowledge on recall in a simulated discharge communication.

Previous studies found that information structuring with an advance organiser (AO) boosts recall in participants who see a video-vignette of an emergency discharge communication (Ackermann et al., 2016; Langewitz et al., 2015). Yet, there is evidence that information structuring not only with an AO, but also a with a post organiser (PO) leads to improved recall (Butz, Miller, & Butz, 2005; Livingston et al., 1979). AOs are synopses provided at the beginning of the communication whereas POs are synopses provided at the end of information provision. Past work has not evaluated the independent contributions of structure and the organising synopsis of an AO versus a PO. In this study, these elements were examined separately.

Therefore, we conducted an experiment investigating whether certain elements of explicit structuring are especially helpful to improve recall of discharge information. Additionally, participants' satisfaction (i.e., structuredness, informativeness, comprehensibility, and recommendation of the physician), and the interplay between different information-structuring measures with pre-existing medical knowledge have been investigated.

We recruited participants via an online platform of the Department of Psychology, University of Basel, Switzerland, and presented them randomly one of four highly standardized

video clips featuring a discharge communication in the ED. Three information-structuring videos simulated a discharge event involving the use of an AO, a PO, or structured communication (S) without an AO or a PO. These conditions were then compared to an unstructured communication event emulating a physician's natural conversational style (NC).

We found that pre-existing medical knowledge but no information-structuring condition (i.e., AO, S, PO) relative to the NC condition was significantly related to increased recall. However, we observed a significant interaction between low pre-existing medical knowledge and information recall in the AO condition, suggesting that an AO can be a powerful tool to eliminate the disadvantage of low pre-existing medical knowledge in recall of discharge information. In comparison to the NC condition, participants in the information-structuring conditions (i.e., AO, S, PO) perceived information as significantly more structured, and they recommended the physician more strongly to family and friends.

These results suggest that an AO may be particularly helpful for individuals with little pre-existing medical knowledge, whereas such an effect could not be demonstrated with a synopsis at the end of information provision or structure by itself. Importantly, the benefits of information structuring were not traded against other quality dimensions of physician–patient communication, such as satisfaction. On the contrary, participants were more likely to recommend the physician to family and friends if discharge communication was explicitly structured.

To date, benefits of information structuring have only been shown in studies that used students as proxy-patients and video vignettes as stimulus material for discharge communication. The results, found under laboratory conditions, raise the question of whether the benefits of information structuring with an AO can be discovered in a real-life setting of an ED as well. The environment of an ED is defined by time-constraints, and patient characteristics usually differ from student characteristics. Patients are older, and show high levels of stress and anxiety (Byrne & Robert, 1996).

Thus, the aim of the next manuscript is threefold: First, to investigate whether communication skills in information structuring with an AO can be taught to physicians. Second, to examine the effects of information structuring with an AO on patients' recall of discharge information and satisfaction. Third, to study whether the anticipated improvement in recall translates into better adherence to recommendations.

Manuscript three

Information structuring in discharge communication: Investigation in the real-life setting of an ED

Siegrist, V., Mata, R., Langewitz, W., Hertwig, R., & Bingisser, R. (2018). Improving discharge communication in the emergency department by information structuring: A cluster randomized clinical trial. Working paper.

In the current manuscript, we compare the influence of two communication skills trainings for physicians on patients' recall of discharge information, satisfaction, and adherence to recommendations.

Previous studies showed positive effects for information structuring on participants recall and satisfaction (Ackermann et al., 2016; Langewitz et al., 2015). What remained unclear was whether these positive effects can be found in the real-life setting of an ED. Although one study on communication training came to the conclusion that a skill transfer from training to actual patient care was not possible (Curtis et al., 2013), another study found that the intervention made a difference (Rao, Anderson, Inui, & Frankel, 2007). Therefore, the first obstacle was the provision of an effective communication skills training. Additionally, the choice of a suitable comparison group needed to be made. We already knew from the previous laboratory studies that information structuring outperforms physicians' natural conversational style and we considered it unethical to teach some physicians communication skills that proved to be beneficial for patients while the comparison group received no training. Patients presenting to the ED are found to have high levels of stress and anxiety (Byrne & Robert, 1996; Ekwall, 2013) and several studies found positive effects on patients' clinical outcomes if physicians showed empathy (Hojat et al., 2011; Kim, Kaplowitz, & Johnston, 2004; Menendez, Chen, Mudgal, Jupiter, & Ring, 2015). Consequently, we decided to test the benefits of

communication training in information-structuring skills (S) against communication training in responding to emotions (i.e., empathy skills, E).

We conducted a two-arm cluster randomized clinical trial investigating the effects of S versus E on patients' recall of discharge information and on patients' satisfaction with the discharge communication and the physicians. Because good physician–patient communication was found to foster adherence (Zolnierek & DiMatteo, 2009), we included patients' self-reported adherence to recommendation as an outcome.

Physicians eligible for the study were junior physicians who started working at the ED of the UHBS within the two-year study period, and who took part in lectures during their first day at work. Patients were suitable for study participation if they presented to the ED with chest pain or abdominal pain, and if they were discharged by a physician included in the study.

Our results show that physicians were able to learn the content of the communication skills training and that they were able to apply their acquired skills during discharge communication. Patients' immediate recall was significantly higher in the structure group in comparison to the empathy group (30.0% versus 26.1%). The positive effect of information structuring on recall was small but in line with the findings of a meta-analysis on the effects of communication training on patient outcomes (Barth & Lannen, 2011). Information structuring had a positive impact on patients' recall of discharge information at the immediate assessment but not in the follow-up assessments 7 days and 30 days later. One explanation might be the setting of our study: Patients presented to the ED with acute complaints and discharge information might not have been relevant to them after some days anymore. Importantly, despite patients' decline in memory with the time, we found positive effects of information structuring on patients' adherence even after 30 days. Moreover, patients in the S group recommended their physician more strongly to family and friends in comparison to patients in the E group.

These results suggest that communication training in S is beneficial for patients' recall of discharge communication. Notably, there was no trade-off: Despite our hypothesis that E would outperform S in terms of patient satisfaction, we found a ceiling effect in both groups. In the most relevant domain "recommendation of the physician" patients in the S group gave significantly higher ratings than patients in the E group. Furthermore, patients in the S group were able to translate their improved immediate recall into better adherence in comparison to patients in the E group.

In sum, *manuscripts 2 & 3* show that information-structuring skills not only outperform a natural conversational style in a laboratory setting but they also outperform empathy skills in the real-life setting of an ED.

Summary and Conclusion

This dissertation contributes to a better understanding of history-taking (*manuscript one*) and discharge communication (*manuscripts two & three*) in the context of an acute care setting, namely an ED.

In *manuscript one*, we studied the quality and usability of history-taking with a web-based software. In *manuscripts two & three,* we followed the call of a recent study by exploring an innovative teaching intervention and its impacts on patient comprehension and outcomes (Alberti & Nannini, 2013). *Manuscript two* explored the effects of information structuring on recall of discharge information in a highly standardized laboratory setting. Specifically, we investigated the benefits of information structuring, its interplay with pre-existing medical knowledge, and its potential trade-offs on participants' satisfaction in proxy-patients. *Manuscript three* focused on the effects of information structuring on ED patients' recall of discharge information, satisfaction and adherence to recommendations. In all manuscripts, we put our emphasis on understanding and improving communication in healthcare.

The novel contribution of this dissertation is twofold: First, it shows that the usability of a web-based software is excellent in patients presenting to the ED with acute but not life-threatening complaints. Because the current version of the software should be used to gather ancillary information of patients' medical history only, further research is needed to improve the algorithm of the software. Second, it shows that information structuring is a communication skill that can be taught to and applied by physicians. Importantly, the use of information structuring by physicians translates into better recall, satisfaction and adherence in ED patients.

Although further research is needed to fully understand the mechanisms behind the benefits of information structuring, the positive findings in patient outcomes resulted already in the continuation of communication-skills trainings for physicians at the UHBS. Additionally, medStandards, the clinical decision support tool of the UHBS, has been adapted according to

our conclusions, focusing more on structuring of discharge communication. Therefore, I believe this dissertation makes a significant contribution to understand and improve communication in healthcare for the scientific community and to physician–patient communication in daily practice.

References

Ackermann, S., Ghanim, L., Heierle, A., Hertwig, R., Langewitz, W., Mata, R., & Bingisser, R. (2016). Information structuring improves recall of emergency discharge information: A randomized clinical trial. *Psychology, Health & Medicine*, *22*(6), 646–662. https://doi.org/10.1080/13548506.2016.1198816

Alberti, T. L., & Nannini, A. (2013). Patient comprehension of discharge instructions from the emergency department: A literature review. *Journal of the American Academy of Nurse Practitioners*, *25*(4), 186–194. https://doi.org/10.1111/j.1745-7599.2012.00767.x

Bachman, J. W. (2003). The patient-computer interview: A neglected tool that can aid the clinician. *Mayo Clinic Proceedings*, *78*(1), 67–78. https://doi.org/http://dx.doi.org/10.4065/78.1.67

Barth, J., & Lannen, P. (2011). Efficacy of communication skills training courses in oncology: A systematic review and meta-analysis. *Annals of Oncology*, *22*(5), 1030–1040. https://doi.org/10.1093/annonc/mdq441

Butz, J. A., Miller, S. P., & Butz, C. (2005). Effect of post-organizers on preservice teachers' content knowledge and understanding of effective teaching behaviors. *Teacher Educator*, *41*(1), 1–15. https://doi.org/10.1080/08878730509555368

Byrne, G., & Robert, H. (1996). Patient anxiety in the accident and emergency department. *Jounral of Clinical Nursing*, *39*(6), 289–295. https://doi.org/https://doi.org/10.1111/j.1365-2702.1997.tb00317.x

Cooley, W. C., McAllister, J. W., Sherrieb, K., & Kuhlthau, K. (2009). Improved outcomes associated with medical home implementation in pediatric primary care. *Pediatrics*, *124*(1), 358–364. https://doi.org/10.1542/peds.2008-2600

Crane, J. A. (1997). Patient comprehension of doctor-patient communication on discharge from the emergency department. *Journal of Emergency Medicine*, *15*(1), 1–7. https://doi.org/10.1016/S0736-4679(96)00261-2

Curtis, J. R., Back, A. L., Ford, D. W., Downey, L., Shannon, S. E., Doorenbos, A. Z., … Engelberg, R. A. (2013). Effect of communication skills training for residents and nurse practitioners on quality of communication with patients with serious illness: A randomized trial. *JAMA: Journal of the American Medical Association*, *310*(21), 2271–2281. https://doi.org/10.1001/jama.2013.282081

Dean, M., Oetzel, J., & Sklar, D. P. (2014). Communication in acute ambulatory care. *Academic Medicine*, *89*(12), 1617–1622. https://doi.org/10.1097/ACM.0000000000000396

Eisenberg, E. M., Murphy, A. G., Sutcliffe, K., Wears, R., Schenkel, S., Perry, S., & Vanaerhoef, M. (2005). Communication in emergency medicine: Implications for patient safety. *Communication Monographs*, *72*(4), 390–413. https://doi.org/10.1080/03637750500322602

Ekwall, A. (2013). Acuity and anxiety from the patient's perspective in the emergency department. *Journal of Emergency Nursing*, *39*(6), 534–538. https://doi.org/10.1016/j.jen.2010.10.003

Engel, K. G., Buckley, B. A., Forth, V. E., McCarthy, D. M., Ellison, E. P., Schmidt, M. J., & Adams, J. G. (2012). Patient understanding of emergency department discharge instructions: Where are knowledge deficits greatest? *Academic Emergency Medicine*, *19*(9), 1035–1044. https://doi.org/10.1111/j.1553-2712.2012.01425.x

Engel, K. G., Heisler, M., Smith, D. M., Robinson, C. H., Forman, J. H., & Ubel, P. A. (2009). Patient comprehension of emergency department care and instructions: Are patients aware of when they do not understand? *Annals of Emergency Medicine*, *53*(4), 454–461.e15. https://doi.org/10.1016/j.annemergmed.2008.05.016

Epstein, W. (1967). Some conditions of the influence of syntactical structure on learning: Grammatical transformation, learning instructions, and "chunking". *Journal of Verbal Learning and Verbal Behavior*, *6*(3), 415–419. https://doi.org/10.1016/S0022-

5371(67)80133-6

Fernando, B., Kalra, D., Morrison, Z., Byrne, E., & Sheikh, A. (2012). Benefits and risks of structuring and/or coding the presenting patient history in the electronic health record: Systematic review. *BMJ Quality and Safety*, *21*(4), 337–346. https://doi.org/10.1136/bmjqs-2011-000450

Hattie, J. (2008). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. New York: Routledge.

Hojat, M., Louis, D. Z., Markham, F. W., Wender, R., Rabinowitz, C., & Gonnella, J. S. (2011). Physicians' empathy and clinical outcomes for diabetic patients. *Academic Medicine*, *86*(3), 359–364. https://doi.org/10.1097/ACM.0b013e3182086fe1

International Organization for Standardization. (2016). Ergonomics of human-system interaction - Part 11: Usability: Definitions and concepts. *ISO/IEC*.

Johnson, A., & Sandford, J. (2005). Written and verbal information versus verbal information only for patients being discharged from acute hospital settings to home: Systematic review. *Health Education Research*, *20*(4), 423–429. https://doi.org/10.1093/her/cyg141

Kessels, R. P. C. (2003). Patients' memory for medical information. *Journal of the Royal Society of Medicine*, *96*(5), 219–222. https://doi.org/10.1258/jrsm.96.5.219

Kiessling, C., & Langewitz, W. (2013). The longitudinal curriculum "social and communicative competencies" within Bologna-reformed undergraduate medical education in Basel. *GMS Zeitschrift für medizinische Ausbildung*, *30*(3), 1–20. https://doi.org/10.3205/zma000874

Kim, S. S., Kaplowitz, S., & Johnston, M. V. (2004). The effects of physician empathy on patient satisfaction and compliance. *Evaluation and the Health Professions*, *27*(3), 237–251. https://doi.org/10.1177/0163278704267037

Kripalani, S., Jackson, A. T., Schnipper, J. L., & Coleman, E. A. (2007). Promoting effective transitions of care at hospital discharge: A review of key issues for hospitalists. *Journal*

of Hospital Medicine, *2*(5), 314–323. https://doi.org/10.1002/jhm.228

Kripalani, S., LeFevre, F., Phillips, C. O., Williams, M. V., Basaviah, P., & Baker, D. W. (2007). Deficits in communication and information transfer between hospital-based and primary care physicians. *JAMA: Journal of the American Medical Association*, *297*(8), 831. https://doi.org/10.1001/jama.297.8.831

Langewitz, W., Ackermann, S., Heierle, A., Hertwig, R., Ghanim, L., & Bingisser, R. (2015). Improving patient recall of information: Harnessing the power of structure. *Patient Education and Counseling*, *98*(6), 716–721. https://doi.org/10.1016/j.pec.2015.02.003

Lindner, T., Slangman, A., Senkin, A., Mocker, M., & Searle, J. (2015). Medical history of elderly patients in the emergency setting: Not an easy point-of-care diagnostic marker. *Emergency Medicine International*, 1–6. https://doi.org/http://dx.doi.org/10.1155/2015/490947

Livingston, A., Frankiewicz, R. G., & Williams, R. E. (1979). Faciliation of learning and repetition of oral instruction using advanced and post organizers. *Journal of Educational Psychology*, *71*(5), 701–707. https://doi.org/10.1037/0022-0663.71.5.701

Menendez, M. E., Chen, N. C., Mudgal, C. S., Jupiter, J. B., & Ring, D. (2015). Physician empathy as a driver of hand surgery patient satisfaction. *Journal of Hand Surgery*, *40*(9), 1860–1865. https://doi.org/10.1016/j.jhsa.2015.06.105

Ong, L. M., de Haes, J. C., Hoos, A. M., & Lammes, F. B. (1995). Doctor-patient communication: A review of the literature. *Social Science & Medicine (1982)*, *40*(7), 903–918. https://doi.org/10.1016/0277-9536(94)00155-M

Powers, R. D. (1988). Emergency department patient literacy and the readability of patient-directed materials. *Annals of Emergency Medicine*, *17*(2), 124–126. https://doi.org/10.1016/S0196-0644(88)80295-6

Rao, J. K., Anderson, L. a, Inui, T. S., & Frankel, R. M. (2007). Communication interventions make a difference in conversations between physicians and patients: A systematic review

of the evidence. *Medical Care*, *45*(4), 340–349. https://doi.org/10.1097/01.mlr.0000254516.04961.d5

Rhodes, K. V, Lauderdale, D. S., Stocking, C. B., Howes, D. S., & Roizen, M. F. (2001). Better health while you wait : A controlled trial of a computer-based intervention for screening and health promotion in the emergency department. *Annals of Emergency Medicine*, *37*(3), 284–291. https://doi.org/https://doi.org/10.1067/mem.2001.110818

Rhodes, K. V, Vieth, T., He, T., Miller, A., & Howes, D. S. (2004). Resuscitating the physician-patient relationship: Emergency department communication in an academic medical center. *Annals of Emergency Medicine*, *44*(3), 262–267. https://doi.org/10.1016/j.annemergmed.2004.02.035

Safwenberg, U., Terént, A., & Lind, L. (2007). The emergency department presenting complaint as predictor of in-hospital fatality. *European Journal of Emergency Medicine*, *14*(6), 324–331. https://doi.org/10.1097/MEJ.0b013e32827b14dd

Samuels-Kalow, M. E., Stack, A. M., & Porter, S. C. (2012). Effective discharge communication in the emergency department. *Annals of Emergency Medicine*, *60*(2), 152–159. https://doi.org/10.1016/j.annemergmed.2011.10.023

Street, R. L. (2013). How clinician-patient communication contributes to health improvement: Modeling pathways from talk to outcome. *Patient Education and Counseling*, *92*(3), 286–291. https://doi.org/10.1016/j.pec.2013.05.004

Tam, V. C., Knowles, S. R., Cornish, P. L., Fine, N., Marchesano, R., & Etchells, E. E. (2005). Frequency, type and clinical importance of medication history errors at admission to hospital: A systematic review. *Canadian Medical Association Journal*, *173*(5), 510–515. https://doi.org/10.1503/cmaj.045311

Taylor, D. M. D., Wolfe, R., & Cameron, P. A. (2002). Complaints from emergency department patients largely result from treatment and communication problems. *Emergency Medicine*, *14*(1), 43–49. https://doi.org/10.1046/j.1442-2026.2002.00284.x

Traupmann, K. L. (1975). Effects of categorization and imagery on recognition and recall by process and reactive schizophrenics. *Journal of Abnormal Psychology*, *84*(4), 307–314. https://doi.org/10.1037//0021-843X.84.4.307

Vashi, A., & Rhodes, K. V. (2011). "Sign right here and you're good to go": A content analysis of audiotaped emergency department discharge instructions. *Annals of Emergency Medicine*, *57*(4), 315–322.e1. https://doi.org/10.1016/j.annemergmed.2010.08.024

Villanueva, T. (2010). Transitioning the patient with acute coronary syndrome from inpatient to primary care. *Journal of Hospital Medicine*, *5*(SUPPL. 4), 8–14. https://doi.org/10.1002/jhm.829

Williams, D. M., Counselman, F. L., & Caggiano, C. D. (1996). Emergency department discharge instructions and patient literacy: A problem of disparity. *American Journal of Emergency Medicine*, *14*(1), 19–22. https://doi.org/10.1016/S0735-6757(96)90006-6

Zakim, D. (2016). Development and significance of automated history-taking software for clinical medicine, clinical research and basic medical science. *Journal of Internal Medicine*, *280*(3), 287–299. https://doi.org/10.1111/joim.12509

Zolnierek, K. B. H., & DiMatteo, M. R. (2009). Physician communication and patient adherence to treatment: A meta-analysis. *Medical Care*, *47*(8), 826–834. https://doi.org/10.1097%2FMLR.0b013e31819a5acc

Manuscript one

Usability of a Web-based Software Tool for History Taking in the Emergency Department

Frey Renggli J*[1], Eken C*[1], Siegrist V[1,2], Nieves Ortega R[1], Nickel CH[1],Rosin C[1], Hertwig R[3], Bingisser R[1]

[1] Emergency Department, University Hospital Basel, Basel, Switzerland

[2] Center for Cognitive and Decision Sciences, University of Basel, Basel, Switzerland

[3] Center for Adaptive Rationality, Max Planck Institute for Human Development, Berlin, Germany

Author note

Correspondence concerning this article should be addressed to Roland Bingisser, Emergency Department, University Hospital Basel, Petersgraben 2, 4031 Basel, Switzerland. Tel.: +41-(0)61-265-58-30. E-mail: roland.bingisser@usb.ch.

ABSTRACT

Background

Medical history taking is an important step within the diagnostic process. Despite the many advances in electronic documentation including the possibility of patient recorded histories, medical history taking has not undergone much change.

Objective

The aim of this study was to assess the quality and usability of a web-based software tool (app) for medical history taking in the emergency department.

Methods

Eligible patients were consecutively recruited during a study period of three weeks. Patients and junior physicians filled out study questionnaires assessing the usability (i.e. effectiveness, satisfaction and efficiency) of a web-based software tool for medical history taking. Senior physicians rated the quality of medical histories taken by junior physicians and the app.

Results

Out of 629 screened patients, 241 were eligible for further analysis. During intervention, junior physicians (n = 28) received helpful information from a source other than their own medical history in 65.7% ($p < .01$). Satisfaction regarding the care of patients remained unaffected by the use of the web-based software tool in both patients and junior physicians. Senior physicians rated medical histories as more complete when the app was used by patients in comparison to conventional history taking alone ($p < .01$). However, the app was perceived as less accurate in comparison to medical histories taken by junior physicians for the categories “history of present illness” and “medication”.

Conclusions

The studied web-based software tool showed an excellent usability in emergency patients who were not in need of immediate medical attention. Nevertheless, the current version of the app should be used to gather ancillary information rather than substituting medical history taking by physicians.

1. INTRODUCTION

Improvements in healthcare have mostly relied on technological advances.[1] So far, progress was made mainly in the fields of clinical chemistry (e.g., early detection of myocardial infarction), imaging (e.g., early detection of tumours) and interventions (e.g., molecular targeting in cancer treatment). However, certain areas in clinical medicine are still in need of research and improvement, such as the very beginning of the diagnostic process, namely medical history taking.[2]

Medical history taking is a pivotal step in the diagnostic process. It has not undergone much change since Hippocrates[3], except for the tools used for recording. Electronic documentation of medical history is nowadays common practice, but there is insufficient evidence for the benefits of structuring and/or coding patient histories using electronic applications.[4] Several factors, such as the resources available, the differences between information given and recorded, and the delays in recording, may contribute to this lack of evidence: First, the time available for direct patient contact has substantially decreased.[5] Second, physicians tend to screen information according to their experience, emphasising information useful for immediate decision-making; e.g., focusing on common specific symptoms, such as chest pain, and potentially underreporting nonspecific symptoms, such as weakness.[6,7] Third, documentation is often not synchronized with history taking. Such delayed documentation is hampered by working memory capacity.[8] As soon as new information becomes apparent, such as results of imaging or blood work, physicians are prone to deviate from their unbiased histories. Furthermore, repetitive questioning of patients, common in teaching hospitals, may alter the memories of patients.[9] These problems may even exacerbate under circumstances of high stress to patients and caregivers, such as in the emergency setting.[10] Thus, a standardised medical history taken by the patient himself with the support of a web-based software tool might help overcome some of the stated problems and improve the quality of care.

