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UNIVERSITY OF COPENHAGEN

PhD thesis

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Developing and Evaluating a Classroom-based Intervention to Improve Hospital Team Communication

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Submitted: 15/03/2011

Ph.d. thesis

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"*There is nothing more difficult to arrange, more doubtful of success, and more dangerous to carry through, than initiating change...*"

Nicollo Machiavelli (1469 – 1527), 'The Prince', 1513

"*One of the best ways to understand the world is to try to change it*."

Chris Argyris (b. 1923), 'Action Science, 1985

The thesis is based on the following manuscripts:

1) Louise Isager Rabøl, Mette Lehmann Andersen, Doris Østergaard, Brian Bjørn, Beth Lilja, Torben Mogensen. Descriptions of verbal communication errors between staff. An analysis of 84 root cause analysis-reports from Danish hospitals. Qual Saf Health Care. 2011 Jan 5. [Epub ahead of print].

2) Louise Isager Rabøl, Mette Arnsfelt McPhail, Doris Østergaard, Torben Mogensen. Promoters and Barriers in Hospital Team Communication. A Focus Group Study. Submitted to Academic Medicine.

3) Louise Isager Rabøl, Doris Østergaard, Torben Mogensen. Outcomes of classroom-based team training interventions for multi-professional hospital staff. A systematic review. Qual Saf Health Care. 2010;19:e27.

4) Louise Isager Rabøl, Doris Østergaard, Mette Arnsfelt McPhail, Henning Boje Andersen, Brian Bjørn, Jacob Anhøj, Torben Mogensen. Outcomes of a classroom-based team training intervention for multi-professional hospital staff. Submitted to Academic Medicine.

Acknowledgements

First of all, I would like to thank my scientific advisors Torben Mogensen, Doris Østergaard and Henning Boje Andersen for sharing insight and giving respectful advice.

I would also like to thank my leaders at the Danish Society for Patient Safety Beth Lilja and Britt Wendelboe for support and encouragement.

I am thankful for the feedback from my colleagues at Unit for Patient Safety and the Danish Society for Patient Safety Annemarie Hellebek, Elisabeth Brøgger Jensen, Jacob Anhøj, Brian Bjørn and Mette Lehmann Andersen, and for the help I received from Karin Bylov Larsen and Botilla Møller.

I would also like to thank my colleagues Peter Oluf Andersen and Kurt Nielsen, Danish Institute of Medical Simulation; Jeanette Kirk, Department of Human Relations, Hvidovre Hospital; Lili Vallebo and Nina Model Jørgensen, Clinic B, Rigshospitalet; Mette Arnsfelt McPhail, sociologist, Connecticut; and the two 'aviators', Pernille Brandt and Mads Rovsing for inspiration and help.

I would like to express special thanks to my international supervisors on this project: Michael Leonard, Physician Leader of Patient Safety, Kaiser Permanente, Colorado; Allan Frankel, MD, Brigham and Women's Patient Safety Center of Excellence, Boston; and Drew Gaffney, Professor of Medicine at Vanderbilt University School of Medicine, Nashville, USA.

I would like to express my gratitude to the patients, staff members and leaders from the involved hospital departments for their active participation and feedback: The Department of Cardiology and Pulmonary Diseases, Hvidovre Hospital, The Department of Cardiology and Department of Obstetrics and Gynaecology, Roskilde Hospital, the Paediatric Department, Viborg Hospital and Department of Internal Medicine, Amager Hospital.

I am grateful for the funding of the project from the *TrygFoundation*, *Det Kommunale Momsfond* and *The Pharmacy Foundation of 1991*.
Finally, thanks to my family for patience and support.

Louise Isager Rabøl, Copenhagen, March 2011.

Contents

Glossary and abbreviations

Adverse event: An undesired patient outcome that may or may not be the result of an error (1).

Assertion: Insistence on having ones opinions and rights recognized (2).

Briefing: A short and concise summary of a situation (3).

Checklist: a cognitive tool that specifies the actions necessary to complete a given task. It serves to improve the quality of care, support the memory of the user and may serve to indicate the necessary communicative steps within a team (4).

Communication: A process of transferring information from one entity to another. In traditional general communication models there is a sender, a receiver, a message, a filter or noise that can alter the message, and (in some models) feedback (5).

Communication error: Missing or wrong information exchange or misinterpretation or misunderstanding (1).

Contributing factor: Additional reasons, not necessarily the most basic reason that an event has occurred (1).

Crew Resource Management (CRM): A concept from aviation described as 'A formal programme of training in teamwork and other non-technical skills' focusing on 'the effective use of all available resources: Human resources, hardware, and information in order to achieve a safe flight' (6).