Quality can be defined as the degree to which a set of inherent characteristics fulfils requirements.[11] In medicine, requirements are usually defined by experts outlining indicators that can be measured and compared to a specific target.[12] Quality can be measured using different dimensions, such as patient satisfaction, effectiveness (i.e. achieving an expected result), or completeness of measures taken or information recorded.[13] Obviously, there is a complex interaction between patient satisfaction, requirements defined by experts, and efficiency (i.e. achieving a result with minimum expenditure).[14] Usability is a concept taking into account that satisfaction, effectiveness and efficiency interact[15], optimal usability being achieved if all three components are perfectly aligned.

The goal of the study was to investigate the quality and the usability of a web-based software tool (app) for medical history taking, adding measures of efficiency, in a cohort of patients with lower acuity presenting to an urban emergency department (ED). Additionally, we compared patients' and physicians' satisfaction regarding care in both junior physician- (i.e., conventional) and patient-generated- medical history taking. It has been shown that patient recorded histories are highly accurate[16,17] and that patients are more likely to write down intimate details rather than share them with their physicians.[18] Thus, we hypothesised that quality defined by the primary endpoint of effectiveness of information gathering, would increase when using an app for medical history taking. Since people tend to have a preference for the current state of affairs (i.e., status quo bias[19])[20], satisfaction might decrease in patients and physicians. So far, only the feasibility of such app has been reported,[21] but quality and usability were never assessed in an emergency setting.

2. METHODS

2.1 Study Population

Patients presenting to the ED were included in the study during a period of 3 weeks if they spoke English or German and gave informed consent. We excluded patients in need of immediate medical attention (Emergency Severity Index,[22] ESI 1-2) or with minor complaints who did not require any resources (ESI 5). Patients with an ESI score of 3 or 4 were seated in the waiting room of the ED, where screening for the study took place 24/7. The study was approved by the regional ethics committee (EKNZ 2016-02091).

2.2 Patient-Generated Medical History Taking Application

We used a commercially available web-based software tool (app) named *Sublimd,* provided by a medtech company (sublimd.com). This app is available in English and German and proposes specific questions to patients in order to generate their medical histories. The content of the app, 150 presenting symptoms with over 3,000 corresponding questions, was aligned with the protocols provided by *medStandards* (www.medstandards.com), a decision support tool owned by the University Hospital Basel, Switzerland, providing over 1'300 diagnostic and therapeutic protocols and algorithms based on current medical evidence and clinical guidelines.

As patients answered the questions presented by the app, the software dynamically adapted the selection of further questions. On this basis, detailed patient histories consisting of the presenting symptoms, medications, allergies, personal and family histories, as well as systematic history of symptoms were obtained. When all necessary information was gathered, the app automatically generated a written report of patients' medical histories.

2.3 Study Procedure

The study was designed as an intervention comparing a baseline (week 1: junior physicians performed history-taking and patients did not record their medical histories electronically) and an intervention (week 3: all included patients recorded their medical histories electronically, and junior and senior physicians had access to this information). Week 2 was a run-in period, in which patients recorded their medical histories on tablets, but only senior physicians had access to this information.

It is common practice in our ED that history taking is performed by junior physicians after patients are assigned a treatment bay in the ED: bedside questioning is followed by recording patients' medical histories in the electronic health record (EHR) system on nearby computers. All patient histories are presented to senior physicians by junior physicians.

The study process was adapted each week as follows (Figure 1): *Baseline* (week 1): Medical history taking was only carried out conventionally. *Run-in* (week 2): Patients received tablets to record their medical history. They were briefly instructed how to use the app by the study team. Junior physicians did not have access to the patient-generated histories, whereas senior physicians had access to those once junior physicians presented their patient histories. Thus, senior physicians rated the quality of patient- versus junior physician-generated medical histories on a visual analogue scale (VAS) from 0 to 10. Additionally, they selected history categories with missing information and rated how strongly the lack of this information would affect patients' successful treatment. *Intervention* (week 3): As in the run-in week, patients received tablets to record their medical histories and were briefly instructed how to use the app. In contrast, junior physicians now had access to the patient-generated histories before taking their own medical histories of patients. Senior physicians had access to both medical histories.

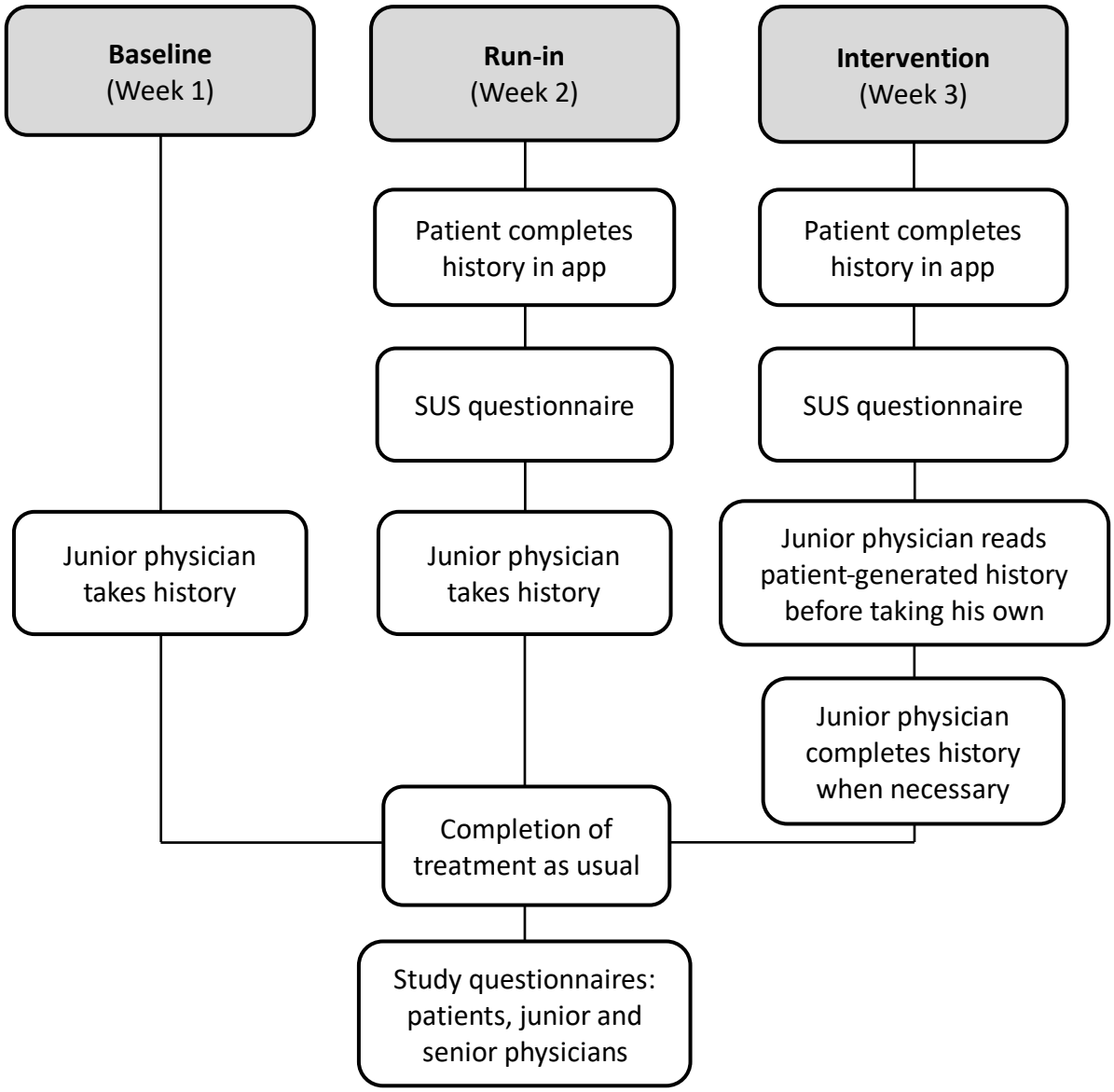


Figure 1. Flow chart showing the study procedure clustered by week.

2.4 Study Questionnaires

After ED work-up, all included patients and their physicians were asked to fill out different questionnaires on tablets, pertaining to the three components of usability: effectiveness, satisfaction and efficiency[15] (Table 1). Answers were given either on a VAS, typed-in numbers or as yes/no options. Questionnaires were translated into English using forward translation and reconciliation followed by back translation.[23]

Primary endpoint was the question "Have you obtained helpful information from another source than your own medical history?" in the junior physicians' questionnaire (Question 1, Table 1). This was defined as the key question testing effectiveness. Secondary outcomes were all remaining questions in the patients', junior and senior physicians' questionnaires. The questions 2-3 and 9-11 were asked to evaluate satisfaction. The effectiveness questions were numbered as 4-6 and 12-15. As a measure of efficiency, questions 7-8 and 16-17 were included in the questionnaires. Finally, questions 18 to 20 were added to measure and control for patients' digital experience. Additionally, senior physicians rated the completeness of the medical histories gathered by junior physicians, and the importance of missing information (questions 21-23).

During the run-in and intervention weeks, each patient completed the System Usability Scale (SUS) questionnaire.[24] The SUS is a ten-item questionnaire with five options (from "strongly agree" to "strongly disagree") measuring the overall usability of a system. Moreover, every junior physician completed the Technology Acceptance Model (TAM) questionnaire[25] at the end of the study period, which assesses how users accept and adopt a new technology. For our purpose, we only used the "perceived usefulness" part of the TAM (6 questions on a 7-Point Likert scale).

2.5 Statistical Analyses

Descriptive data are presented as mean values with standard deviation (*SD*) for normally distributed variables, median with first and third quartiles for non-normally distributed variables, or as absolute numbers and percentages of the study population for categorical variables. Chi-squared Test and Fisher's Exact Test were used for hypothesis testing in count data.

Generalised linear regression analysis with negative binomial distribution was used to model the association between continuous dependent variables (questionnaire answers) and the study groups. Logistic regression analysis was performed for binary variables. A multivariate adjusted analysis included the covariates: age, sex and years of experience of the junior physicians. Model assumptions were tested using diagnostic plots. Results were expressed as estimates with standard errors (SE) and *p*-values. An odds ratio with confidence interval (CI) was calculated when applicable. A *p*-value of $< .05$ was considered statistically significant. All calculations were made using the statistical software R version 3.3.2 (https://www.R-project.org).

3. RESULTS

3.1 Study Population

During the study period of 3 weeks, 629 patients were screened of which 320 were enrolled in the study (Figure 2). Exclusion rate was 49.1%: the main reasons for these 309 exclusions were "declined without reason statement" (43.4%), "symptoms did not allow participation" (22.3%), and "language barrier" (15.9%). Three patients mentioned data safety concerns. Out of the 320 patient files, 241 were complete and therefore used for further analysis. Demographic characteristics in each study period are shown in Table 2. There was a significant

difference in median age between included (median = 41 years) and excluded patients (median = 51 years) ($p < .05$).

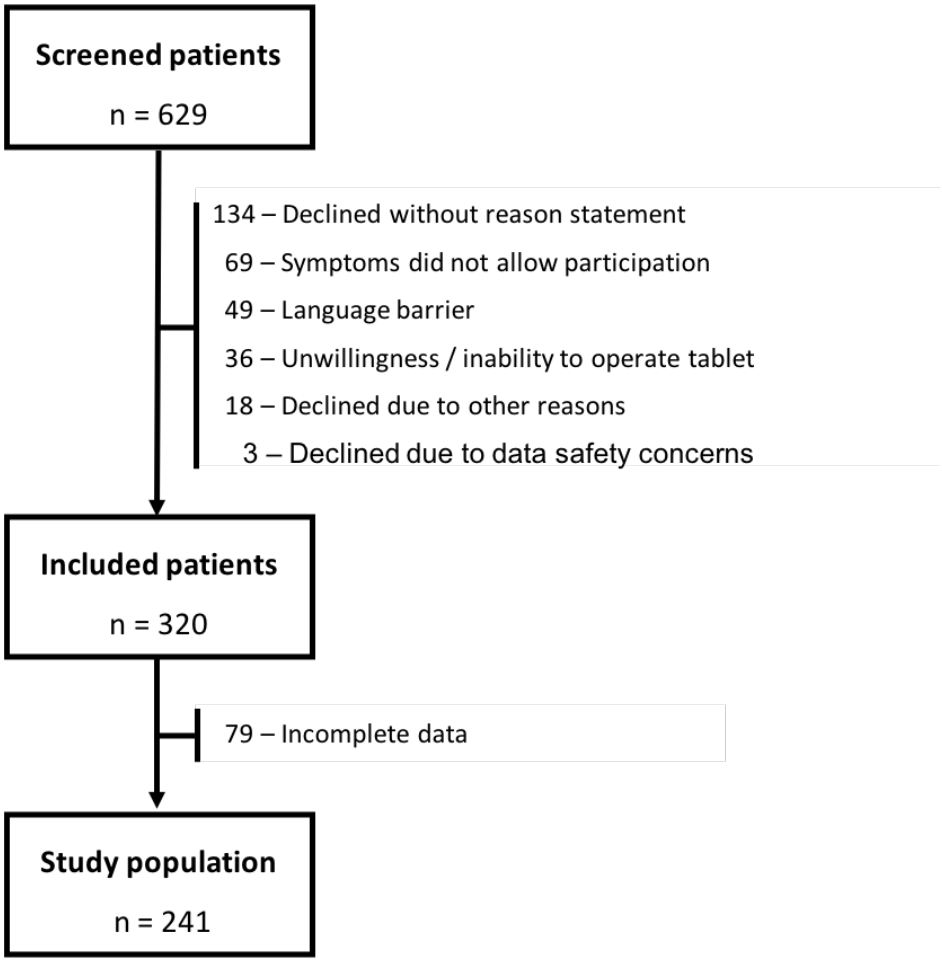


Figure 2. Patient inclusion flow chart.

Table 2

Study population – Demographics clustered by study period

Week	**n (%)**	**Age median**	**Male sex, n (%)**
Baseline	86 (35.7)	48.5	49 (57.0)
Run-in	85 (35.3)	42.0	39 (45.9)
Intervention	70 (29.1)	39.5	34 (48.6)
Total	241	41.0	122 (50.6)

3.2 Endpoints

As primary endpoint, junior physicians (n = 28) stated that they obtained helpful information from another source than their own medical histories in 46 cases (65.7%) in the intervention week, as opposed to 24 cases (34.3%) in the baseline week ($p < .01$) (Table 1), corresponding to an odds ratio of 2.5 (CI = 1.3 - 5.1) using an adjusted regression model.

Ratings of satisfaction showed to be high in the baseline and the intervention week, resulting in a ceiling effect (Table 1). Accordingly, there was no significant difference in satisfaction ratings between baseline and intervention.

Physicians rated their confidence in their diagnoses with a median of 8.4 (Q1 = 6.0, Q3 = 10.0) in the baseline and with 9.1 (Q1 = 7.1, Q3 = 10.0) in the intervention ($p = .23$; Table 1). During the intervention, physicians answered that they have been able to obtain all relevant information from patient-generated histories in 48.6% of the cases. Additionally, they rated the ability to integrate the information from the app in their workflow with a median of 7.4 (Q1 = 4.4, Q3 = 8.9) (Table 1).

Patients' effectiveness ratings were not significantly different between comparison weeks. Patients rated the helpfulness of the app to discuss essential points with their physicians

with a median of 7.5 (Q1 = 5.5, Q3 = 9.0). Additionally, 21.4% of the patients preferred disclosing information about sensitive topics to the app rather than talking to their physician. In this patient group 47% had a positive screening for high-risk alcohol consumption (i.e., AUDIT C Score[26]), and 29% reported drug abuse.

Regarding efficiency, junior physicians rated that the app reduced their workload in 54.3% of the cases during intervention. Additionally, the potential of the patient-generated histories to be used as EHR documentation was rated high with a median of 8.1 (Q1 = 7.1, Q3 = 9.1) (Table 1). For patients, there was no change in efficiency between baseline and intervention.

Senior physicians rated the medical histories gathered by junior physicians as significantly more complete during the intervention (median = 10; Q1 = 9, Q3 = 10) as compared to the baseline (median = 10; Q1 = 8, Q3 = 10; $p < .01$). When rating the importance of the information missing in the medical histories, no significant difference was found between weeks ($p = .07$; Table 1).

The median SUS score for patients (n = 141 completed questionnaires) using the app was 82.5 (Q1 = 65.0, Q3 = 90.0), showing excellent usability for the app. The TAM score for physicians was a mean of 5.1 (*SD* = 1.1) on a 7-Point Likert-scale, showing a good acceptance of the app.

3.3 Comparison of Medical Histories Taken by Web-Based Software Tool versus Junior-Physicians

85 pairs of independent patient and physician histories were rated for completeness by senior physicians during the run-in week. Percentages of histories with missing information in the categories “history of present illness”, “social history”, “personal history”, “medications”, “review of systems”, “family history”, “health habits” and “allergies” are shown in Figure 3.

Results showed that the category "history of present illness" was perceived as significantly less accurate for medical histories taken by the app in comparison to those taken by junior physicians (information missing in 49.4% versus 14.1%, $p < .01$), while "social history" was significantly more complete in the app in comparison to physicians' histories (2.4% versus 8.2% incomplete histories, $p < .01$). Although not significant, the app showed a trend towards higher completeness in the remaining categories except for "medications".

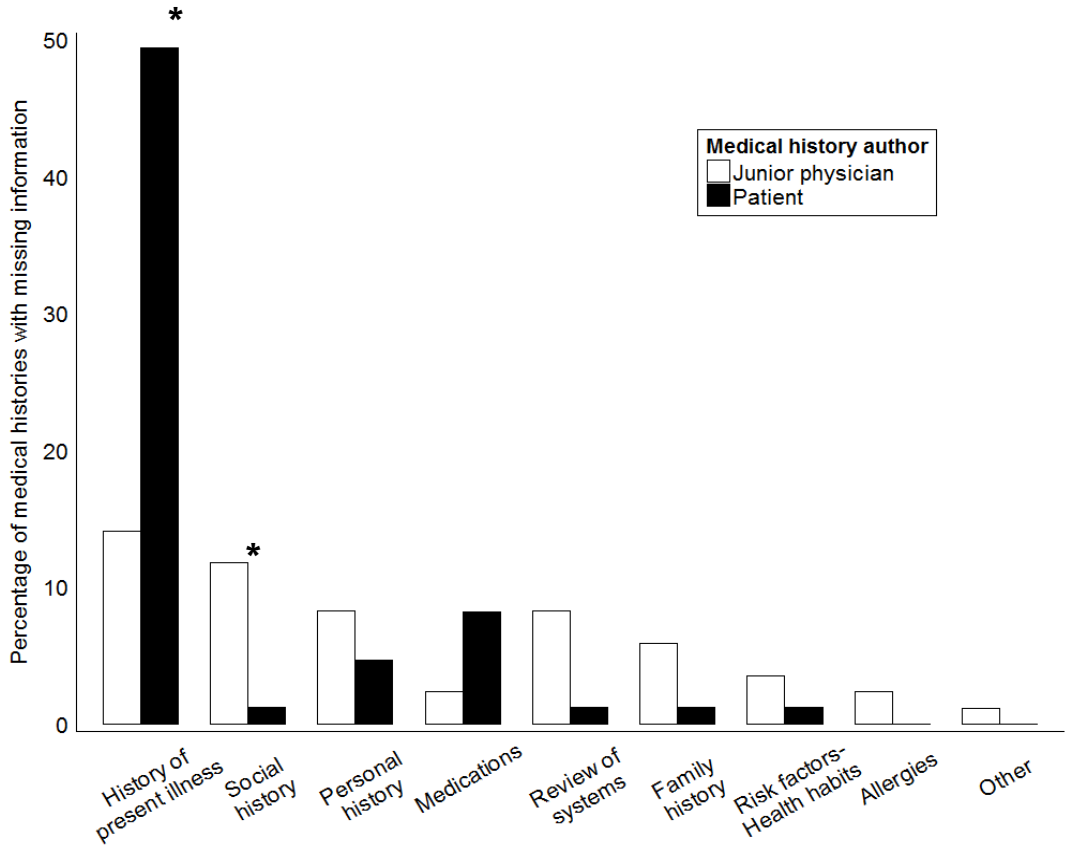


Figure 3. Missing information in medical histories. In the run-in week, senior physicians rated whether information was missing in each section of the junior physicians' and patients' self-taken medical histories. Percentages were calculated over the total number of histories evaluated by senior physicians. Histories were gathered independently. *$p < .01$.

4. DISCUSSION

The main results are the confirmation of effectiveness, evidence of increased efficiency, and an excellent usability in the investigated web-based software tool for medical history taking. Previous studies showed the feasibility and the relative increase in standardised information gathered by the use of a history taking application;[17,21,27-29] this was confirmed by our data.

The following results merit discussion: First, effectiveness was tested using the primary outcome of "obtaining helpful information". This outcome clearly focused on physicians' requirements. In light of the importance of the diagnostic process in the emergency setting, this should not be underestimated. Physicians must be effective at information gathering, as the consequence of incomplete or missing information may be a diagnostic error. It is therefore crucial to improve the diagnostic process and to reduce diagnostic errors that has been linked to cause up to 10% of total mortality.[30] A recent report stated that "although health IT has the potential to improve diagnosis and reduce diagnostic errors, many experts are concerned that it currently is not effectively facilitating the diagnostic process and may even be contributing to errors".[31] However, in our study, junior physicians felt significantly more confident about their diagnoses if supported by the patient-generated history. This effect might be explained by the more systematic approach of a web-based software tool for medical history taking, by reduced workload, and by ancillary information adding pieces to the diagnostic puzzle. Junior physicians also reported a high ability to integrate the app into their workflow, and specifically to use the patient-generated history as documentation in the EHR. Furthermore, senior physicians considered the patient-generated history in combination with the physician-generated history to be superior to either one alone.

Second, there was some evidence for increased efficiency in the history taking process, as the majority of the junior physicians reported a decreased workload using the app. Of note, perceived waiting times were unchanged when patients used the app.

Third, to our surprise, satisfaction did not decrease in patients. There was no trade-off between efficiency and satisfaction with the care patients received from their doctor.

Fourth, usability scores showed excellent values taken from the patients' perspective. Usability should not be measured using a single test only, but effectiveness, satisfaction, and efficiency need to be jointly appraised. All three dimensions, though not perfectly aligned, were rated higher in the intervention phase in comparison to the baseline.

Senior physicians stated that important information was missing when comparing the patient-generated with the junior physician-generated medical histories. Interestingly, "history of present illness" and "medications" were superior in the junior-physicians' histories.

Nevertheless, patients' health status or restraint to use a tablet, as well as limitations regarding the completeness of the category "history of presenting illness" may hinder the use of this app.

Indeed, there are several limitations to this study: First, this is a single centre study. However, our population is comparable to other European urban EDs regarding case mix,[22] hospitalisation rate (> 30%) and immigrant population (> 30%).[6-7] Despite the moderate number of participants included in the study, the large effect size allows to confirm the hypothesis regarding the primary endpoint.

Second, the number of exclusions was higher than in another recent study,[32] possibly due to the use of a tablet, particularly daunting to the older population. Of note, median age of patients declining to participate was ten years higher as compared to the included population. Obviously, younger patients are more experienced in the use of tablets or other technology and

may therefore be overrepresented in our study. Nevertheless, the oldest patient taking part in this study was 85 years old.

Third, even though a medically trained study team was present in three shifts around the clock, recruiting patients arriving late at night was challenging. One might speculate that night-shift patients are different from other emergency patients as to willingness to participate in a study. However, recruitment during night-time is rarely attempted in such study designs.

Finally, the application was available in English and German only. Surprisingly, we did not have to exclude more than 8% of the patients due to language barriers – our expectation being around 30% due to the large immigrant population in Basel, Switzerland. The limited amount of languages offered did lead to the exclusion of some patients, but the potential for future applications offering a selection of languages is apparent: to reach patients who do not speak one of the languages spoken by the physicians.

4.1 Conclusions

Taken together, a patient-generated medical history using a web-based software tool with a tablet resulted in excellent usability in an emergency population of lower acuity. However, its use in the current form is limited by shortfalls in the categories “history of present illness” and “medication”. Therefore, its potential remains in gathering ancillary information rather than substituting history taking by physicians. It is evident that physicians focus on the diagnostic process, such as gathering complete information in order to reduce diagnostic error, while patients may rather focus on conveying information deemed important and on receiving information facilitating the transition process.[33] Thus, such apps could help to save the physicians’ time and simultaneously benefit the patients’ need to convey all information they consider important.

REFERENCES

1. Bingisser R, Nickel CH. The last century of symptom-oriented research in emergency presentations--Have we made any progress? Swiss Medical Weekly 2013;143:w13829.

2. Pincus T, Yazici Y, Swearingen CJ. Quality control of a medical history: Improving accuracy with patient participation, supported by a four-page version of the multidimensional health assessment questionnaire (MDHAQ). Rheumatic Diseases Clinics of North America 2009;35:851-60, xi.

3. Srinivasan M. From the editors' desk: Hippocrates and patient-centered medicine. Journal of General Internal Medicine 2012;127:135.

4. Fernando B, Kalra D, Morrison Z, Byrne E, Sheikh A. Benefits and risks of structuring and/or coding the presenting patient history in the electronic health record: Systematic review. BMJ Quality and Safety 2012;21:337-346.

5. Meyer BR, Golder L, Longchamp C. Administrativer Aufwand für Ärzte steigt weiter an. Schweizerische Ärztezeitung 2016:6-8.

6. Bingisser R, Dietrich M, Nieves Ortega R, Malinovska A, Bosia T, Nickel CH. Systematically assessed symptoms as outcome predictors in emergency patients. European Journal of Internal Medicine 2017;45:8-12.

7. Weigel K, Nickel CH, Malinovska A, Bingisser R. Symptoms at presentation to the emergency department: Predicting outcomes and changing clinical practice? International Journal of Clinical Practice 2017;72:e13033.

8. Oberauer K, Farrell S, Jarrold C, Lewandowsky S. What limits working memory capacity? Psychological Bulletin 2016;142:758-799.

9. Loftus EF. Planting misinformation in the human mind: A 30-year investigation of the malleability of memory. Learning & Memory 2005;12:361-366.

10. Westbrook JI, Raban MZ, Walter SR, Douglas H. Task errors by emergency physicians are associated with interruptions, multitasking, fatigue and working memory capacity: A prospective, direct observation study. BMJ Quality and Safety 2018;bmjqs-2017

11. Standardization IOf. ISO 9000 : International standards for quality management. Genève, Switzerland 1992.

12. McGlynn EA, Asch SM, Adams J, et al. The quality of health care delivered to adults in the United States. New England Journal of Medicine 2003;348:2635-2645.

13. Howell V, Schwartz AE, O'Leary JD, Mc Donnell C. The effect of the SQUIRE (Standards of QUality Improvement Reporting Excellence) guidelines on reporting standards in the quality improvement literature: A before-and-after study. BMJ Quality and Safety 2015;24:400-406.

14. Porter ME. What is value in health care? New England Journal of Medicine 2010;363:2477-2481.

15. Standardization IOf. Ergonomics of human-system interaction — Part 11: Usability: Definitions and concepts. 2016.

16. Brodman K, Erdmann AJ, Jr., et al. The Cornell medical index; a adjunct to medical interview. Journal of the American Medical Association 1949;140:530-534.

17. Zakim D. Development and significance of automated history-taking software for clinical medicine, clinical research and basic medical science. Journal of Internal Medicine 2016;280:287-299.

18. Turner CF, Ku L, Rogers SM, Lindberg LD, Pleck JH, Sonenstein FL. Adolescent sexual behavior, drug use, and violence: Increased reporting with computer survey technology. Science 1998;280:867-873.

19. Samuelson W, Zeckhauser R. Status quo bias in decision making. Journal of Risk and Uncertainty 1988;1:7-59.

20. Kim H-W, Kankanhalli A. Investigating user resistance to information systems implementation: A status quo bias perspective. Management Information Systems Quarterly 2009:567-582.

21. Benaroia M, Elinson R, Zarnke K. Patient-directed intelligent and interactive computer medical history-gathering systems: A utility and feasibility study in the emergency department. International Journal of Medical Informatics 2007;76:283-288.

22. Grossmann FF, Nickel CH, Christ M, Schneider K, Spirig R, Bingisser R. Transporting clinical tools to new settings: Cultural adaptation and validation of the Emergency Severity Index in German. Annals of Emergency Medicine 2011;57:257-264.

23. Wild D, Grove A, Martin M, et al. Principles of good practice for the translation and cultural adaptation process for Patient-Reported Outcomes (PRO) measures: Report of the ISPOR task force for translation and cultural adaptation. Value in Health 2005;8:94-104.

24. Brooke J. SUS - A quick and dirty usability scale. Usability evaluation in industry 1996;189:4-7.

25. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. Management Information Systems Quarterly 1989;13:319-340.

26. Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA. The AUDIT alcohol consumption questions (AUDIT-C): An effective brief screening test for problem drinking. Archives of Internal Medicine 1998;158:1789-1795.

27. Slack WV, Kowaloff HB, Davis RB, et al. Evaluation of computer-based medical histories taken by patients at home. Journal of the American Medical Informatics Association 2012;19:545-548.

28. Cullinan S, O'Mahony D, Byrne S. Application of the structured history taking of medication use tool to optimise prescribing for older patients and reduce adverse events. International Journal of Clinical Pharmacy 2016;38:374-379.

29. Doerr M, Edelman E, Gabitzsch E, Eng C, Teng K. Formative evaluation of clinician experience with integrating family history-based clinical decision support into clinical practice. Journal of Personalizes Medicine 2014;4:115-136.

30. Shojania KG, Burton EC, McDonald KM, Goldman L. Changes in rates of autopsy-detected diagnostic errors over time: A systematic review. Journal of the American Medical Association 2003;289:2849-2856.

31. Improving diagnosis in health care. Military Medicine 2016;181:183-185.

32. Rohacek M, Nickel CH, Dietrich M, Bingisser R. Clinical intuition ratings are associated with morbidity and hospitalisation. International Journal of Clinical Practice 2015;69:710-717.

33. Ackermann S, Ghanim L, Heierle A, et al. Information structuring improves recall of emergency discharge information: A randomized clinical trial. Psychology Health & Medicine 2017;22:646-662.

Table 1
Study questionnaires

	Baseline (n = 86)	Intervention (n = 70)	Estimate (SE)	*p*-value
Junior physicians				
1. Have you obtained helpful information from another source other than your own history?	No: 51.2%, Yes: 48.8%	No: 34.3%, Yes: 65.7%	0.92 (0.36)	< .01
2. How good was the interaction between you and your patient?	8.2 (6.9 - 9.4)	8.6 (7.3 - 9.8)	0.24 (0.17)	.18
3. How satisfied are you with how you cared for your patient?	7.7 (5.2 - 9.2)	8.2 (6.7 - 9.6)	0.26 (0.18)	.16
4. How certain are you about your patient's diagnosis?	8.4 (6.0 - 10.0)	9.1 (7.1 - 10.0)	0.25 (0.21)	.23
5. Have you obtained all relevant information for the care of your patient from the application?	-	No: 50.0%, Yes: 48.6%, NA: 1.4%	-	-
6. Could you integrate the information from the app in your workflow?	-	7.4 (4.4 - 8.9)	-	-
7. Has the program reduced your workload?	-	No: 45.7%, Yes: 54.3%	-	-
8. Is the medical history obtained through the app useful to be used as patient documentation?	-	8.1 (7.1 - 9.1)	-	-
Patients				
9. All in all, how satisfied were you with your ED stay today?	8.4 (6.4 - 9.9)	7.7 (6.5 - 10.0)	- 0.10 (0.25)	.69
10. How good was the interaction with your doctor?	9.2 (7.5 - 10.0)	9.3 (7.4 - 10.0)	0.02 (0.21)	.92
11. How satisfied are you with the care you received from your doctor?	8.9 (7.6 - 10.0)	9.2 (7.7 - 10.0)	0.14 (0.21)	.52
12. Were you able to give information about all your essential health issues?	9.0 (7.3 - 10.0)	9.2 (8.0 - 10.0)	0.20 (0.21)	.47
13. Do you think the program helped you discuss the essential points with your doctor?	-	7.5 (5.5 - 9.0)	-	-
14. Did you give the program sensitive information, which you might not have told your doctor?	-	No: 80.0%, Yes: 12.9%, NA: 7.1%	-	-
15. Would you give information regarding a sensitive topic to a tablet rather than to a doctor?	-	No: 62.9%, Yes: 21.4%, NP: 15.7 %	-	-
16. How did you experience today's waiting time in the ED?	3.7 (0.8 - 6.7)	3.1 (1.2 - 6.7)	- 0.04 (0.19)	.83
17. Please estimate how much time your doctor needed to take your medical history.	10 min (7.0 - 15.0)	10 min (5.0 - 19.8)	0.14 (0.17)	.42
18. Was the language of the program easy to understand?	-	No: 4.3%, Yes: 94.3%, NA: 1.4%	-	-
19. Do you use a computer or other related electronic devices, e.g., tablets or smartphones?	-	No: 10.0%, Yes: 88.6%, NA: 1.4%	-	-
20. In a typical day how long do you use a tablet or related electronical devices on a daily basis?	-	60 min (51 - 180)	-	-
Senior physicians				
21. Did the junior physician report all the essential information from the history?	10 (8 - 10)	10 (9 - 10)	0.78 (0.30)	< .01
22. In case information was missing, how strongly would they have negatively affected the care?	2 (1 - 8)	2 (1 - 3)	- 0.52 (0.28)	.07
23. Were important points missing from the patient's self-taken history?	-	No: 52.9%, Yes: 41.4%, NA: 5.7%	-	-

Note. Numeric answers are expressed as median with first and third quartiles. Categorical variables are expressed as percentage over the total answers. Regression estimates are shown with standard errors and *p*-values whenever comparisons between groups were made; SE = standard error, min = minutes, NA = not applicable, NP = no preference.

Manuscript two

Discharge Communication Using the Book Metaphor:

An Advance Organiser Reducing the Impact of Health Literacy on Recall

Victoria Siegrist[1,2], Wolf Langewitz[3], Rui Mata[2], Dominik Maiori[2,4], Ralph Hertwig[5], Roland Bingisser[1]

[1] Emergency Department, University Hospital Basel, Basel, Switzerland

[2] Center for Cognitive and Decision Sciences, University of Basel, Basel, Switzerland

[3] Department of Psychosomatic Medicine, University Hospital Basel, Basel, Switzerland

[4] Department of Digital Film Production, SAE Institute Zurich, Zurich, Switzerland

[5] Center for Adaptive Rationality, Max Planck Institute for Human Development, Berlin, Germany

Author note

Correspondence concerning this article should be addressed to Victoria Siegrist, Emergency Department, University Hospital Basel, Petersgraben 2, 4031 Basel, Switzerland. Tel.: +41-(0)61-328-71-89. E-mail: victoria.siegrist@usb.ch.

ABSTRACT

Objective

We investigated the effects of information structuring and its potential interaction with pre-existing medical knowledge on recall in a simulated discharge communication.

Methods

127 participants were randomly assigned to one of four conditions. Video vignettes provided identical information, differing in the means of information structuring only. The natural conversation (NC) condition was not explicitly structured whereas the structure (S) condition presented information organised by chapter headings. The advance organiser (AO) and the post organiser (PO) condition also presented structured information but in addition included a synopsis, either at the beginning or at the end of discharge communication, respectively. Participants' recall, perception of quality and medical knowledge were assessed.

Results

Information structuring (conditions: S, AO, PO) did not increase recall in comparison to the NC condition, but medical knowledge increased recall ($p = .001$). An interaction between medical knowledge and recall in the AO condition was found ($p = .02$). In comparison to the NC condition, participants in the information structuring conditions perceived information as more structured ($p < .001$) and they more strongly recommended the physician to family and friends ($p < .001$).

Conclusions

Structured discharge communication complemented by an AO is beneficial in individuals with lower pre-existing medical knowledge.

Practice Implications

The lower pre-existing medical knowledge the more recipients will profit from an advance organiser.

1. INTRODUCTION

Discharge from the emergency department (ED) is a crucial event often accompanied by stress and vulnerability. Patients' understanding of key aspects of post-discharge care is generally described as poor [1,2] yet strategies for fostering the transition are still little understood [3], with some authors advocating a 'resuscitation of physician–patient communication' [4]. For instance, recent evidence suggests no effect of electronic tools for discharge communication on readmission rates, adverse events or mortality [5,6]. Patients who cannot recall or comprehend discharge plans are vulnerable to risks of medical error, adverse events or failure to seek further help from healthcare providers [7]. Consequently, the ability to recall information provided during discharge is an indispensable condition for patients' informed decisions and well-being. Unfortunately, research suggests that patients' recall and comprehension is severely limited and can negatively impact their health-related choices [8,9]. As a result of ever increasing time constraints, patient-centred communication is severely under pressure. Scientific advances have accelerated diagnostic pathways and rendered possible 'fast-track' emergency care, such as the rapid exclusion of myocardial infarction [10]. Therefore, an expeditious diagnostic process needs to be matched by on-time and efficient discharge communication.

Structuring oral information has been shown to be a powerful tool for boosting memory and recall in educational settings [11], and pre-existing knowledge structures have been demonstrated to foster the processing and future recall of new information in standard memory experiments [12]. Less is known about the role of information structuring and pre-existing knowledge in the medical domain and, specifically, in the context of discharge communication. The structuring of information has been found to boost recall in simulated emergency discharge communications [13]. An early landmark study suggested providing patients with an initial and brief synopsis prior to the provision of the full and detailed information [14]. Analogous to the

table of contents of a book -we refer to this method as the 'book metaphor' [13,15]- recall of medical information may be improved. The book metaphor can be thought of as a specific implementation of an 'advance organiser' (AO) successfully used in educational contexts. Similarly, 'post organisers' (PO), synopses provided at the final stage of the process of information provision, may also foster patients' recall performance [16,17]. Crucially, there is some indication that patients with lower health literacy [18] may especially benefit from information structuring [15]. They benefit most from the provision of a scheme to represent and store information that is at least partly already available to individuals with higher health-literacy. So far, few studies have considered the possibility that information structuring can prove a facilitator in the process of conveying information to individuals with different levels of health literacy.

We examined the impact of information structuring in the context of discharge communication and its potential interaction with pre-existing medical knowledge. Specifically, we designed and presented four highly standardised video clips featuring a discharge communication in the ED to individuals with varying degrees of pre-existing medical knowledge. The three information-structuring videos simulated a discharge event involving the use of an advance organiser, a post organiser, and structured communication without an AO or a PO. These conditions were then compared to an unstructured communication event emulating a physician's natural conversation style. Our first objective was to assess the effect of information structuring on recall performance as well as any potential interaction with individuals' pre-existing medical knowledge. In addition, we tested for a possible trade-off between recall and patient perceptions of quality. Such a trade-off could mean that any benefits of structured communication come at the expense of lower satisfaction with the physician relative to a less structured but more natural conversation style.

2. METHODS

2.1 Participants

Participants were recruited via an online platform of the Department of Psychology, University of Basel, Switzerland. The study description spelled out inclusion criteria: less than 30 years of age, no hearing impairment, and native German speaker. Participants were reimbursed for their participation in terms of credit points or 7.50 Swiss Francs. The study was approved by the institutional review board of the Department of Psychology (015-16-1).

2.2 Study Material

The four video vignettes (Figure 1) depicted an ED physician, recorded from a first person's view. The physician was oriented toward an imaginary patient (the viewer). The patient had presented with chest pain to the ED and was to be discharged after a myocardial infarction could be ruled out. Further work-up was warranted. The study material (i.e., video vignettes) is available online at the following Open Science Framework workspace: osf.io/w5bpa.

In the natural conversation condition (*NC condition*), the same information as in the other conditions was presented but without any explicit structure. Segments were presented in a natural order, as judged by emergency physicians practising such routines on a daily basis. In the structure condition (*S condition*), the same segments were presented in the following well-defined order with additional chapter headings according to the mnemonic acronym InFARcT: **In**formation on diagnosis (In), **F**ollow-up suggestions (F), **A**dvice on self-care (A), **R**ed flags (R), and **c**omplete **T**reatment (cT) [19]. In the advance organiser plus structure condition (*AO condition*), an AO preceded the same sequence of segments: 'We will now talk about the

following five topics…'. In the post organiser plus structure condition (*PO condition*), the sequence of segments was concluded with a PO: 'We have just talked about the following five topics…'.

All videos featured an emergency physician who presented the identical set of 42 utterances (see appendix). The videos employed the same footage and differed only by means of information structuring (i.e., order of the information, chapter headings, and the organiser). Each of the different video segments consisted of one to six utterances. The individual segments were interrupted by black screens of 0.8 sec duration in order to permit the organisation of the segments in the defined orders. The duration of the video clips was 3:52 min (NC condition), 4:23 min (S condition) and 4:46 min (AO condition and PO condition). The differences in duration can be fully explained by the means of information structuring. The additional provision of chapter headings took 31 sec and the provision of a synopsis took 24 sec. Although there was a time difference of up to 55 sec between conditions, the additional elements of information structuring did not provide any additional information.

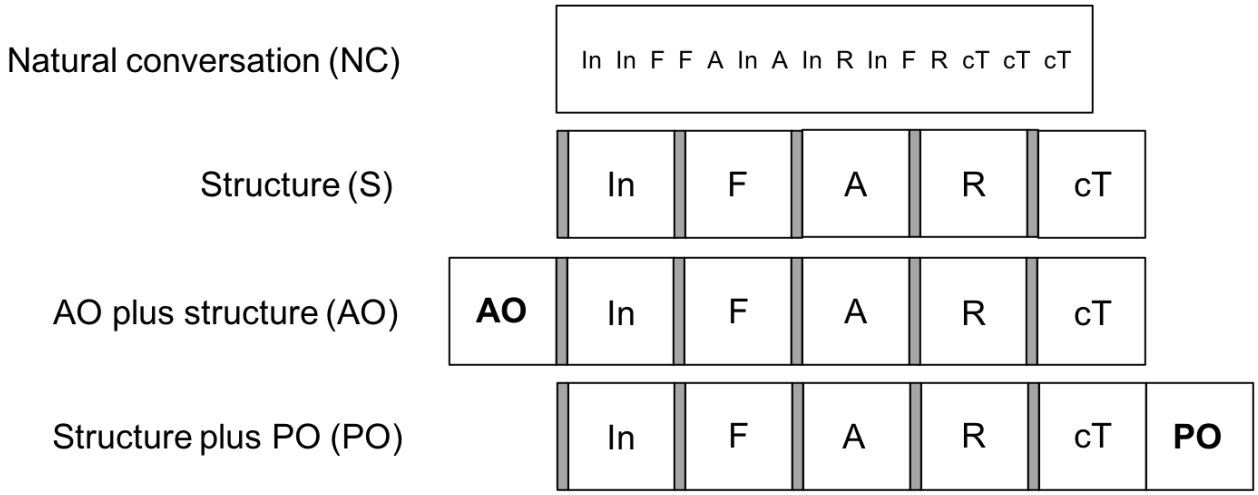


Figure 1. A schematic overview of the four video vignettes: The natural conversation condition did not include any means of information structuring. The structure condition already structured the information according to the InFARcT scheme of Ackermann and colleagues and used 'chapter headings'. The advance and post organizer conditions additionally included a synopsis, once given in the beginning (AO) and once at the end of the discharge video (PO), respectively. The grey bars represent the provision of a chapter heading.

2.3 Study Protocol

Participants gave their informed consent before the study began. After signing informed consent, they were randomly assigned to one of the four conditions. They were instructed to adopt a patient's perspective and to evaluate the discharge communication depicted in the video. After the presentation of the discharge video, individually on computer screens, participants rated the discharge communication on four dimensions, using visual analogue scales (VAS). The VAS ranged from 0 to 10 and the dimensions were (1) how easy to understand was the communication?, (2) how structured was the communication?, (3) how informative was the communication?, and (4) how much would you recommend the physician

to family and friends?. After their evaluation of the quality of discharge communication, participants were asked to write down all the information that they could remember from discharge. The minimum recall period was a time-slot of 5 min. No participant extended the recall period beyond these 5 min. Furthermore, a questionnaire probed participants' pre-existing medical knowledge (see appendix). It consisted of a 12-item multiple-choice test that was validated in a pilot study, using undergraduate year 1 psychology students and undergraduate year 1 and year 3 medical students. Finally, demographic data and control variables (e.g. what is your native language?) were recorded.

2.4 Transcript Coding

The occurrence of an element from the 42 utterances was coded by comparing participants' entries into their memory protocol with the information given. We examined intercoder reliability between two raters, using a subset of 40 participants. Intercoder reliability refers to the extent to which two independent coders agree on the coding of utterances in question, assuming the same coding scheme [20]. The intraclass correlation (ICC) for the total amount of utterances recalled was very high (ICC = .95).

2.5 Statistical Analyses

All analyses were performed using the software R (Version 3.4.1). We calculated a multiple regression analysis with number of utterances recalled as the dependent variable, and degree of pre-existing medical knowledge and condition as independent variables. The NC condition was taken as the comparison condition. Pre-existing medical knowledge and condition were entered as an interaction into the model. Pre-existing medical knowledge was

centred to the mean knowledge of participants in order to make the estimates easier to interpret. We also calculated Pearson correlation coefficients between the number of utterances recalled and the medical knowledge score to quantify the degree of association between these two variables. Additionally, we computed linear regressions for all four measurements of participants' subjective ratings of quality, with condition as independent variable. A *p*-value of $p<.05$ was considered statistically significant. The data analysis script, data, and the coding scheme are available online at the following Open Science Framework workspace: osf.io/w5bpa.

3. RESULTS

3.1 Participants

A total of 133 participants were recruited of which 127 were used for data analysis. We excluded six participants for the following reasons: software failure during data collection (n = 2); medical diploma (n = 2); hearing impairment (n = 1) and very strong preference for alternative medicine, prompting exceedingly low ratings in quality (n = 1). Participants' age ranged from 18 to 29 years with a mean age of 21.6 years (*SD* = 2.6); 82.7% were female and 85% were undergraduate psychology students.

3.2 Primary Outcome: Information Recall and Pre-Existing Medical Knowledge

We conducted a multiple regression analysis to test for the role of information structuring in improving recall relative to a natural conversation style and to find out whether benefits of information structuring are associated with individuals' pre-existing medical knowledge (see Table 1). We found that no condition was significantly related to increased recall relative to the

NC condition; however, we observed a significant interaction between pre-existing medical knowledge and information recall in the AO condition (B = -3.1, p = .02), suggesting that the relation between medical knowledge and information recall was different in the AO relative to the remaining conditions.

Table 1

Results from multiple regression analysis with the dependent variable recall

	Estimate	Std. Error	t-value	*p*-value
Intercept	19.02	0.92	20.58	.00***
Structure	0.60	1.32	0.46	.65
AO plus structure	1.94	1.30	1.49	.14
Structure plus PO	-0.94	1.31	-0.72	.47
Medical knowledge	3.30	0.99	3.32	.001**
Structure:medical knowledge	-1.29	1.30	-0.99	.32
AO plus structure:medical knowledge	-3.09	1.35	-2.29	.02*
Structure plus PO:medical knowledge	-1.78	1.42	-1.25	.21

Note. In the regression analysis pre-existing medical knowledge was centred to the mean knowledge of participants. This measure was taken to make the estimates easier to interpret. * $p < .05$. ** $p < .01$. *** $p < .001$.

Next, a Pearson correlation analysis indicated a significant positive association between pre-existing medical knowledge and recall across all conditions ($r(125) = .28$, $p = .002$). Analysing the correlation separately for the four different conditions, however, we found significant associations between recall and pre-existing medical knowledge in the NC and the

S conditions but not in the PO and AO conditions (see Table 2). As can be seen in Figure 2, prior medical knowledge is positively associated with information recall in most conditions, with the smallest correlation in the AO condition ($r(30) = -.04$, $p = .85$).

Table 2

Correlations between medical knowledge and recall by condition

Condition	*r*	*p*-value
Natural conversation	.57	<.001***
Structure	.38	.037*
AO plus structure	-.04	.85
Structure plus PO	.24	.18

Note. The correlation coefficient *r* was computed with a Pearson correlation.

* $p < .05$. ** $p < .01$. *** $p < .001$.

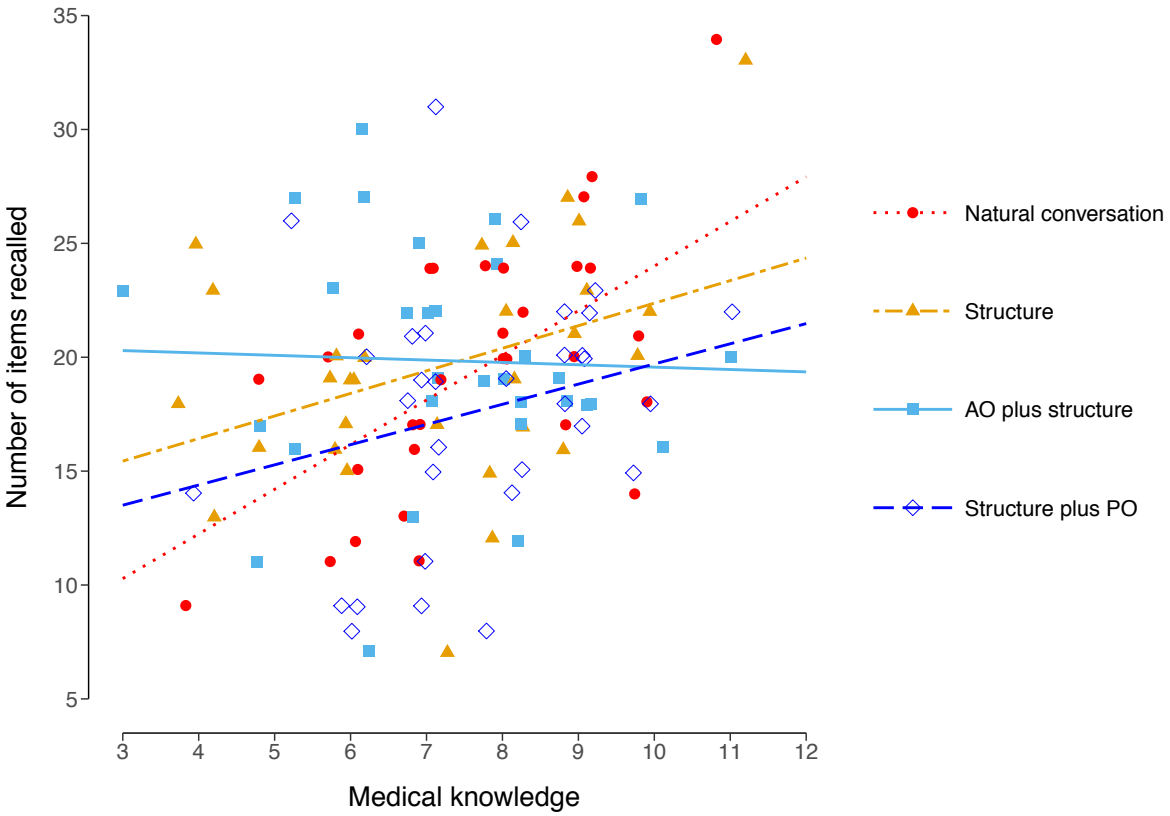


Figure 2. Scatterplot with regression lines showing the relationship between medical knowledge and recall performance clustered by condition.

3.3 Secondary Outcome: Ratings of Quality

Linear regressions were used to examine the relationship between participants' ratings of quality and communication condition (see Table 3). Confirming the validity of our experimental conditions, participants rated discharge communication as more structured in the three structured conditions relative to the NC condition ($F(3, 123) = 18.62$, $p < .001$): S condition ($p < .001$), AO condition ($p < .001$) and PO condition ($p < .001$). Additionally, participants more strongly recommended the physician to family and friends in all three structured conditions relative to the NC condition ($F(3, 123) = 6.43$, $p < .001$): S condition (p

< .001), AO condition ($p < .001$) and PO condition ($p < .001$). In contrast, there was no significant difference on the dimensions of comprehensibility ($F(3, 123) = 1.15$, $p = .33$), and informativeness ($F(3, 123) = 1.43$, $p = .24$) between conditions.

Table 3

Participants' subjective ratings of quality by condition

	Structuredness		Recommendation		Comprehensibility		Informativeness	
Condition	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Natural conversation	6.4	2.3	6.6	2.4	8.8	1.6	7.5	1.9
Structure	9.0	1.1	8.5	1.3	9.2	0.9	8.2	1.2
AO plus structure	8.8	1.2	7.9	1.7	9.2	1.1	8.0	1.9
Structure plus PO	8.7	1.7	8.0	1.8	9.2	0.9	7.6	1.4

Note. Participants rated the quality of discharge communication on a VAS from 0 to 10. Mean and *SD* for all four subjective ratings of quality were clustered by condition.

4. DISCUSSION

Effective discharge communication is crucial to ensure the successful transition from hospital to ambulatory care, yet past research suggests that comprehension and recall of such information is poor [21–23]. We aimed to foster recall of discharge communication by examining the combination of information structuring and the use of advance organisers or post organisers; that is, synopses previewing or retrospectively summarising information. More specifically, we studied how such communication methods can improve recall performance in individuals with varying degree of pre-existing medical knowledge.

Our study found some support for the advantage of information structuring for information recall and patients' subjective ratings of comprehension. Importantly, the results suggest that information structuring, particularly through an AO, has a beneficial role and can be a powerful tool to eliminate the disadvantage of low pre-existing medical knowledge in recall of new information. Our results thus may represent a first small step towards designing effective communication strategies that can help patients with diverse backgrounds and contribute to mitigating health inequalities.

The mnemonic benefits of information structure, relative to a natural conversation style is not new [11,13]. However, past work has not evaluated the independent contributions of structure and the organising synopsis of an AO vs PO [13]. In the present study, these elements were analysed separately, we thus were able to evaluate whether certain elements of explicit structuring are especially helpful to either improve recall or to mitigate the influence of pre-existing medical knowledge on recall. Our results suggest that an advance organiser ("In the following I will talk about five different aspects: first ……") may be particularly helpful for individuals with little prior medical knowledge whereas such an effect could not be demonstrated with a résumé at the end of providing information ("I have been talking about five different aspects: first….") Importantly, these mnemonic benefits of structure do not need to be traded against other important quality dimensions of patient–physician communication: To the contrary, participants were more likely to recommend the physician to family and friends if discharge communication was explicitly structured.

One of our limitations is that we used video-taped rather than face to face interactions; therefore, we cannot be sure whether in real life we would have found similar results. However, we wanted to ensure strict standardisation of the content of discharge information. In a natural setting and given a sensitive patient-centred professional, patients have a chance to contribute to the speed of delivery of information by non-verbal cues like nodding, gaze direction, etc. or

by verbal input, e.g. by asking questions. Although such adaptive and finely tuned communication strategies are, in principle, possible, the ample evidence for poor discharge communication suggests that in reality they are not widely used.

Admittedly, the knowledge about signs, symptoms, and risk factors of myocardial infarction (as tested here) represents only a small slice of health literacy [18]. Yet, we found a clear relationship between pre-existing medical knowledge and recall performance, most pronounced in the NC condition, and almost eliminated in the advance organiser condition. In order to fully appreciate this link, it is important to note that it is likely that general health literacy is above average in the present sample of university students relative to the population of emergency department patients. In other words, our study may, if anything, underestimate the link between recall performance and pre-existing medical knowledge. The provision of an advance organiser appears to mitigate or even eliminate this link. This is obviously important for the average emergency patient, who is expected to retain dozens of often new pieces of information when being discharged [24]. Past studies have shown that standardised [25] or simplified [26] discharge information may increase comprehension and recall. Yet, the crucial link between health literacy and memory performance has previously received little attention [15].

A further limitation is that university students are not representative for the typical patient presenting to an emergency department with symptoms of chest pain. This patient is likely to be older and less educated and certainly less used to memorising new information. Note, however, that our results do not seem to be the product of ceiling effects; there was still a large variance of the percentage of utterances recalled: Only 37% of the students remembered more than half of the utterances provided, the best performing students recalled around 80% of all utterances. Regardless, the students' age [27,28] and routine of memorising information is an advantage. In addition, students did not suffer from the potentially high levels of stress or

anxiety emergency patients experience at work-up and discharge [29]. Taken together, one may therefore expect that our results overestimate the recall performance of patients in emergency care and, by extension, perhaps underestimate the benefit of a structured discharge communication using an advance organiser.

4.1 Conclusions

Structuring of discharge information and the use of an advance organiser appears to be a relatively simple and cost-effective method of compensating for the heterogeneity in pre-existing medical knowledge. This is a relevant advantage because the patients' ability to remember discharge information is linked to pre-existing medical knowledge. Before these findings are implemented into student education and physician training, however, the data presented in a student population need to be replicated in a prospective randomised study with patients discharged from the emergency department.

4.2 Practice Implications

In daily practice, it is difficult to assess pre-existing medical knowledge. Therefore, the usefulness of a communication tool should be independent of the patients' medical knowledge. Our data supports the use of an advance organiser due to the fact that especially in limited pre-existing knowledge recall of information can be improved.

For teaching purposes, we coined the term 'book metaphor' instead of advance organiser because it readily elicits a conception of the explicit structure featuring a table of content, chapter headings, and text – analogous to the structure of a textbook.

REFERENCES

[1] Horwitz LI, Moriarty JP, Chen C, Fogerty RL, Brewster UC, Kanade S, et al. Quality of discharge practices and patient understanding at an academic medical center. JAMA Intern Med 2013;8093:1715–22. doi:10.1001/jamainternmed.2013.9318.

[2] Makaryus AN, Friedman EA. Patients' understanding of their treatment plans and diagnosis at discharge. Mayo Clin Proc 2005;80:991–4. doi:10.4065/80.8.991.

[3] Hansen LO, Young RS, Hinami K, Leung A, Williams MV. Interventions to reduce 30-day rehospitalization: A systematic review. Ann Intern Med 2011;155:520–8. doi:10.7326/0003-4819-155-8-201110180-00008.

[4] Rhodes K V, Vieth T, He T, Miller A, Howes DS. Resuscitating the physician-patient relationship: Emergency department communication in an academic medical center. Ann Emerg Med 2004;44:2–7. doi:10.1016/j.annemergmed.2004.02.035.

[5] Motamedi SM, Posadas-Calleja J, Straus S, Bates DW, Lorenzetti DL, Baylis B, et al. The efficacy of computer-enabled discharge communication interventions: A systematic review. BMJ Qual Saf 2011;20:403–15. doi:10.1136/bmjqs.2009.034587.

[6] Santana MJ, Holroyd-Leduc J, Southern DA, Flemons WW, O'Beirne M, Hill MD, et al. A randomised controlled trial assessing the efficacy of an electronic discharge communication tool for preventing death or hospital readmission. BMJ Qual Saf 2017:bmjqs-2017-006635. doi:10.1136/bmjqs-2017-006635.

[7] Kripalani S, Jackson AT, Schnipper JL, Coleman EA. Promoting effective transitions of care at hospital discharge: A review of key issues for hospitalists. J Hosp Med 2007;2:314–23. doi:10.1002/jhm.228.

[8] Miller GA. The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychol Rev 1956;63:81–97. doi:10.1037/h0043158.

[9] Van Merriënboer JJG, Sweller J. Cognitive load theory in health professional education: Design principles and strategies. Med Educ 2010;44:85–93. doi:10.1111/j.1365-2923.2009.03498.x.

[10] Wildi K, Nelles B, Twerenbold R, Rubini Giménez M, Reichlin T, Singeisen H, et al. Safety and efficacy of the 0 h/3 h protocol for rapid rule out of myocardial infarction. Am Heart J 2016;181:16–25. doi:10.1016/j.ahj.2016.07.013.

[11] Hattie J. Visible learning: A synthesis of over 800 meta-analyses relating to achievement. New York: Routledge; 2013.

[12] Brod G, Werkle-Bergner M, Shing YL. The influence of prior knowledge on memory: A developmental cognitive neuroscience perspective. Front Behav Neurosci 2013;7:1–13. doi:10.3389/fnbeh.2013.00139.

[13] Langewitz W, Ackermann S, Heierle A, Hertwig R, Ghanim L, Bingisser R. Improving patient recall of information: Harnessing the power of structure. Patient Educ Couns 2015;98:716–21. doi:10.1016/j.pec.2015.02.003.

[14] Ley P. Memory for medical information. Br J Clin Psychol 1979;18:245–55. doi:10.1111/j.2044-8260.1979.tb00333.x.

[15] Ackermann S, Ghanim L, Heierle A, Hertwig R, Langewitz W, Mata R, et al. Information structuring improves recall of emergency discharge information: A randomized clinical trial. Psychol Health Med 2016;8506:1–17. doi:10.1080/13548506.2016.1198816.

[16] Livingston A, Frankiewicz RG, Williams RE. Facilitation of learning and repetition of oral instruction using advanced and post organizers. J Educ Psychol 1979;71:701–7. doi:10.1037/0022-0663.71.5.701.

[17] Butz JA, Miller SP, Butz C. Effect of post-organizers on preservice teachers' content knowledge and understanding of effective teaching behaviors. Teach Educ 2005;41:1–15. doi:10.1080/08878730509555368.

[18] Nutbeam D. The evolving concept of health literacy. Soc Sci Med 2008;67:2072–8. doi:10.1016/j.socscimed.2008.09.050.

[19] Ackermann S, Heierle A, Bingisser M-B, Hertwig R, Padiyath R, Nickel CH, et al. Discharge communication in patients presenting to the emergency department with chest pain: Defining the ideal content. Health Commun 2016;31:557–65. doi:10.1080/10410236.2014.979115.

[20] Burla L, Knierim B, Barth J, Liewald K, Duetz M, Abel T. From text to codings: Intercoder reliability assessment in qualitative content analysis. Nurs Res 2008;57:113–7. doi:10.1097/01.NNR.0000313482.33917.7d.

[21] Kessels RPC. Patients' memory for medical information. J R Soc Med 2003;96:219–22. doi:10.1258/jrsm.96.5.219.

[22] Sanderson BK, Thompson J, Brown TM, Tucker MJ, Bittner V. Assessing patient recall of discharge instructions for acute myocardial infarction. J Healthc Qual 2009;31:25–34. doi:10.1111/j.1945-1474.2009.00052.x.

[23] Price JR, Mayou RA, Bass CM, Hames RJ, Sprigings D, Birkhead JS. Developing a rapid access chest pain clinic: Qualitative studies of patients' needs and experiences. J Psychosom Res 2005;59:237–46. doi:10.1016/j.jpsychores.2005.04.004.

[24] Ackermann S, Bingisser MB, Heierle A, Langewitz W, Hertwig R, Bingisser R. Discharge communication in the emergency department: Physicians underestimate the time needed. Swiss Med Wkly 2012;142:1–6. doi:10.4414/smw.2012.13588.

[25] Issacman D, Purvis K, Gyuro J, Anderson Y, Smith D. Standardised instructions: Do they improve communication of discharge from the emergency department. Pediatrics 1992;89:1204–7.

[26] Jolly BT, Scott JL, Sanford SM. Simplification of emergency department discharge instructions improves patient comprehension. Ann Emerg Med 1995;26:443–6.

[27] Jansen J, Butow PN, Van Weert JCM, Van Dulmen S, Devine RJ, Heeren TJ, et al. Does age really matter? Recall of information presented to newly referred patients with cancer. J Clin Oncol 2008;26:5450–7. doi:10.1200/JCO.2007.15.2322.

[28] Brown SC, Park DC. Theoretical models of cognitive aging and implications for translational research in medicine. Gerontologist 2003;43:57–67. doi:10.1093/geront/43.suppl_1.57.

[29] Schwabe L, Wolf OT. Learning under stress impairs memory formation. Neurobiol Learn Mem 2010;93:183–8. doi:10.1016/j.nlm.2009.09.009.

APPENDIX

A1. Utterances Provided by the Physician in all Four Conditions

Utterances
Patient can go home
Right now it is no myocardial infarction
Patient was reassured („you were right to come here“)
Presumptive diagnosis of Angina Pectoris
Explanation of Angina Pectoris („narrowing of cardiac blood vessels“)
Narrowing of cardiac vessels means problems with oxygen supply
Narrowing of cardiac vessels is painful under streneous exercise
Myocardial scintigraphy will be performed
Myocardial scintigraphy clarifies the extent of narrowing
Myocardial scintigraphy will be performed next week
Myocardial scintigraphy will be done here in hospital
Information on time and location of the test will be sent by post
Prior to myocardial scintigraphy
... no coffee
... no tea
... no chocolate
Patient was told try to abstain from smoking
Patient was told to avoid physical stress
... until the examination was performed

Patient was told to come back to the ED

... if he was dyspnoeic

... if he experienced chest pain

... if the symptoms lasted longer than 10 minutes

... if chest-pain radiated into arms

... if chest-pain radiated into jaws

Patient was informed that the ED is open 24/7

Patient was told that treatment needs to start immediately

Patient was given a prescription

The prescription was for medication

The prescripiton listed 3 different medications

Name of the new medication was given: Aspirin

Dose of Aspirin: 100 mg

Mode of intake of Aspirin: in the morning

Name of the new medication was given: Beloc

Dose of Beloc: 100 mg

Mode of intake of Beloc: in the morning

Name of the new medication was given: Nitroglycerine

Dose of nitroglycerine: 1-2 pumps

When to take nitroglycerine: acute complaints

When to take nitroglycerine: chest pain

Patient was told that nitroglycerine will help within 2 to 3 minutes

Physician wished the patient all the best

A.2 Pilot Study: Pre-Existing Medical Knowledge

To assess participants pre-existing medical knowledge, a multiple-choice test was developed. It consisted of 12 questions with four answer options, of which only one answer was correct each. The test was validated in a pilot study, using undergraduate year 1 psychology students and undergraduate year 1 and year 3 medical students. We chose this sample, assuming that psychology students have the lowest medical knowledge, followed by medical students in their first year and medical students in their third year.

To examine the validity of the test, undergraduate year 1 psychology students (P1), undergraduate year 1 medical students (M1) and year 3 medical students (M3) were recruited. Each group consisted of 30 participants. P1's mean age was 21.4 years (SD = 1.7), while M1's and M3's mean age was 20.7 years (SD = 2.1) and 22.2 years (SD = 1.7), respectively. 83.3% of the P1 group and 66.7% of both medical student groups (i.e., M1 and M3) were women. The test showed a mean inter-item-correlation of .1 and a Cronbach's α of .7. Computing a logistic regression, the test was able to distinguish significantly between the three student groups ($p < .001$) (see Figure 1).

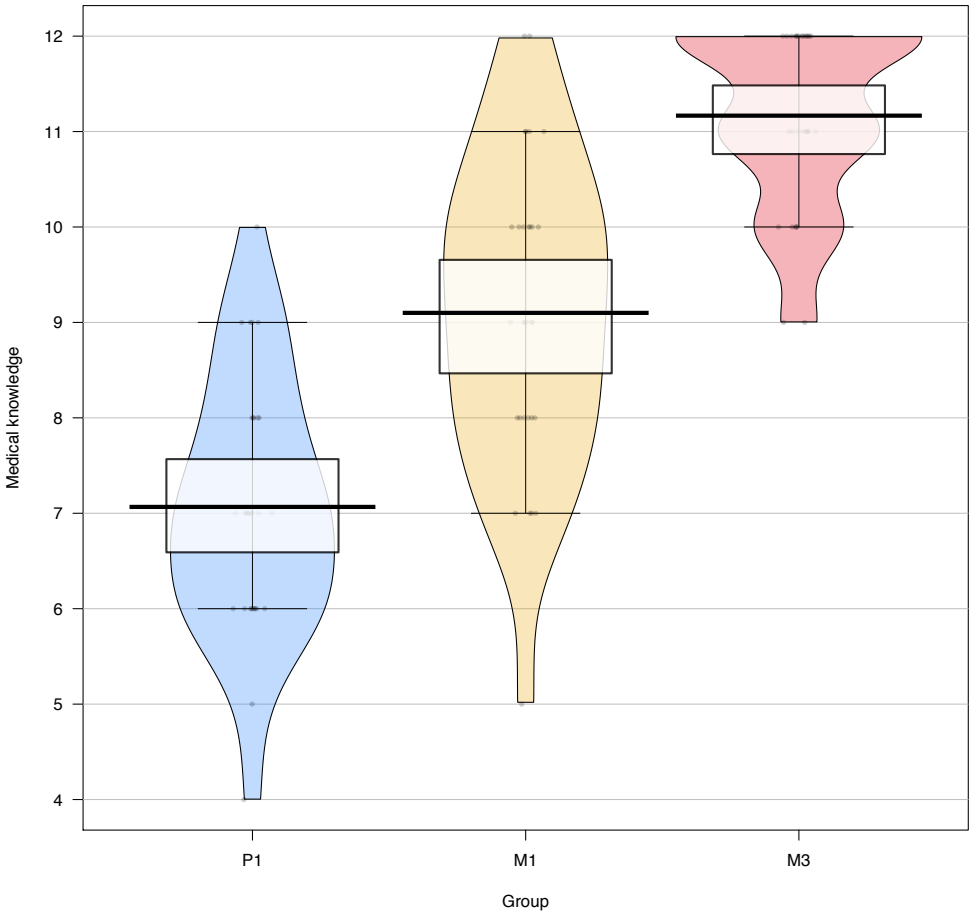


Figure 1. A pirateplot showing the distribution of the correct answers clustered by student group.

A3. Assessment of Pre-Existing Medical Knowledge

The following 12 questions were used to assess participants' pre-existing medical knowledge. The correct answers are indicated in bold.

1) Hypertension is dangerous because

a) It can lead to diabetes mellitus

b) It can lead to cancer

c) It can lead to stroke

d) It may damage the lungs

2) A myocardial infarction (heart attack) is

a) An occlusion of a cardiac artery

b) An occlusion of a cardiac vein

c) A tear in the heart muscle

d) A tear in a heart valve

3) A normal value of blood pressure is

a) 200/60 mmHg

b) 170/60 mmHg

c) 160/60 mmHg

d) 120/60 mmHg

4) Which of the following symptoms is normally **not** caused by a heart attack?

a) Pain in the left shoulder

b) Pain in the jaw

c) Headaches

d) Upper abdominal pain

5) Which conditions do **not** increase the risk for a heart attack?

a) Nicotine consumption

b) Chronic bronchitis

c) Elevated cholesterol levels

d) Hypertension

6) Smoking increases the risk of

a) Calcification of blood vessels

b) Diabetes mellitus

c) Glaucoma

d) Liver damage

7) Myocardial infarction is:

a) A suddenly occurring irregularity of the rhythm of the heart, leading to severe pain.

b) A slowly occurring narrowing of the coronary arteries

c) A suddenly occurring weakness of the heart muscle

d) Death of the heart muscle due to lack of oxygen

8) Angina pectoris refers to:

a) Shortness of breath combined with galloping heart rhythm

b) Pain due to heart overload

c) Pain due to momentarily inadequate supply of oxygen to the heart muscle

d) Galloping heart rhythm due to momentarily inadequate supply of oxygen to the heart muscle

9) What is a risk factor for diseases of the cardiovascular system:

a) High level of physical exertion (heavy labour, high-performance sport)

b) Diabetes

c) Frequent viral infections

d) Electromagnetic radiation (for example, mobile phones)

10) Typical pain during a heart attack:

a) Becomes stronger with deep breathing

b) Radiates to the left arm

c) Comes with sudden movement

d) Radiates from the left chest area to the right chest area

11) A cardiac-catheterisation procedure is:

a) An ultrasound of the coronary arteries

b) A computed-tomography scan of the heart

c) An ultrasound of the heart

d) A radiographic investigation of the coronary arteries

12) Typical cardiac pain becomes worse with:

a) Rapid breathing

a) Emotional stress

c) Physical effort

d) Raising of the arms

Manuscript three

Improving Discharge Communication by Information Structuring: A Cluster Randomized Clinical Trial

Victoria Siegrist[1,2], Rui Mata[2], Wolf Langewitz[3], Ralph Hertwig[4], Roland Bingisser[1]

[1] Emergency Department, University Hospital Basel, Basel, Switzerland

[2] Center for Cognitive and Decision Sciences, University of Basel, Basel, Switzerland

[3] Department of Psychosomatic Medicine, University Hospital Basel, Basel, Switzerland

[4] Center for Adaptive Rationality, Max Planck Institute for Human Development, Berlin, Germany

Author note

Correspondence concerning this article should be addressed to Victoria Siegrist, Emergency Department, University Hospital Basel, Petersgraben 2, 4031 Basel, Switzerland. Tel.: +41-(0)61-328-71-89. E-mail: victoria.siegrist@usb.ch.

ABSTRACT

Importance

Effective discharge communication represents an integral component of medical care, yet patients' recall of information about crucial aspects of post-discharge care is often described as poor.

Objective

To determine whether the effects of a communication training focusing on information structuring skills surpass those of a communication training focusing on responding to emotions.

Design

We conducted a cluster randomized clinical trial for two years (April 2015 to April 2017). Outcomes were measured in patients immediately after discharge (recall and satisfaction), and after 7 and 30 days (recall and adherence to recommendations).

Setting

The study was conducted at the emergency department (ED) of the University Hospital Basel, Switzerland.

Participants

Out of 117 junior physicians 115 were included for initial training. 80 junior physicians completed all three modules of training, and 63 discharged at least one patient under study. Junior physicians were cluster-randomized to one of eight clusters of communication training (either focusing on responding to emotions or information structuring skills). Out of 1,915 patients presenting with chest or abdominal pain, 265 outpatients were included, 196 had

complete data immediately after discharge, 171 completed a follow-up 7 days later and 143 completed another follow-up 30 days later.

Intervention

Two types of communication trainings focusing either on responding to emotions (empathy group) or on information structuring (structure group) were given -using the same intensity of the training modules: 30 minutes for general communication with ED patients, 75 minutes either for "empathy" or "structure" training, and 15 minutes for feedback on the job, before including the first patient.

Main Outcomes

Patients' recall of discharge information immediately after discharge, 7 days, and 30 days later. Secondary outcomes were patients' satisfaction and adherence to recommendations.

Results

80 junior physicians (69.5%) completed all three training modules. Out of 1,915 screened patients, 196 (mean age = 44.8 years, *SD* = 16.4; 42.9% women) participated in the study and completed the first assessment. Patients' immediate recall of discharge information was superior in patients in the structure group in comparison to patients in the empathy group (B = .04, p = .016). There was no significant difference in recall at days 7 and 30. Patients' satisfaction showed ceiling effects in both groups, but patients in the structure group more strongly recommended the junior physician to family and friends (B = .77, p = .04). Additionally, patients in the structure group adhered to more recommendations given by the discharging junior physician within 30 days (B = 1.43, p = .024).

Conclusions and Relevance

Patients' immediate recall (but not 7 & 30 days later), satisfaction, and adherence to recommendations were superior in the structure group as compared to the empathy group. Junior physicians can be trained in the skills of explicitly structuring discharge information with limited effort and resources. This type of training should therefore be considered to be part of the general curriculum of physicians.

Trial Registration

ClinicalTrials.gov; Identifier: NCT02468869;

URL: https://clinicaltrials.gov/ct2/show/NCT02468869

1. INTRODUCTION

The need to communicate effectively is pervasive in healthcare[1], but it is of utmost importance in the acute care setting, such as an emergency department (ED)[2]. Patients are typically discharged within few hours once life-threatening conditions have been excluded, but serious conditions may still be under investigation in the outpatient setting. Importantly, effective patient-physician communication has an impact on physicians and patients alike: Physicians' communication behaviour was found to be linked to the charge of malpractice claims[3]. Furthermore, patients' health outcomes are related to the quality of communication with their physicians[4]. Obviously, patients need to be well-informed to be able to follow the recommendations of their physicians[5] but patients recall only a fraction of the information given by their physicians[5-8]. Therefore, previous studies stressed the importance of information delivery at ED discharge, and its downstream implications for recall and patient outcomes[9,10].

Several communication techniques were found to be associated with better recall of medical information. One is the additional provision of written information[11]. However, this is not always possible, when information has to be tailored to an individual patient, when patient literacy is low, or when diagnoses are yet unclear—as is often the case in the ED. Several studies have demonstrated that written ED discharge instructions often exceed patients' health literacy or even levels of reading skills and understanding[12,13].

Among other verbal communication techniques, information structuring has provided promising evidence: Previous studies have found beneficial effects on recall if medical information was explicitly structured in experiments with college students[14,15]. These studies used a specific way of information structuring, namely the so-called "book metaphor": Discharge information was provided with an initial "table of contents" followed by "chapter headings"[16]. Despite the promising results of these studies, there were some limitations. The studies were conducted under laboratory conditions: Improvement of recall of discharge information was

only proven in proxy-patients, namely college students, after viewing video vignettes presenting a physician discharging a patient. The obvious differences between proxy- and real-life patients are the younger age and the better training in memorising certain amounts of information in college students[14,15].

We therefore conducted a cluster randomized clinical trial to investigate the effects of information structuring on patients' recall, satisfaction, and adherence to recommendations. Since previous studies have already shown superiority of information structuring versus physicians' natural conversation, we decided to compare the effects of information structuring to another communication training. Patients presenting to the ED are found to have high levels of stress and anxiety[17,18] and several studies found positive effects on patients' clinical outcomes if physicians showed empathy[19–21]. Consequently, we decided to test the benefits of communication training in information-structuring skills (S) against communication training in responding to emotions (empathy skills, E).

An implicit aim was to assess feasibility (whether explicit information structuring can effectively be taught to junior physicians within three short modules and an overall time of two hours). The main outcome was the patients' immediate recall comparing communication trainings in E and S. Additionally, patients' recall 7 days and 30 later was assessed using telephone interviews. Third, we assessed patients' satisfaction with both the junior physician and the discharge communication, in order to test for the assumption that explicit structuring may cause irritation in patients, as this sort of communication may be judged to be artificial, mechanical and inhuman. Especially in comparison to junior physicians trained in E, as empathy has long been advocated as a central element to patient satisfaction[20,21]. Fourth, patients who do not accurately understand or recall information forfeit the possibility to be adherent to instructions[5]. Therefore, the last secondary outcome was the association between information structuring and adherence.

2. METHODS

2.1 Design, Setting and Participants

This two-arm, cluster randomized controlled trial was conducted at the ED of the University Hospital Basel (UHBS), Switzerland. The study was approved by the Ethics Committee Northwest and Central Switzerland on December 3, 2014 (EKNZ 2014-379) and published in ClinicalTrials.gov on June 11, 2015 (NCT02468869). Junior physicians and patients were enrolled between April 2015 and April 2017.

Physicians eligible for the study were junior physicians starting at the ED. Each junior physician underwent a basic training module, one of two randomized advanced training modules, one focusing on empathy and one on structuring information, and one feedback on the job. Junior physicians were clustered according to their first day at work (January, April, July, and October). Accordingly, eight clusters of junior physicians were included. All junior physicians gave written informed consent before undergoing the three modules of the communication training (see section 2.2 below).

Patients were eligible if they presented to the ED with chest pain or abdominal pain and were discharged by a study physician. Patients were not eligible if they met one of the following exclusion criteria: no written consent, younger than 18 years old, non-German speaker, or a diagnosis of dementia.

2.2 Interventions

Junior physicians received a communication training consisting of three distinct teaching modules: i) general communication with ED patients, ii) empathy vs. structure training, and iii) feedback on the job by an expert in communication. Subsequently, four clusters of junior physicians took part in an advanced module focusing on “how to respond to emotions”

(empathy group), while four clusters of junior physicians took part in an advanced module focusing on explicit "information structuring" (structure group).

i) The "general communication with ED patients" module was standard practice at the ED for new physicians and took 30 minutes, embedded in lectures focusing on principles of triage, working with protocols, legal aspects, and the most important patient needs. Discharge information was one of the main topics, highly standardized for the needs of junior physicians. The results of recent studies[10,22,23] were discussed, emphasizing the content of discharge information, namely diagnosis, follow-up, advice on self-care, red flags, and treatment.

ii) The "empathy vs. structure training" module was provided in a 75 minutes session. It covered the following topics in both groups of physicians: evidence from communication research, teaching of communication skills, and practical training in groups of two. Thereafter, the study protocol was explained, informed consent obtained, and surveys on demographics and junior physicians' understanding on the acquired communication skills (scored on a numeric rating scale (NRS), range 0-10) were completed. Physicians in the empathy group were taught to respond to patients' emotions with the tool NURSE.[24] The acronym N-U-R-S-E assists with responding verbally to patients' emotions: **N**ame the emotion; **U**nderstand the emotion; **R**espect the patient; **S**upport the patient; **E**xplore the emotion. Physicians in the structure group were taught to use explicit verbal structuring, by (1) presenting discharge information on the basis of the "book metaphor",[14,15] and (2) selecting information according to the acronym InFARcT[23]. The book metaphor describes the structure of an advance organiser, whereas the acronym InFARcT defines relevant topics to be addressed in any discharge communication (i.e., **In**formation on diagnosis, **F**ollow-up, **A**dvice on self-care, **R**ed flags, **c**omplete **T**reatment).

iii) The "feedback on the job" module consisted of an individual feedback on the job. As junior physicians were discharging a patient, a communication expert accompanied them. After being introduced, the expert remained silent during discharge communication. Subsequently,

the junior physician received feedback pertaining to the empathy or structure focus of his training. After concluding this three-module training, junior physicians were eligible to participate in the study. The expert rated the junior physician's ability using the techniques conveyed earlier on an NRS from 1-6.

2.3 Procedure

Patients presenting to the ED were screened for the main complaint of chest or abdominal pain using the web-based electronic health record (EHR). If patients were eligible, trained study personnel explained the study procedure and informed consent was obtained. Patients were blind to the communication training the junior physician had previously received (empathy or structure). Information on demographics, mental and physical health (12-Item Short Form Health Survey; SF-12)[25], and anxiety and depression (Hospital Anxiety and Depression Scale; HADS-D)[26] was obtained. Data were recorded using the web-based software secuTrial® by study personnel.

After the study personnel completed all surveys with the patient, the junior physician was given an audio recorder, handling was explained, and the junior physician was instructed to call the study personnel at the end of the discharge communication. Study personnel immediately assessed patient satisfaction and recall of discharge information. Before discharge, appointments were made for the follow-up calls 7 and 30 days later.

2.4 Outcomes

The primary outcome of the study was the patients' immediate recall of discharge information as a function of the junior physicians' communication training (E or S). Additionally, two telephone interviews, 7 and 30 days after discharge, took place to assess the patients' longer-term recall performance and related measures.

Secondary outcomes were patients' satisfaction and self-reported adherence to recommendations. Patients' satisfaction was measured immediately after discharge communication, but before recall assessment, on four visual analogue scales (VAS). Each of these scales ranged from 0 to 10 and the dimensions were (1) "how easy was it to understand what your doctor said?", (2) "how structured was the communication?", (3) "how informative was the communication?", and (4) "how strongly would you recommend the doctor to family and friends?". Additionally, 7 days after discharge, patients completed the German version of the Patient Reaction Assessment (PRA-D)[27,28], which measures the relationship of the patient-provider medical relationship. Specifically, it reports patients' perceived quality of the informative (patient information index) and affective (patient affective index) behaviours of the physician and patients' perceived ability to initiate communication (patient communication index). Patients completed the survey after seven days in order to limit the time burden due to the study immediately after discharge. 7 days and 30 days after discharge patients were asked "which recommendations did you follow since your visit at the ED?". The answer to this open-ended question was recorded.

Audio records of discharge communication, patients' recall, and patients' reports on adherence were transcribed with the software f4transkript. A specific coding scheme was developed for this study that covered all types of utterances that could be found in the transcripts (Appendix). An utterance was defined as the smallest speech segment that expresses or implies a complete thought and to which a coder can assign a classification. Seven different groups of utterances and more than 100 distinct utterances were defined: (1) explicit structure, (2) information on diagnosis, (3) follow-up, (4) advice on self-care, (5) red-flags, (6) complete treatment, and (7) other. After study completion, two independent coders, blind to physicians' ID, cluster, and group rated all transcripts. A subset of 10 patients were randomly drawn to compute interrater agreements: An intra-class correlation (ICC)[29] for the rater agreement of the

number of utterances identified and recalled and Cohen's Kappa ($\varkappa$)[30] for the rater agreement of the assigned codes (i.e., unique code for every utterance according to the coding scheme) were calculated. In total, five patients of the empathy group (two patients with chest pain and three patients with abdominal pain) and five patients from the structure group (three patients with chest pain and two patients with abdominal pain) were used for these analyses. Using the R package irr, a two-way random consistency average model was computed. The agreement with an ICC = .999 and 95% CI = .998 - .999 showed excellent reliability for 37 transcripts (10 discharge communications, 10 immediate recalls and 17 follow-up transcripts). Cohen's Kappa for two raters showed an almost perfect agreement with $\varkappa$ = .88 and 95% CI = .86 - .91 for 747 coded utterances.

Additionally, each discharge communication was rated based on the audio recording and the transcript by the same two blinded and independent raters on the amount of empathic communication and explicit structure (i.e., manipulation check). The two items measuring structuredness were "physician gives an outline" and "physician leads explicitly from one segment of the consultation to another". The two items assessing emotion handling were "physician reacts when the patient shows an emotion" and "the physician checks with the patient whether his concerns are clear". Scores for these measures were 0, 1, 2 or NA (i.e., not given, partially given, completely given, could not be judged).

2.5 Randomization

Clusters of physicians were pseudo-randomly assigned to one of two communication trainings (E or S). To determine the content of the communication training for the first cluster of physicians, we used a randomizer (randomizer.org).

2.6 Sample Size and Statistical Analyses

The study was powered at 80% (two-sided test, α level of .05) to detect a difference in recall performance for two patient groups discharged either by a physician trained in E or S. With an estimated effect size of .4, a total sample size of 200 was required.

Analyses were conducted using R, version 3.4.4. The dependent variable was the patients' immediate relative recall of the discharge information (i.e., number of utterances recalled immediately after discharge by the patient divided by utterances given by the physician during discharge). Recall performance of discharge information, was analysed with a linear mixed-effects model from the package lme4[31]. The model included the absolute number of utterances given because we observed substantial interindividual variability in the number of physicians' utterances (see Appendix). Additionally, the model controlled for the random effects cluster and physician, acknowledging that physicians were nested under cluster.

Patient satisfaction ratings showed ceiling effects and were therefore converted from interval into integer numbers. This permitted the computation of an ordinal model with the R package ordinal. Each of the four satisfaction ratings were analysed with a cumulative link mixed model[32]. The models controlled for the random effects cluster and physician.

Patients' adherence to recommendations was defined as the overall self-reported adherence within one month relative to the number of recommendations given by the physician during discharge. If patients reported that they followed the same recommendation during follow-up 1 and 2, it was only counted once. A linear mixed-effects model, controlling for the random effects cluster and physicians was used for analysis.

3. RESULTS

3.1 Participants

117 junior physicians started working in the ED during the study period, of which 115 signed consent (Figure 1). Cluster size ranged from 12 to 20 junior physicians. 80 junior physicians completed all three training modules and 63 included patients (range: 1-19 patients). Junior physicians were on average 30.7 years old (*SD* = 3.9) and had a work experience of 2.9 years (*SD* = 1.9) (Table 1). Almost half of the junior physicians were women (47.6%). The empathy and the structure groups scored equally well in understanding and application of the communication skills taught and in the modules ii) empathy vs. structure training, and iii) feedback on the job. There was no significant difference between physicians in E and S clusters in terms of time spent on training or proficiency in German.

In total, 1,915 patients with chest or abdominal pain were screened for eligibility (Figure 2). Of those, 1,650 were excluded, the main reason being that they did not meet the inclusion criteria (80.0%). A total of 265 patients were included in the study; 146 and 119 were treated by junior physicians from the empathy and structure group, respectively. A total of 196 patients completed the immediate assessment. Dropout rate from immediate assessment to follow-up 2 was 27%. Patients with chest and abdominal pain did not differ in terms of recall performance. For this reason, both patient groups were collapsed in the following analyses. Patients had a mean age of 44.8 years (*SD* = 16.4), 42.9% were women (Table 1), and 76.5% were native German speakers. There was no difference in education, health related quality of life (SF-12), and anxiety and depression scores (HADS-D) for patients in the empathy and structure group, indicating that both patient groups were comparable.

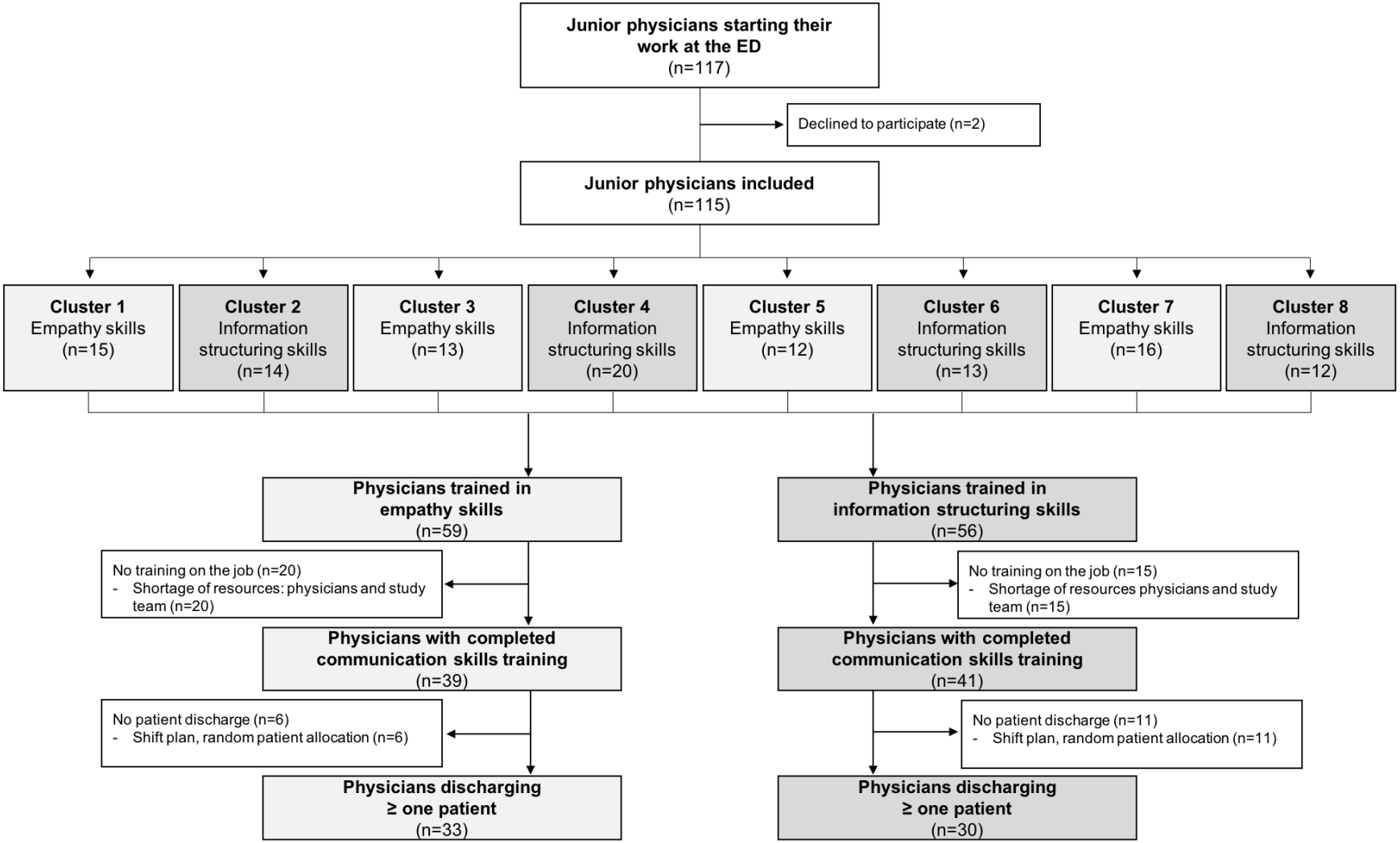


Figure 1. Flow chart of junior physicians

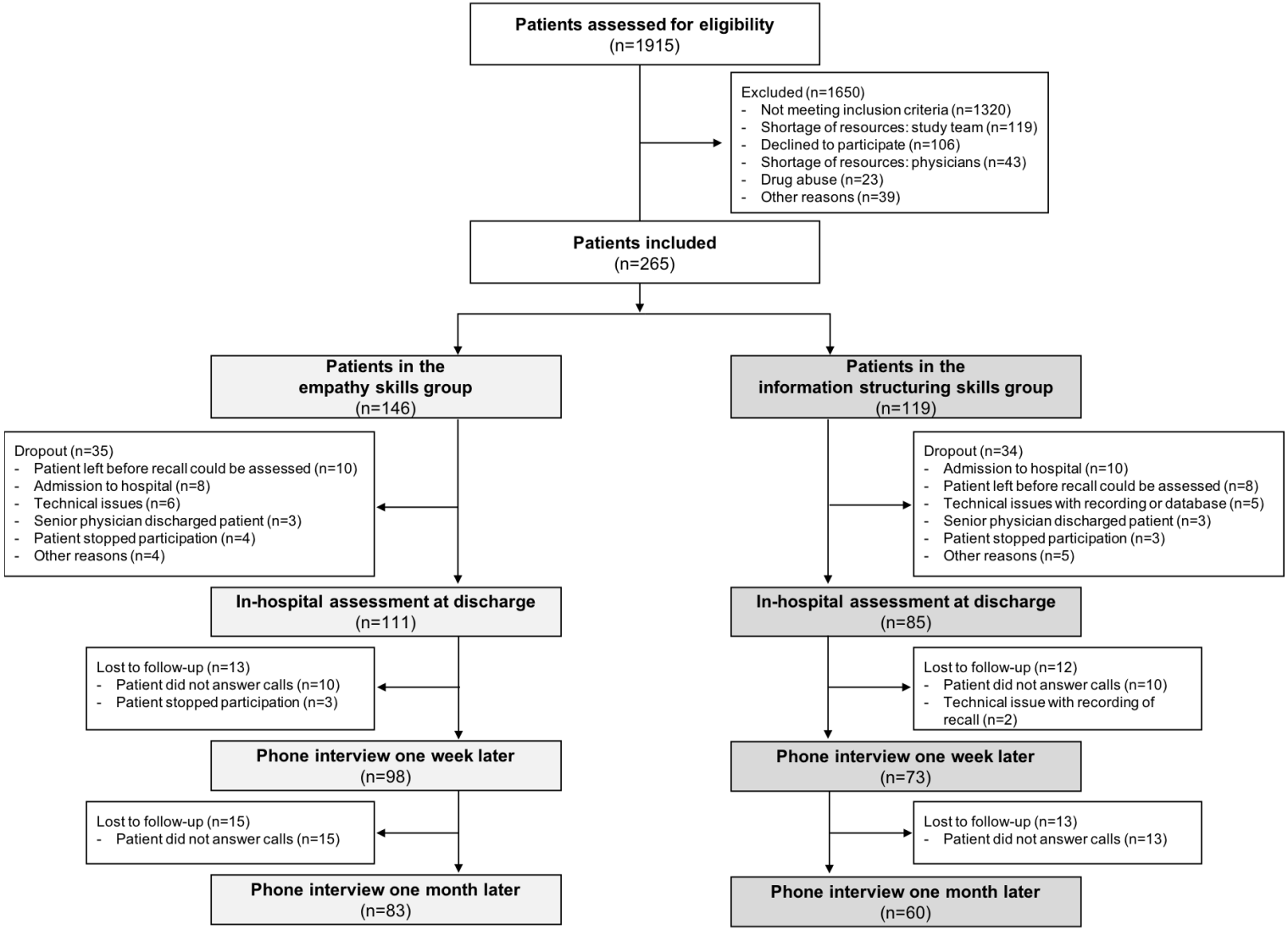


Figure 2. Flow chart of patients

Table 1

Demographics of physicians and patients overall and by group

	All	Empathy	Structure
Physicians (N)	63	33	30
Age, mean (*SD*)	30.7 (3.9)	30.4 (3.2)	31.0 (4.6)
Female sex, N (%)	30 (47.6)	16 (48.5)	14 (46.7)
Nationality, N (%)			
Swiss	20 (31.8)	7 (21.2)	13 (43.3)
German	29 (46.0)	18 (54.6)	11 (36.7)
Austria	6 (9.5)	2 (6.1)	4 (13.3)
Other	8 (12.7)	6 (18.2)	2 (6.7)
Native language German N (%)	52 (82.5)	26 (78.8)	26 (86.7)
Civil status married, N (%)	11 (17.5)	8 (24.2)	3 (10.0)
Work experience, years, mean (*SD*)	2.9 (1.9)	2.8 (1.8)	3.1 (1.9)
Test scores			
Module: empathy vs. structure training	7.0 (1.8)	6.9 (1.5)	7.1 (2.0)
Module: feedback on the job	4.6 (0.7)	4.7 (0.6)	4.6 (0.8)
Time between training and inclusion of a patient, mean (*SD*)	50.5 (50.6)	45.2 (38.1)	56.3 (61.6)
Patients (N)	196	111	85
Complaint			
Chest pain, N (%)	100 (51.0)	48 (43.2)	52 (61.2)
Abdominal pain, N (%)	96 (49.0)	63 (56.8)	33 (38.8)
Age, mean (*SD*)	44.8 (16.4)	44.5 (17.4)	45.1 (15.1)
Female sex, N (%)	84 (42.9)	46 (41.4)	38 (44.7)
Nationality, N (%)			
Swiss	132 (67.4)	77 (69.4)	55 (64.7)
German	21 (10.7)	9 (8.1)	12 (14.1)
Other	43 (21.9)	25 (22.5)	18 (21.2)
Education level, N (%)			
≤ job training	105 (53.6)	59 (53.1)	46 (54.1)
≥ higher education	91 (46.4)	52 (46.9)	39 (45.9)
Native language German N (%)	150 (76.5)	87 (78.4)	63 (74.1)
Civil status married, N (%)	91 (46.4)	47 (42.3)	44 (51.8)
SF12, mean (*SD*)			
Mental health	50.6 (10.3)	50.1 (10.3)	51.1 (10.4)
Physical health	47.0 (9.9)	45.6 (10.2)	48.7 (9.4)
HADS, mean (*SD*)			
Anxiety	6.0 (3.8)	6.0 (3.7)	5.9 (3.9)
Depression	3.7 (3.5)	4.0 (3.7)	3.4 (3.2)

3.2 Discharge Communication

An overview of the characteristics of discharge communication overall and by group can be found in Table 2. When doing a manipulation check, physicians' information-structuring and empathy skills during discharge communication were assessed. As expected, discharge communication was significantly more structured in S-trained physicians compared to E-trained physicians ($p < .001$). 83.2% of patients showed no obvious emotions during discharge communication. Accordingly, for most patients, only the item "the physician checks with the patient, whether his concerns are clear" was used to assess skills in responding to emotions. There was no significant difference in empathy ratings between empathy and structure groups ($p = .06$). Physicians conveyed on average 39.0 ($SD = 15.0$) utterances with a range from 7 to 108 utterances. There was no difference between groups on the dimensions *duration of discharge communication* ($p = .4$) and *number of patient contributions* ($p = .3$). Physicians in the structure group provided fewer diagnosis-related ($p < .01$), and other ($p < .001$) utterances but scored higher in structuring ($p < .001$), advice on self-care, and red flag ($p < .001$) utterances.

Table 2

Information about discharge communications overall and by group

	All	Empathy	Structure
Utterances given by the physician, mean (*SD*)			
Explicit structure (book metaphor)	1.5 (2.1)	0.1 (0.4)	3.4 (2.0)
Information on diagnosis	13.1 (6.5)	14.1 (6.8)	11.8 (5.9)
Follow-up	6.7 (5.6)	6.7 (6.1)	6.7 (4.9)
Advice on self-care	2.6 (3.1)	2.2 (3.2)	3.1 (2.9)
Red flag	4.3 (2.7)	3.6 (2.9)	5.3 (1.9)
complete **T**reatment	9.1 (8.0)	10.1 (7.0)	7.7 (9.1)
Other	1.7 (1.8)	2.2 (1.8)	1.1 (1.6)
Total	39.0 (15.0)	38.9 (14.3)	39.0 (16.1)
Patient contributions, mean (*SD*)			
Questions asked	2.7 (3.7)	2.7 (3.6)	2.7 (3.9)
Inputs given	6.5 (6.7)	7.0 (6.5)	5.8 (6.9)
Total	9.2 (9.0)	9.8 (8.7)	8.5 (9.4)
Duration of discharge communication, minutes, mean (*SD*)	4.7 (2.6)	4.5 (2.4)	4.9 (2.9)
Manipulation check, mean (*SD*)			
Structuredness rating	1.2 (1.5)	0.1 (0.3)	2.6 (1.3)
Empathy rating	1.7 (0.8)	1.8 (0.7)	1.6 (0.9)

3.3 Primary Outcome: Patient Recall

An overview of patients' absolute and relative recall for all three time points of assessment can be found in Table 3. Overall, immediate recall of patients was low with 10.3 (SD = 4.7) utterances, corresponding to 27.8% of information originally presented. Patients in the structure group had a higher immediate relative recall in comparison to patients in the empathy group in regard to the five InFARcT categories (B = .04, p = .015), but also in regard to the full set of utterances (B = .04, p = .016), including structuring and "other" utterances. There was no difference between groups in recall performance one week (p = .96) and one month (p = .34) after discharge.

Table 3

Information about patients' recall by assessment and group

	All		**Empathy**		**Structure**	
	Absolute mean, *SD*	Relative [%] mean, *SD*	Absolute mean, *SD*	Relative [%] mean, *SD*	Absolute mean, *SD*	Relative [%] mean, *SD*
Immediate recall						
Explicit structure (book metaphor)	0.3 (0.9)	14.1 (27.0)	0.0 (0.0)	0.0 (0.0)	0.6 (1.2)	15.0 (27.7)
Information on diagnosis	3.8 (2.6)	31.1 (19.7)	3.9 (2.8)	29.0 (19.0)	3.7 (2.5)	33.9 (20.3)
Follow-up	2.1 (2.2)	34.0 (29.8)	2.1 (2.5)	31.6 (28.9)	2.2 (1.8)	37.0 (30.6)
Advice on self-care	0.6 (1.2)	27.8 (35.3)	0.4 (1.0)	21.6 (32.6)	0.9 (1.4)	33.2 (36.8)
Red flag	1.2 (1.5)	28.7 (30.3)	1.0 (1.3)	29.4 (30.6)	1.4 (1.6)	28.0 (30.2)
complete **T**reatment	2.1 (2.5)	26.2 (24.5)	2.2 (2.2)	24.9 (22.4)	2.1 (2.8)	28.0 (27.1)
Other	0.1 (0.4)	7.2 (20.3)	0.2 (0.5)	6.5 (18.7)	0.1 (0.3)	8.6 (23.5)
Total recall	10.3 (4.7)	27.8 (11.4)	9.7 (4.8)	26.1 (11.1)	11.0 (4.5)	30.0 (11.5)
Confabulation	1.5 (1.9)	--	1.5 (1.8)	--	1.6 (2.1)	--
Recall one week later						
Explicit structure (book metaphor)	0.2 (0.6)	9.6 (22.5)	0.0 (0.1)	20.0 (44.7)	0.3 (0.8)	8.7 (20.2)
Information on diagnosis	2.8 (2.3)	21.9 (17.3)	3.0 (2.5)	21.2 (17.7)	2.5 (2.0)	22.7 (16.9)
Follow-up	1.0 (1.3)	16.8 (22.2)	1.1 (1.4)	17.0 (22.9)	1.0 (1.2)	16.7 (21.5)
Advice on self-care	0.4 (1.1)	14.4 (24.5)	0.4 (1.0)	13.9 (22.4)	0.5 (1.1)	14.7 (26.3)
Red flag	0.7 (1.2)	15.4 (24.4)	0.5 (1.0)	11.8 (22.8)	1.0 (1.4)	18.9 (25.5)
complete **T**reatment	1.3 (1.7)	16.8 (19.6)	1.5 (1.9)	17.6 (20.2)	1.1 (1.5)	15.7 (18.8)
Other	0.1 (0.3)	3.7 (14.7)	0.1 (0.4)	4.9 (16.9)	0.0 (0.1)	1.3 (8.0)
Total recall	6.5 (3.6)	17.6 (10.7)	6.5 (3.8)	17.7 (10.5)	6.4 (3.3)	17.5 (11.0)
Confabulation	1.9 (2.1)	--	2.2 (2.1)	--	1.5 (2.1)	--
Recall one month later						
Explicit structure (book metaphor)	0.2 (0.6)	8.0 (17.7)	0.0 (0.1)	0.0 (0.0)	0.3 (0.8)	8.8 (18.3)
Information on diagnosis	2.4 (2.0)	19.3 (15.9)	2.4 (2.1)	17.8 (15.3)	2.3 (1.9)	21.4 (16.5)
Follow-up	0.9 (1.1)	14.3 (19.4)	0.8 (1.2)	13.7 (20.8)	1.0 (1.1)	15.1 (17.5)
Advice on self-care	0.4 (1.0)	14.5 (25.3)	0.4 (0.8)	13.9 (22.1)	0.5 (1.1)	15.0 (28.2)
Red flag	0.7 (1.1)	17.2 (24.5)	0.6 (1.0)	16.5 (24.8)	0.9 (1.2)	18.0 (24.4)
complete **T**reatment	0.9 (1.2)	12.9 (18.9)	1.1 (1.3)	12.5 (17.7)	0.7 (0.9)	13.5 (20.6)
Other	0.1 (0.3)	3.5 (16.0)	0.1 (0.4)	3.7 (15.4)	0.0 (0.1)	3.0 (17.4)
Total recall	5.5 (3.0)	15.4 (9.0)	5.3 (3.1)	14.7 (8.7)	5.7 (2.9)	16.2 (9.4)
Confabulation	1.5 (1.6)	--	1.9 (1.7)	--	1.0 (1.2)	--

3.4 Secondary Outcomes: Satisfaction and Adherence

We hypothesized that patient satisfaction would be higher in the empathy group because explicit structure is so uncommon in medical communication that patients might respond with irritation. However, our results show that patient ratings were high in both groups on all four dimensions of satisfaction (Table 4). Patients in the structure group recommended more strongly the physician to family and friends ($p = .036$) relative to patients in the empathy group (appendix). All patient ratings of PRA-D were high, without a significant difference in any of the three indexes ($p > .05$).

We hypothesized that memory is a prerequisite for adherence since patients' need to remember information in order to adhere to it. Accordingly, patients' self-reported adherence to recommendations within one month had a mean of 1.5 elements of adherences ($SD = 1.2$) and was significantly higher in patients in the structure group relative to the empathy group ($p = .024$). In line with our hypothesis, adherence to recommendations correlated significantly with patients' recall at the immediate assessment, $r(141) = .33$, $p < .001$.

Table 4

Information about patients' outcomes overall and by group

	All		**Empathy**		**Structure**	
	Absolute	Relative [%] mean, *SD*	Absolute	Relative [%] mean, *SD*	Absolute	Relative [%] mean, *SD*
Patient satisfaction, median (*IQR*)						
Comprehensibility of the discharge communication	9.9 (9.0 - 10.0)	--	9.2 (9.0 - 10.0)	--	9.9 (9.0 - 10.0)	--
Structuredness of the discharge communication	9.2 (8.0 - 10.0)	--	9.1 (8.0 - 10.0)	--	9.4 (8.9 - 10.0)	--
Recommendation of the physician to family and friends	10.0 (9.0 - 10.0)	--	9.5 (9.0 - 10.0)	--	10.0 (9.0 - 10.0)	--
Informativeness of the discharge communication[a]	9.5 (8.7 - 10.0)	--	9.4 (8.0 - 10.0)	--	9.6 (9.0 - 10.0)	--
PRA-D, mean (*SD*)						
Patient affective index	30.6 (4.4)	--	30.2 (4.7)	--	31.1 (4.0)	--
Patient communication index	31.1 (5.3)	--	30.8 (5.7)	--	31.6 (4.6)	--
Patient information index	27.9 (5.4)	--	27.4 (5.4)	--	28.5 (5.3)	--
Total	89.6 (11.7)	--	88.4 (11.9)	--	91.2 (11.2)	--
Adherence to recommendations, mean (*SD*)						
One week later	1.0 (1.0)	22.6 (22.0)	0.9 (0.9)	19.9 (21.8)	1.2 (1.0)	26.1 (21.9)
One month later	0.5 (0.7)	9.9 (16.0)	0.3 (0.6)	6.4 (13.5)	0.7 (0.8)	14.6 (17.8)
Total	1.5 (1.2)	32.1 (26.2)	1.2 (1.1)	26.8 (24.5)	1.8 (1.3)	39.5 (26.8)

Note. [a] 13 missings (6 patients in the empathy group and 7 patients in the structure group).

4. DISCUSSION

We designed, implemented, and evaluated two different communication trainings to compare the benefits of explicit information structuring to the benefits of responding to emotions. The main findings of our study were the positive association between structuring of discharge information and immediate recall performance, the comparable satisfaction to empathy-enhanced communication, and the improved adherence to recommendations.

In this study, the communication trainings consisted of three teaching modules with an overall duration of two hours each. Thus, our interventions was much shorter than most other communication trainings[33,34]. In spite of this, information-structuring skills could successfully be taught to junior physicians as shown by the use of more elements of the book metaphor during discharge communication.

Patients' immediate recall was significantly higher in the structure group in comparison to the empathy group (30.0% versus 26.1%). The standardized coefficient of the communication training on immediate recall revealed an effect size of .17, CI = .04 - .30. The positive effect of information structuring is small but in line with the findings of a meta-analysis on the effects of communication training on patient outcomes[34]. Information structuring had a positive impact on patients' recall of discharge information at the immediate assessment but not in the follow-up assessments 7 days and 30 days later. One explanation might be the setting of our study: Patients presented to the ED with acute complaints and discharge information might not have been relevant to patients after some days anymore.

Patient's satisfaction was high in both groups as assessed by four ratings immediately after discharge communication and by the evaluation of the PRA-D one week after discharge. The choice of more items or more specific items might have been beneficial in order to discriminate better

between groups. Nevertheless, our finding is common in literature[35–37]. Notably, the benefits of improved recall due to information structuring were not traded-off against patients' satisfaction.

Patient adherence was found to be associated with patient recall in several healthcare settings[7,38,39]. Our results of the immediate assessment are in line with these findings. Moreover, despite patients' decline in memory with time, we found positive effects of information structuring on patients' adherence even after 30 days.

Efficiency was shown in terms of time spent for discharge communication. Despite the findings from a previous study on recall-promoting physician behaviour[40], the physicians in the structure group did not need more time for discharge communication in comparison to the empathy group. This is particularly important in an ED environment, as throughput is one of the major challenges. However, keeping the time spent for discharge communication short is not the primary goal of any communication technique; instead, content of information, recall by patients, satisfaction with physicians and their information giving and adherence to recommendations are far more important, and were shown in this intervention trial.

Our study has several limitations. First, the study setting: Our study was a single center study, the number of physicians in each cluster was small and the patient sample comprised patients with chest and abdominal pain only. However, our population is comparable to other European EDs and our sample of junior physicians is representative. All junior physicians but two were included, and 69.6% of the junior physicians completed all three modules of the communication training. Patients with chest and abdominal pain were chosen as a study population because these complaints have a high prevalence in EDs[41]. Despite the differences in age, sex, and complaints between the two patient groups, we found no differences in terms of recall, PRA-D scores, and adherence.

Second, the communication trainers could not be blinded to the interventions. Yet, the test scores of the empathy vs. structure training, and of the feedback on the job modules showed, that both groups were equally successful in learning and applying their communication skills.

Third, the current study did not check for relevance of the recalled utterances. However, we do not assume that irrelevant information was recalled at the expense of more relevant information as we found the same effects on patients' immediate recall if we looked at all utterances, at the InFARcT utterances, or at the red flag utterances.

Fourth, patients' adherence was based on self-reports. We were not able to check whether patients actually did adhere to the recommendations (e.g. by taking blood samples and checking drug level). Therefore, one could question the credibility of patients' reports. However, patients' self-reported adherence was rather low and a potential bias would apply for both groups.

Fifth, the choice of our comparison group, namely empathy skills: In our study, only a minority of patients showed emotions during discharge communication and physicians had only few chances to show how good their competences are in responding to emotions. Yet, this was not a study to check for the impact of responding to emotions, but to have a credible comparison group.

4.1 Conclusions

Summarizing our findings, we could confirm our hypothesis that teaching the use of information structuring skills to junior physicians is effective (i.e., immediate recall, and adherence to recommendations) and efficient (i.e., time spent for discharge communication), and does not come at the price of reduced patient satisfaction. Further research should focus on refining this intervention, such as combining the structured approach with techniques using empathy.

REFERENCES

1. Ong LM, de Haes JC, Hoos AM, Lammes FB. Doctor-patient communication: A review of the literature. *Soc Sci Med*. 1995;40(7):903–918. doi:10.1016/0277-9536(94)00155-M.
2. Eisenberg EM, Murphy AG, Sutcliffe K, et al. Communication in emergency medicine: Implications for patient safety. *Commun Monogr*. 2005;72(4):390–413. doi:10.1080/03637750500322602.
3. Levinson W, Roter DL, Mullooly JP, Dull VT, Frankel RM. Physician-patient communication: The relationship with malpractice claims among primary care physicians and surgeons. *JAMA*. 1997;277(7):553–559. doi:10.1001/jama.1997.03540310051034.
4. Street RL, Makoul G, Arora NK, Epstein RM. How does communication heal? Pathways linking clinician-patient communication to health outcomes. *Patient Educ Couns*. 2009;74(3):295–301. doi:10.1016/j.pec.2008.11.015.
5. Laws MB, Lee Y, Taubin T, Rogers WH, Wilson IB. Factors associated with patient recall of key information in ambulatory specialty care visits: Results of an innovative methodology. *PLoS One*. 2018;13(2):1–13. doi:10.1371/journal.pone.0191940.
6. Gabrijel S, Grize L, Helfenstein E, et al. Receiving the diagnosis of lung cancer: Patient recall of information and satisfaction with physician communication. *J Clin Oncol*. 2008;26(2):297–302. doi:10.1200/JCO.2007.13.0609.
7. Jansen J, Butow PN, Van Weert JCM, et al. Does age really matter? Recall of information presented to newly referred patients with cancer. *J Clin Oncol*. 2008;26(33):5450–5457. doi:10.1200/JCO.2007.15.2322.
8. Kessels RPC. Patients' memory for medical information. *J R Soc Med*. 2003;96(5):219–222. doi:10.1177/014107680309600504.
9. Engel KG, Buckley BA, Mccarthy DM, Forth VE, Adams JG. Communication amidst chaos : Challenges to patient communication in the emergency department. *J Sci Commun*.

2010;17(10):449–452.

10. Vashi A, Rhodes K V. “Sign right here and you’re good to go”: A content analysis of audiotaped emergency department discharge instructions. *Ann Emerg Med*. 2011;57(4):315–322.e1. doi:10.1016/j.annemergmed.2010.08.024.

11. Johnson A, Sandford J. Written and verbal information versus verbal information only for patients being discharged from acute hospital settings to home: Systematic review. *Health Educ Res*. 2005;20(4):423–429. doi:10.1093/her/cyg141.

12. Powers RD. Emergency department patient literacy and the readability of patient-directed materials. *Ann Emerg Med*. 1988;17(2):124–126. doi:10.1016/S0196-0644(88)80295-6.

13. Williams DM, Counselman FL, Caggiano CD. Emergency department discharge instructions and patient literacy: A problem of disparity. *Am J Emerg Med*. 1996;14(1):19–22. doi:10.1016/S0735-6757(96)90006-6.

14. Langewitz W, Ackermann S, Heierle A, Hertwig R, Ghanim L, Bingisser R. Improving patient recall of information: Harnessing the power of structure. *Patient Educ Couns*. 2015;98(6):716–721. doi:10.1016/j.pec.2015.02.003.

15. Ackermann S, Ghanim L, Heierle A, et al. Information structuring improves recall of emergency discharge information: A randomized clinical trial. *Psychol Health Med*. 2016;22(6):646–662. doi:10.1080/13548506.2016.1198816.

16. Kiessling C, Langewitz W. The longitudinal curriculum “social and communicative competencies” within Bologna-reformed undergraduate medical education in Basel. *GMS Z Med Ausbild*. 2013;30(3):1–20. doi:10.3205/zma000874.

17. Byrne G, Robert H. Patient anxiety in the accident and emergency department. *Jounral Clin Nurs*. 1996;39(6):289–295. doi:https://doi.org/10.1111/j.1365-2702.1997.tb00317.x.

18. Ekwall A. Acuity and anxiety from the patient’s perspective in the emergency department. *J Emerg Nurs*. 2013;39(6):534–538. doi:10.1016/j.jen.2010.10.003.

19. Hojat M, Louis DZ, Markham FW, Wender R, Rabinowitz C, Gonnella JS. Physicians' empathy and clinical outcomes for diabetic patients. *Acad Med*. 2011;86(3):359–364. doi:10.1097/ACM.0b013e3182086fe1.

20. Kim SS, Kaplowitz S, Johnston M V. The effects of physician empathy on patient satisfaction and compliance. *Eval Heal Prof*. 2004;27(3):237–251. doi:10.1177/0163278704267037.

21. Menendez ME, Chen NC, Mudgal CS, Jupiter JB, Ring D. Physician empathy as a driver of hand surgery patient satisfaction. *J Hand Surg Am*. 2015;40(9):1860–1865. doi:10.1016/j.jhsa.2015.06.105.

22. Ackermann S, Bingisser MB, Heierle A, Langewitz W, Hertwig R, Bingisser R. Discharge communication in the emergency department: Physicians underestimate the time needed. *Swiss Med Wkly*. 2012;142(June):1–6. doi:10.4414/smw.2012.13588.

23. Ackermann S, Heierle A, Bingisser M-B, et al. Discharge communication in patients presenting to the emergency department with chest pain: Defining the ideal content. *Health Commun*. 2016;31(5):557–565. doi:10.1080/10410236.2014.979115.

24. Back AL, Arnold RM, Baile WF, Tulsky JA, Fryer-Edwards K. Approaching difficult communication tasks in oncology. *CA Cancer J Clin*. 2005;55(3):164–177. doi:10.3322/canjclin.55.3.164.

25. Ware J, Kosinski M, Keller SD. A 12-item short-form health survey : Construction of scales and preliminary tests of reliability and validity. *Med Care*. 1996;34(3):220–233.

26. Herrmann-Lingen C, Buss U, Snaith P. *Hospital Anxiety and Depression Scale-Deutsche Version (HADS-D)*.; 2011.

27. Galassi JP, Schanberg R, Ware WB. The patient reactions assessment: A brief measure of the quality of the patient-provider medical relationship. *Psycholoical Assess*. 1992;4(3):346–351.

28. Brenk-Franz K, Hunold G, Galassi JP, et al. Quality of the physician-patient relationship – evaluation of the German version of the Patient Reactions Assessment (PRA-D). *Z Allgemeinmed*. 2016;92(3):103–108. doi:10.3238/zfa.2016.0103-0108.

29. Bartko JJ. The intraclass correlation coefficient as a measure of reliability. *Psychol Rep*. 1966;19(1):3–11. doi:10.2466/pr0.1966.19.1.3.

30. McHugh ML. Interrater reliability: The kappa statistic. *Biochem Medica*. 2012:276–282. doi:10.11613/BM.2012.031.

31. Bates D, Mächler M, Bolker BM, Walker SC. *Fitting linear mixed-effects models using lme4*.; 2014. doi:10.1126/science.1176170.

32. Christensen RHB. Ordinal-Rgression models for ordinal data. *R Packag*. 2015;06.

33. Liénard A, Merckaert I, Libert Y, et al. Is it possible to improve residents breaking bad news skills? A randomised study assessing the efficacy of a communication skills training program. *Br J Cancer*. 2010;103(2):171–177. doi:10.1038/sj.bjc.6605749.

34. Barth J, Lannen P. Efficacy of communication skills training courses in oncology: A systematic review and meta-analysis. *Ann Oncol*. 2011;22(5):1030–1040. doi:10.1093/annonc/mdq441.

35. Hekkert KD, Cihangir S, Kleefstra SM, van den Berg B, Kool RB. Patient satisfaction revisited: A multilevel approach. *Soc Sci Med*. 2009;69(1):68–75. doi:10.1016/j.socscimed.2009.04.016.

36. Gany F, Leng J, Shapiro E, et al. Patient satisfaction with different interpreting methods: A randomized controlled trial. *J Gen Intern Med*. 2007;22(SUPPL. 2):312–318. doi:10.1007/s11606-007-0360-8.

37. Harms C, Nübling M, Langewitz W, Kindler CH. Patient satisfaction with continued versus divided anesthetic care. *J Clin Anesth*. 2007;19(1):9–14. doi:10.1016/j.jclinane.2006.04.004.

38. Dong L, Lee JY, Harvey AG. Do improved patient recall and the provision of memory support enhance treatment adherence? *J Behav Ther Exp Psychiatry*. 2017;54:219–228. doi:10.1016/j.jbtep.2016.08.017.

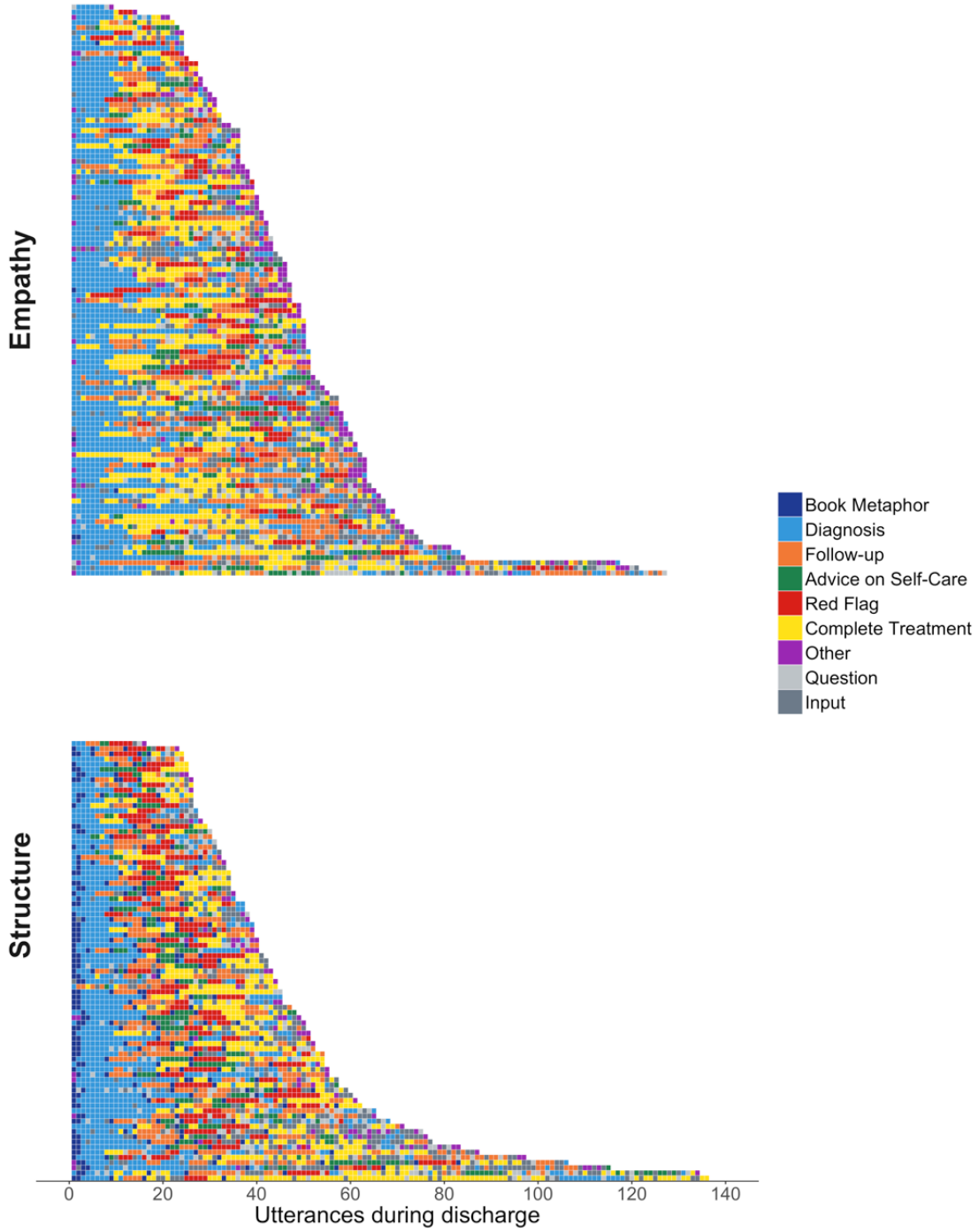
39. Linn AJ, van Dijk L, Smit EG, Jansen J, van Weert JCM. May you never forget what is worth remembering: The relation between recall of medical information and medication adherence in patients with inflammatory bowel disease. *J Crohn's Colitis*. 2013;7(11):e543–e550. doi:10.1016/j.crohns.2013.04.001.

40. Silberman J, Tentler A, Ramgopal R, Epstein RM. Recall-promoting physician behaviors in primary care. *J Gen Intern Med*. 2008;23(9):1487–1490. doi:10.1007/s11606-008-0597-x.

41. Cordell WH, Keene KK, Giles BK, Jones JB, Jones JH, Brizendine EJ. The high prevalence of pain in emergency medical care. *Am J Emerg Med*. 2002;20(3):165–169. doi:10.1053/ajem.2002.32643.

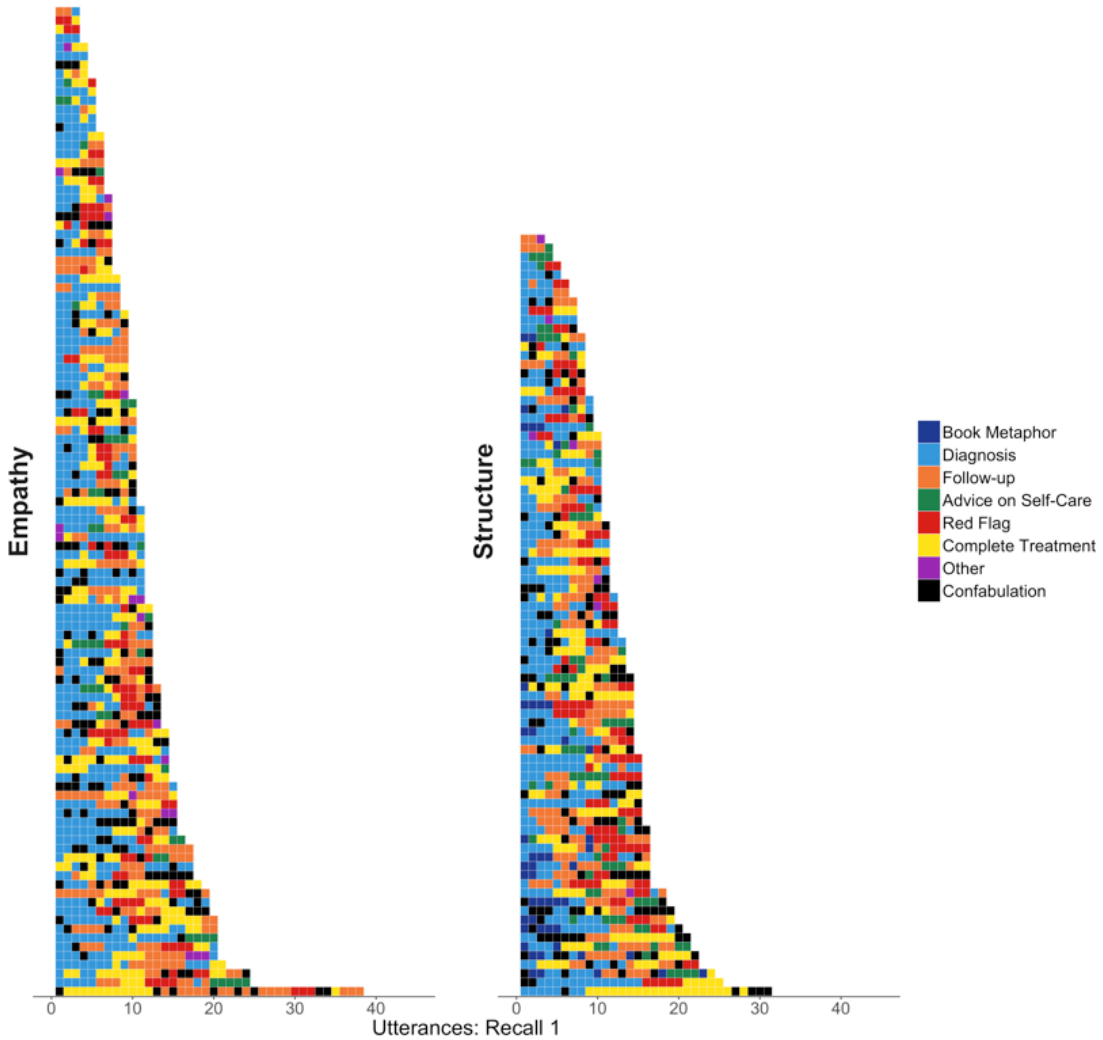
APPENDIX

A.1 Visual Representation of Discharge Communication by Group



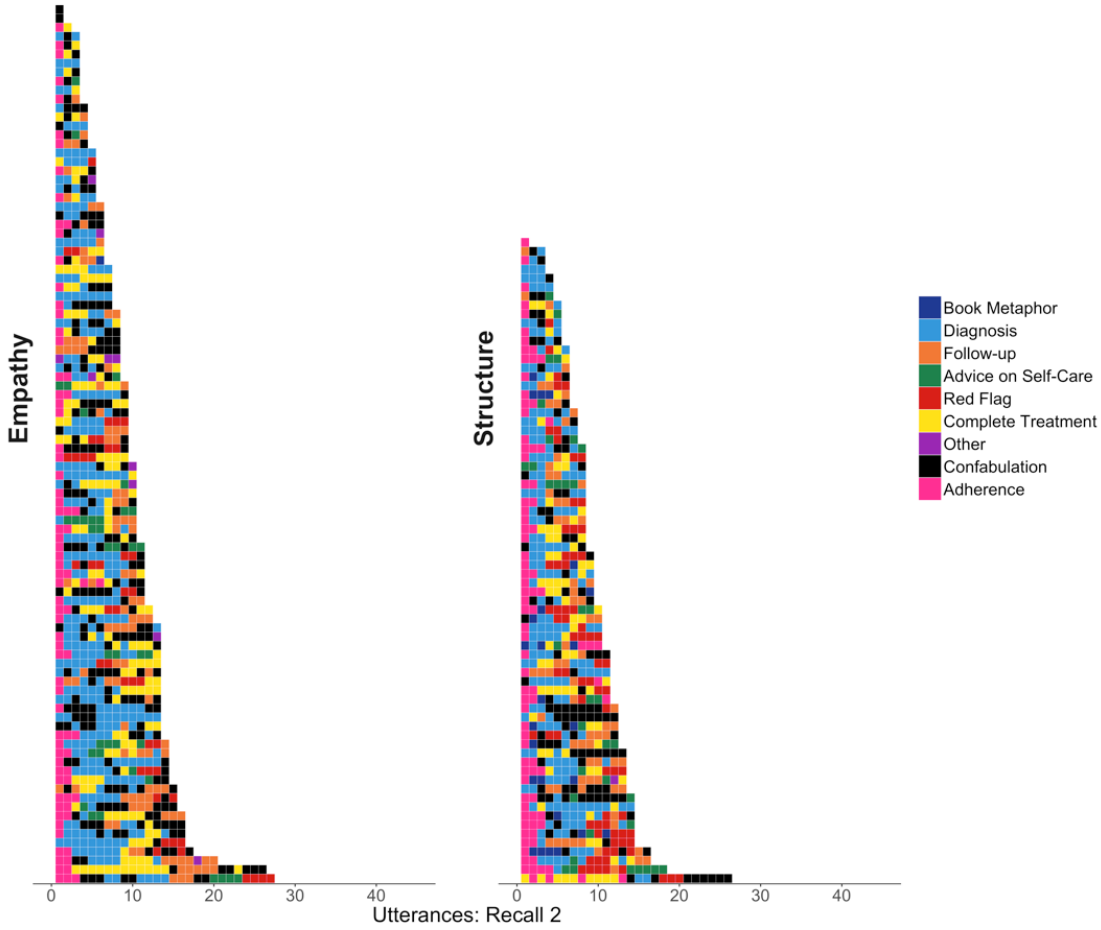
Note. Every row represents one discharge communication, while every square characterizes one utterance.

A.2 Visual Representation of Patients' Immediate Recall by Group



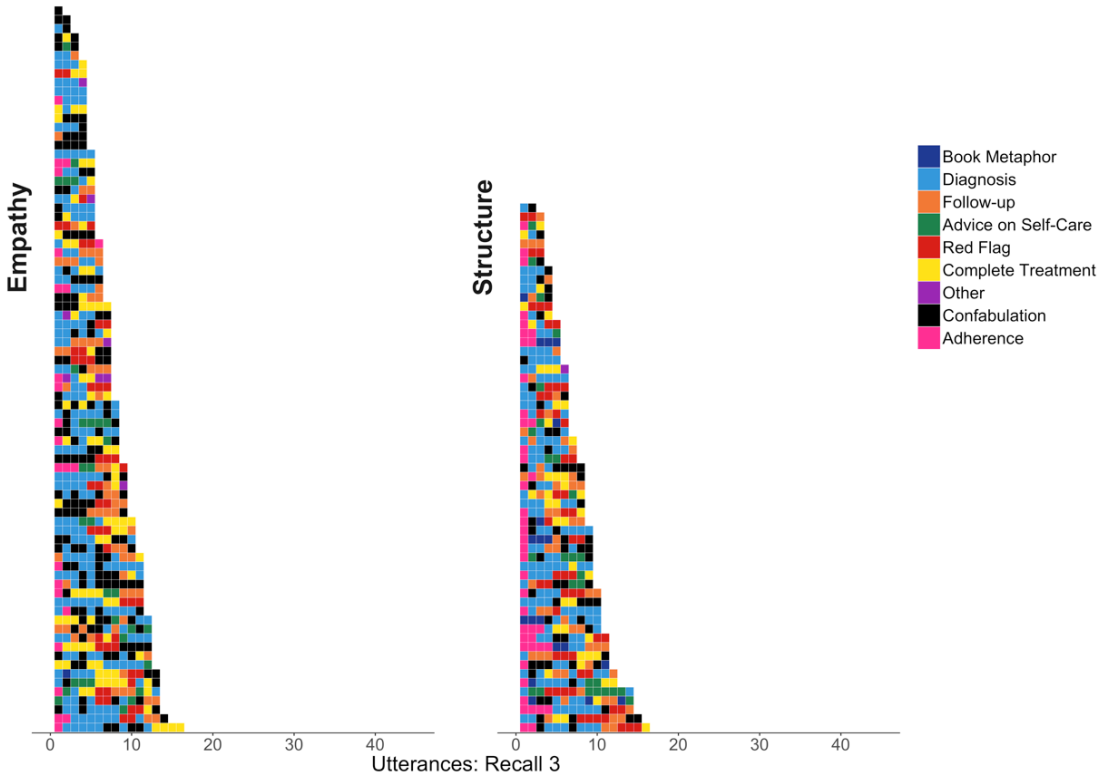
Note. Every row represents the recall assessment of one patient, while every square characterizes one utterance.

A.3 Visual Representation of Patients' Recall 7 Days after Discharge



Note. Every row represents the recall assessment of one patient, while every square characterizes one utterance.

A.4 Visual Representation of Patients' Recall 30 Days after Discharge



Note. Every row represents the recall assessment of one patient, while every square characterizes one utterance.

A5. Stepwise Regression Table for Immediate Recall

Predictors	*Relative recall at immediate assessment*														
	Model 1			Model 2			Model 3			Model 4			Model 5		
	B	*CI*	*p*	*B*	*CI*	*p*	*B*	*CI*	*p*	*B*	*CI*	*p*	*B*	*CI*	*p*
Fixed Parts															
(Intercept)	0.36	0.31 – 0.40	<.001	0.39	0.33 – 0.44	<.001	0.40	0.34 – 0.46	<.001	0.39	0.33 – 0.45	<.001	0.42	0.36 – 0.48	<.001
Group (structure)	0.04	0.01 – 0.07	.016	0.04	0.01 – 0.07	.012	0.04	0.01 – 0.07	.013	0.04	0.01 – 0.07	.011	0.04	0.01 – 0.07	.004
Number of utterances given at discharge	-0.00	0.00 – 0.00	<.001	-0.00	0.00 – 0.00	<.001	-0.00	0.00 – 0.00	<.001	-0.00	0.00 – 0.00	<.001	-0.00	-0.00 – -0.00	<.001
Age				-0.00	0.00 – 0.00	.082	-0.00	-0.00 – 0.00	.112	-0.00	-0.00 – 0.00	.160	-0.00	0.00 – 0.00	.157
Sex (male)							-0.02	-0.05 – 0.01	.170	-0.02	-0.05 – 0.01	.123	-0.02	-0.05 – 0.00	.097
Education (>= higher education)										0.03	0.00 – 0.06	.047	0.02	-0.01 – 0.05	.249
Native language German (no)													-0.08	-0.12 – -0.05	<.001
Random Parts															
σ^2		0.011			0.011			0.011			0.011			0.010	
$\tau_{00,\ physician:cluster}$		0.000			0.000			0.000			0.000			0.000	
$\tau_{00,\ cluster}$		0.000			0.000			0.000			0.000			0.000	
$N_{physician:cluster}$		63			63			63			63			63	
$N_{cluster}$		8			8			8			8			8	
$ICC_{physician:cluster}$		0.000			0.000			0.000			0.000			0.000	
$ICC_{cluster}$		0.000			0.000			0.000			0.000			0.000	
Observations		196			196			196			196			196	

Note. Linear mixed-effects models, controlling for the random effects cluster and physicians were used for analyses.

A6. Regression Table for Intention to Treat versus Actual Treatment

Predictors	*Relative recall at immediate assessment*					
	Intention to treat (allocation to group E vs S)			Actual treatment (use of structure during discharge)		
	B	*CI*	*p*	*B*	*CI*	*p*
Fixed Parts						
(Intercept)	0.36	0.31 – 0.40	<.001	0.40	0.36 – 0.45	<.001
Group (structure)	0.04	0.01 – 0.07	.016			
Number of utterances given at discharge	-0.00	0.00 – 0.00	<.001	-0.00	0.00 – 0.00	<.001
Actual treatment (no structure)				-0.04	-0.07 – -0.01	.016
Random Parts						
σ^2		0.011			0.011	
$\tau_{00,\ physician:cluster}$		0.000			0.000	
$\tau_{00,\ cluster}$		0.000			0.000	
$N_{physician:cluster}$		63			63	
$N_{cluster}$		8			8	
$ICC_{physician:cluster}$		0.000			0.000	
$ICC_{cluster}$		0.000			0.000	
Observations		196			196	
R^2 / Ω_0^2		.136 / .136			.135 / .135	

Note. Intention to treat is the allocation of the physician to a communication training (E versus S), while actual treatment stands for the actual use of information structuring during discharge. Actual treatment was defined as a score of at least 1 (out of 4) on the use of information structuring during discharge communication. Linear mixed-effects models, controlling for the random effects cluster and physicians were used for analyses.

A.7 Regression Table for Patients' Satisfaction

Predictors	*Satisfaction*																							
	Comprehension						Structuredness						Recommendation						Informativeness					
	Estimate	*Std. Error*	*Exp (Estimate)*	*Lower 95%*	*Upper 95%*	*P*	*Estimate*	*Std. Error*	*Exp (Estimate)*	*Lower 95%*	*Upper 95%*	*P*	*Estimate*	*Std. Error*	*Exp (Estimate)*	*Lower 95%*	*Upper 95%*	*P*	*Estimate*	*Std. Error*	*Exp (Estimate)*	*Lower 95%*	*Upper 95%*	*P*
Fixed Parts																								
Group (Structure)	0.17	0.32	*1.19*	*0.63*	*2.24*	0.592	0.40	0.34	1.49	0.76	2.91	0.247	0.77	0.37	2.17	1.05	4.46	0.036 *	0.47	0.68	1.60	0.42	6..04	0.487
AIC	510.61						596.49						492.81						533.42					
Physician.(Intercept)	0						0						0.63						0.37					
Cluster.(Intercept)	0.19						0.25						0						0.75					

Note. Patient satisfaction scores were analyzed with cumulative link mixed models controlling for the random effects cluster and physicians.

A.8 Regression Table for Patients' Adherence

	Adherence		
	Odds Ratio	*CI*	*p*
Fixed Parts			
(Intercept)	0.26	0.21 – 0.33	<.001
group (Structure)	1.43	1.05 – 1.96	.024
Random Parts			
$\tau_{00,\ physician:cluster}$		0.000	
$\tau_{00,\ cluster}$		0.000	
$N_{physician:cluster}$		52	
$N_{cluster}$		8	
$ICC_{physician:cluster}$		0.000	
$ICC_{cluster}$		0.000	
Observations		143	
Deviance		105.043	

Note. Patients' adherence was the overall self-reported adherence within one month relative to the number of recommendations given by the physician during discharge. A linear mixed-effects model, controlling for the random effects cluster and physicians was used for analysis.

A.9 Coding scheme

Group	ID	Cat	Description	Comments	Example
Structure	St1		Physician provides a "table of contents"	Assessment based on start of discharge communication	0 = Not given
					1 = Partly given (with St2: as soon as there is one transition)
	St2		Physician leads explicitly from one segment of the consultation to another	Assessment based on entire discharge communication	2 = Completely given (even when the content structure is in an adapted form)
Empathy	E1		Reaction when patient shows emotions	Assessment over the entire discharge communication, on basis of audio file	0 = Physician completely ignores emotion
					1 = Physician responds in some way (noticeable pause, echoing, naming an emotion without waiting for the patient's reaction)
					2 = Physician responds to patient's emotion (naming, understanding, respecting, supporting, exploring)
					NA = Could not be judged because the patient shows no emotion
	E2		Checks with patient whether his concerns are clear	Assessment over the entire discharge communication	0 = Not given or only "okay?"
					1 = Enquiry in the course of the dialogue, without asking at the end
					2 = Enquiry at the end of the dialogue
Contents	I1	Contents and heading	**In**formation on diagnosis	Any information connected to the content counts as one utterance	First, we come to the **diagnosis** *(1)*.
	I2		**F**ollow-up	Any information connected to the content counts as one utterance	Then I will discuss the **next steps** *(1)*.
	I3		**A**dvice on self-care	Any information connected to the content counts as one utterance	In the following, I will show you **what you can do for your own health** *(1)*.
	I4		**R**ed flags	Any information connected to the content counts as one utterance	Then I would like to point out what the **warning signs** are *(1)* and **how you must react** *(2)*.
	I5		**c**omplete **T**reatment	Any information connected to the content counts as one utterance	Finally, we come to the **treatment** *(1)*.
	I6		**"Table of contents" at the beginning of the discharge communication**	Coded as one utterance	I received **advance information** *(1)* prior to the discharge communication
Engagement	Question		Every **question** by patients as an indication of commitment	Every question (during discharge communication) counts as one utterance	**How likely is it that I have a vascular condition?** *(1)*.
	Input		Every **active input** by patients as an indication of commitment	Every input (during discharge communication) counts as one utterance	**I can't keep the appointment. I will be on holiday at the beginning of September** *(1)***.**

Adherence	**Ad**		**Recommendations** that were mentioned in discharge communication and put into practice by patients	Every recommendation put into practice counts as one item	I've been **looking after myself** *(1)* and **taken paracetamol** *(2)* and **ibuprofen** *(3)*.
					I've been **looking after myself** *(1)*, **taken the medication** *(2)* and **not eaten any fruit** *(3)*.
False memory	**In1**		**Falsely remembered by patients**	Every utterance that was discussed during discharge communication and falsely remembered by the patient	Physician: Please don't eat any chocolate over the next few days.
					Patient: I should **eat less chocolate** *(1)*.
	In2		**Not part of the discharge communication**	Every utterance that was not part of the recorded discharge communication but was highly likely discussed at some other time (e.g., with the nurse)	
Information on diagnosis (In)	**D1**	Investigation	Patient's **[symptom/complaint]**	Every symptom/complaint counts as one utterance	You came to the emergency department because of **chest pain** *(1)*.
	D2		**[Investigation]** that was carried out	Every investigation (including specification) counts as one utterance	First, we did a **scan of your stomach** *(1)*. And then we carried out a **laboratory analysis of your blood** *(2)* and **urine** *(3)*.
					The ultrasound carried out by the radiologist *(1)*.
	D3		**[Reason]** for carrying out the investigation	Every reason counts as one utterance	We wanted to see **if your pain was caused by a kidney stone** *(1)*.
	D4		**What** the investigation **showed**	Every finding, including "nothing unusual" and "abnormality", counts as one utterance	We could see that the **levels of inflammation are elevated** *(1)***.**
	D5		**What** the abnormality/result of the investigation **reveales**	Every possible conclusion counts as one utterance	Blood cells in the urine show that your **urine is not completely clean** *(1)*.
	D6		**[Details]** of the abnormality/result of the investigation	Every detail counts as one utterance	The size of the kidney stone is **3 mm** *(1)*.
	D7		**Exempted from [investigation]** ...	Every exempted investigation counts as one utterance	In the end, we decided not to carry out a **CT scan** *(1)*...
	D8		...because **[reason]**	Every reason counts as one utterance	...because of **exposure to radiation** *(1)*.
	D9		**Opinion** of **[another physician]** sought	Every physician counts as one utterance	I have discussed the results with the **gastroenterologists** *(1)*.
	D10	Diagnosis	**(Suspected) [diagnosis]** lay or medical term	Every diagnosis counts as one utterance	**Gastritis, also known as gastroenteritis** *(1)*.
	D11		**[Confidence rating]** regarding the (exclusion/secondary/differential) diagnosis	Every confidence rating counts as one utterance (e.g., very, quite, just a suspicion)	We are **not certain** *(1)*, but it could be acute gastroenteritis.
	D12		**Diagnosis could not be made (yet)**/cause of the complaints could not be identified (yet)	This statement counts as one utterance	Unfortunately, we have **not discovered** the cause of your pain *(1)*.
	D13		**[Exclusion diagnosis]** lay or medical term	Every exclusion diagnosis counts as one utterance	We were able to rule out **appendicitis** *(1)*.
	D14		**[Secondary diagnosis/additional findings]** lay or medical term	Every secondary diagnosis/additional finding counts as one utterance	We have also seen that you suffer from **low blood pressure**, also known as **hypotension** *(1)*.
	D15		**[Differential diagnosis]** lay or medical term	Every differential diagnosis counts as one utterance	But it could also be that you have **stomach worms** *(1)*.

	D16		**[Explanation]** of the (exclusion/secondary/differential) diagnosis	Every specification counts as one utterance	Answer to the question: "Is it *acute* gastroenteritis?" "Yes, it is **acute** gastroenteritis" *(1)*.
	D17		[Reason] for this suspicion	Every reason counts as one utterance	Especially since you **were abroad, where you ate out** *(1)*.
	D18		**Explanation of interrelationships or consequences (physiology, etiology, symptoms, diagnosis)**	Every history counts as one utterance	Because the **mucous membranes of the stomach are no longer protected by the acid, there is a wound and this then causes the pain** *(1)*.
	D19		**Expected course** of illness	Every course of illness counts as one utterance	There may be a **further increase in pain** *(1)* in the next few days. **There should be an improvement** *(2)* in a week at the latest.
					Your symptoms should **go away by itself** *(1)*.
	D20		Expected [**timeframe**] of the pathogenesis	Every time designation counts as one utterance	There may be a further increase in pain **in the next few days** *(1)*. There should be an improvement **in a week at the latest** *(2)*.
	D21		Physician **reassures** the patient	Every reassurance counts as one utterance	Gastroenteritis **is not serious** *(1)*.
					You don't need to worry *(1)*.
	D22		Physician **discharges patient to home**	This statement counts as one utterance	You can **go home** *(1)*.
	D23		**Any other information** regarding *Diagnosis*	Any other information regarding *diagnosis* counts as one utterance	
Follow-up (F)	**F1**	Appointment	No follow-up appointment necessary	This statement counts as one utterance	In my view, you **don't really need a follow-up appointment** *(1)*.
	F2		**[Symptom(s)/differential diagnosis]** that must still be **clarified**	Every symptom/differential diagnosis counts as one utterance	If it really were **stomach worms** *(1)*, you would have to clarify this with your primary care physician.
	F3		**[Symptom]** must be carefully **monitored**	Every symptom counts as one utterance	Monitor whether you have **extrasystoles** *(1)* in the near future.
	F4		**[Circumstances]** under which…	Every instance counts as one utterance	**As soon as there are stones in the sieve** *(1)*, you should make an appointment with your primary care physician.
	F5		**…[something]** should be done	Every action counts as one utterance	As soon as there are stones in the sieve, **you should make an appointment with your primary care physician** *(1)*.
	F6		Patient should arrange follow-up appointment with [physician/department]	Every appointment counts as one utterance	**Make an appointment with your primary care physician** *(1)***.**
	F7		Physician has arranged follow-up appointment with [physician/department]	Every appointment counts as one utterance	**I have made a cardiology appointment for you** *(1)*.
	F8		**[Patient receives message/call]** for the follow-up appointment	Every message/call counts as one utterance	**Our colleagues in cardiology will get in touch with you by phone** *(1)*.
	F9		**[Date]** regarding follow-up appointment or contact	Every date counts as one utterance	Our colleagues in cardiology will get in touch with you **in the next few days** *(1)*.
					I recommend that you have a follow-up consultation with your primary care physician **next week** *(1)*.

	F10		**[Details]** about follow-up physician	Every detail counts as one utterance	He is a **specialist in this field** *(1)*.
	F11	Investigation	**[Follow-up investigation]** lay or medical term	Every investigation counts as one utterance	I recommend that you have a **stress echo test** *(1)*.
	F12		**[Explanation** of the investigation**]**	Every explanation counts as one utterance	**This is a ultrasonic investigation of your heart under stress conditions** *(1)***.**
	F13		**[Explanation] why** the investigation will be made	Every reason counts as one utterance	Because you have **diarrhoea** *(1)* and **abdominal pain** *(2)*, you should have another CT scan.
	F14		**[Duration]** of the investigation	Every date counts as one utterance	The ultrasound examination lasts for **about half an hour** *(1)*.
	F15		**[Implication]** if there is a specific investigation result	Every implication counts as one utterance	In the case of a negative result, you'll have to get used to the idea of a **cardiac pacemaker** *(1)*.
	F16		**Follow-up investigation will not take place at the emergence department…**	This statement counts as one utterance	We exclude only the most dangerous here, therefore **you cannot have the investigation carried out by us** *(1)*.
	F17		…because **[reason]**	Every reason counts as one utterance	**We exclude only the most dangerous here** *(1)*, therefore you cannot have the investigation carried out by us.
	F18		**[Points]** that **should be discussed** in follow-up investigation	Every point counts as one utterance	I would also mention to your primary care physician that you are **moving house** *(1)* and you are under **stress** *(2)*.
	F19		[**Documentation**] that will be sent to [physicians/wards]	Every document to be sent counts as one utterance	We will send the **report** *(1)* to your primary care physician in the next few days.
	F20		[Documentation] that will be sent to [**physicians/wards**]	Every physician or ward counts as one utterance	We will send the report **to your primary care physician** *(1)* in the next few days.
	F21		[**Date**] when documents are sent/delivered	Every date counts as one utterance	We will send the report to your primary care physician **in the next few days** *(1)*.
	F22		**[Investigations/treatment]** that relatives should undertake	Every investigation counts as one utterance	Your **partner must also be treated for worms** *(1)*.
	F23		**Any other information regarding** *Follow-Up*	Any other information regarding *follow-up* counts as one utterance	

Advice on self-care (A)	**A1**		Patient can't do much (with regard to *self-care*)	This statement counts as one utterance	**There is not a lot/nothing special** *(1)* that you can do.
	A2		Patient should **take care of him/herself**	This statement counts as one utterance	However, you should **take care of yourself** *(1)*.
	A3		**[more/less/abstain from: specific items of food]**	Every item of food counts as one utterance	Avoid **spicy** *(1)* and **fatty** *(2)* foods. Don't drink **coffee** *(3)*.
	A4		**[more/less/abstain from: physical activity/work]**	Every physical activity/work counts as one utterance	You should **walk a lot** *(1)* and **sit as little as possible** *(2)*.
	A5		No **[contact with (specific groups of) people]**	Every type of contact counts as one utterance	I would recommend that at you **avoid the visit from your brother** *(1)* until Friday.
	A6		...(until) **[date]**	Every date provided counts as one utterance	I would recommend that you avoid the visit from your brother **until Friday** *(1)*.
	A7		…[**reason**] for this measure	Every reason counts as one utterance	... because you are still very **contagious** *(1)*.

	A8		**under which circumstances]** something should/must be done	Every circumstance counts as one utterance	**When you feel well enough** *(1)*, you can go back to work.
	A9		**Any other information** regarding S*elf-Care*	Any other information regarding *advice on self-care* counts as one utterance	
Red flags (R)	**R1**		In **[which case/ciricumstance]** ...	Every circumstance counts as one utterance	**If the pain doesn't go away** *(1)*, you should definitely come back.
					If the **painkillers don't help** *(1)* ...
	R2		...should the patient present to **[the emergency department/specific physician]**	Every physician or ward counts as one utterance	...you should **come back to the emergency department** (1).
	R3		... should the patient present for **[clarification/intervention]**	Every clarification counts as one utterance	...for an **ECG** *(1).*
					...so that we could **admit you as an inpatient** *(1).*
	R4		**[Timeframe]** within or outside which something must be acted upon/done	Every date provided counts as one utterance	...in the **next few days** *(1).*
	R5		**The emergency department is always open**	This statement counts as one utterance	...you **don't need an appointment, you can just come along** *(1).*
	R6		**Any other information regarding Red Flags**	Every Any other information regarding *red flags* counts as one utterance	
complete Treatment (cT)	**C1**	Medication	**Prescription** is issued/handed over	This statement counts as one utterance	I've written you **a prescription** *(1).*
	C2		**[Medication]** (generic/brand name, descriptor e.g., painkiller)	Every medication counts as one utterance	**Triatec is a blood-pressure medication** *(1).*
					I prescribe you **metamizole** (1) and **aspirin** (2).
	C3		Patient should **continue to take medication**	This statement counts as one utterance	**Continue** *(1)* to take aspirin.
	C4		**[Reserve medication]** (generic/brand name, descriptor)	Every reserve medication counts as one utterance	As a reserve, I will **give** you **metamizole** *(1).*
	C5		**[In which scenario]** the (reserve) medication **should be taken**	Every scenario counts as one utterance	Take the medication**, when the pain gets worse** *(1).*
	C6		Medication **must also be taken** when **symptoms are no longer present**	This statement counts as one utterance	Take the medication for 14 days, **even when the pain has gone away** *(1).*
	C7		How the medication **works [process]**	Every explanation counts as one utterance	Riopsan is a gel that **lines the mucous membranes of the stomach and forms a soothing layer** *(1).*
	C8		**[Metaphor]** of the process	Every metaphor counts as one utterance	If you cut yourself and **put a plaster on a wound, it doesn't mean that it heals faster. But it helps prevent a new injury. And it's exactly the same with the gastric mucosa** *(1).*
	C9		**Reason why the medication is needed**	Every justification counts as one utterance	Pantoprazole, because from time to time **Voltarol (diclofenac sodium) attacks the stomach** *(1).*
	C10		**[Dose]**	Every dose (e.g., in mg, high/low dose/two at a time) counts as one utterance.	We start with a **dose of 5 mg** *(1).*

	C11		**How** the medication should be taken	Every explanation (e.g., chewed, swallowed, as a plaster, with food, on an empty stomach) counts as one utterance	Take the medication **on an empty stomach** *(1).*
					Take the tablet with water *(1).*
	C12		**How often (max) should medication be taken/temporal distance**	Every frequency (e.g., how often daily or weekly) counts as one utterance	Take paracetamol **four times a day** *(1).*
	C13		**[Time (of day)]** when medication should be taken	Every timepoint counts as one utterance	Take paracetamol in the **morning** *(1)***,** at **lunchtime** *(2)***,** in the **evening** *(3)* and at **night** *(4).*
					You can already start *(1)* taking the medication.
	C14		**Number of** tablets **still to be taken today**	This statement counts as one utterance	That means that you can take **one more tablet today** *(1).*
	C15		**[Until when]** should medication be taken	Every day or event counts as one utterance	Take the medication until the **gastric investigation** *(1).*
	C16		Which **combinations of medication** are allowed/prohibited	Every explanation counts as one utterance	Do **not take this medication with any other painkiller** *(1).*
	C17		**[Medication] that the patient should discontinue**	Every medication counts as one utterance	Stop taking the **paracetamol** *(1).*
	C18		**[When] the medication should show an effect**	Every timepoint counts as one utterance	The antibiotics should have an **effect from tomorrow** *(1).*
	C19		**[When] the medication can be collected**	Every timepoint counts as one utterance	You can pick up the medication **tomorrow** *(1).*
	C20		**[Where] the medication can be collected**	Every place counts as one utterance	There is an **emergency pharmacy** *(1)* here, where you can pick up the medication.
	C21		The patient has **already received the medication at the emergency department**	This statement counts as one utterance	It's the **same medication that you got here at the emergency department** *(1).*
	C22		(Possible) **[side effects]** of the medication	Every side effect counts as one utterance	The medication might make you **tired** *(1).*
	C23	Therapy	**[Therapeutic possibility]**	Every possibility counts as one utterance	Kidney stones can be treated **surgically** *(1)* or **conservatively** *(2).*
	C24		**[Therapy]**	Every therapy counts as one utterance	For the treatment of musculoskeletal pain, I recommend **physiotherapy** *(1).*
	C25		**[Justification]** of need for therapy	Every justification counts as one utterance	Physiotherapy will **strenghten your muscles** *(1)* ...
	C26		**[Effect]** of the therapy	Every effect counts as one utterance	... and this will help you to **have less back pain** *(1).*
	C27		**[Special task]**	Every task counts as one utterance	In the meantime, your **urine should be sieved** *(1).*
	C28		**[Justification]** for special task	Every justification counts as one utterance	The **abdominal belt supports the abdominal wall** *(1)*, which now has holes in it.
	C29	Certificate	**Medical certificate**	This statement counts as one utterance	I'll give you a medical certificate... *(1)*
	C30		**[Duration]**	Date up to which certificate issued counts as one utterance	…for **the next 7 days** *(1).*
	C31		**Any other information regarding complete Treatment**	Any other information regarding *complete treatment* counts as one utterance	

Other	**S1**		Advance information about **[who]** has still to see the patient	Every person (e.g., senior physician, nurse) counts as one utterance	Someone **from the study still has to come and see you** *(1).*
					A **nurse still has to see you** *(1).*
	S2		**…**reason **[why]** this person has still to come	Every reason counts as one utterance	… **to remove the cannula** *(1).*
	S3		Physician **wishes the patient well/a good recovery**	Every good wish counts as one utterance	**I wish you all the best** *(1)*.
	S4		**Comment** about **study**	Every comment counts as one utterance	Now we need to **record the consultation** *(1).*
	S5		**Any other information**	Any other information that is not classified in the "*InFARcT*" and "*other*" groups	