Error: The failure of a planned action to be completed as intended or use of a wrong, inappropriate, or incorrect plan to achieve an aim (1).

Handover: The transfer of professional responsibility and accountability for some or all aspects of the care of a patient, or group of patients, to another person or professional group on a temporary or permanent basis (7).

High reliability organisation: An organisation in which errors can have catastrophic consequences, but in which errors are avoided most of the time. In these organisations error avoidance and safety are as much a part of the bottom line as is productivity (8).

Human factors: The scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the professions that apply the theory, principles, data and methods to design in order to optimize human well-being and overall system performance (9).

Interprofessional training: The instances when two or more professions learn with, from and about each other to improve collaboration and quality of care (10).

ISBAR: Mnemonic for structuring of communication during handover of patient information (11).

ISBAR med SALSA: Mnemonic for structuring of communication during transfer of patients (11).

Multiprofessional training: When participants from two or more professions learn along each other (rather than interactively) (10).

Non-technical skills: The cognitive and social skills, not directly related to surgeons' clinical knowledge, dexterity and use of equipment, which underpin technical performance and have been identified as requirements for a competent surgeon (12).

Patient safety: Freedom, for a patient, from unnecessary harm or potential harm associated with healthcare (1).

Patient safety incident: An event or circumstance which could have resulted, or did result, in unnecessary harm to a patient (1).

Patient safety practice: A type of process or structure whose application reduces the probability of adverse events resulting from exposure to the health care system across a range of diseases and procedures (13)

Read-back: Repetition of (central parts of) instructions received (verbally) (14).
Root cause analysis (RCA): A systematic iterative process whereby the most fundamental reasons an event has occurred(1) are sought identified by reconstructing the sequence of events and repeatedly asking "why?" until the underlying root causes have been elucidated (1).
Safety Attitude Questionnaire (SAQ): A snapshot of the safety culture through surveys of frontline worker perceptions (15).
Safety Culture: The product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisations health and safety management (16).
Simulation: An educational technique that allows realistic interaction by recreating a clinical experience without exposing patients to the associated risks (17). This is often accomplished through the use of mannequins and advanced software (18).
Team: [Two or more] interdependent individuals with specialized knowledge and designated roles with respect to a common goal (19).
Team training: Applying a set of instructional strategies, to specific team competencies (20).
Transfer (of training): The degree to which trainees apply the knowledge, skills, behaviours, and attitudes they gained in training to their jobs (21).
Trigger: Information in a patient record indicating a possible deviation from normal (22).

Two abbreviations used in the thesis are not mentioned above:
RCAR: Root causes analysis report
VCE: Verbal communication error

Introduction

Safety as a healthcare research field came on the agenda in 1999 when Institute of Medicine[1] issued the report 'To Err is Human: Building a Safer Health System' (23). The report was based on studies from the 1990's on the incidence and preventability of adverse events in American and Australian healthcare institutions (24-26). Audits of more than 60,000 patient records found adverse event rates between 2.9% and 16.6%. Based on these data the report estimated that 44,000 to 98,000 deaths occur annually in US as the consequence of healthcare adverse events - equalling the eighth leading cause of death, or more deaths than from breast cancer, vehicle accidents or AIDS. The report became the starting point of extensive funding of patient safety research in especially the US.

From safety in other domains to patient safety

Previously, most errors in healthcare were viewed as a result of personal incompetence and lack of dedication. However, this view made adverse events hard to prevent as all humans can make mistakes ('The human Factor') and 'trying harder' is an unreliable safety barrier (27). Patient safety researchers therefore had to look to other domains for inspiration on how to strengthen safety in healthcare:

By looking at aviation, patient safety researchers found 'The system perspective': Healthcare staff goes to work with the best of intentions. Prevention of adverse events should consequently not focus on the individual but on improving the barriers in order to prevent the unavoidable human errors from harming the patients (28-30).

Safety barriers have a key position in the system approach: Alarms, physical barriers and automatic shutdowns, people, procedures and administrative controls function is to protect patients from hazards. The barriers have weaknesses, however. This is famously illustrated by the 'Swiss cheese-model' developed by James Reason. The presence of holes in a 'slice' does not normally lead to a bad outcome. Usually, this can happen only when the holes in many layers momentarily line up thereby permitting hazards to harm patients. The barriers have holes because of 'active failures' and 'latent conditions' which nearly all adverse events are a result of. 'Active failures' are the unsafe acts committed by people who are in direct contact with the patient or system. 'Latent conditions' arise from decisions made by designers, builders, procedure writers, and top level management (30).

[1] Institute of Medicine is part of the United States National Academy of Sciences

In order to manage errors there is a need for categorisation: Slips and lapses happen when someone executes an action sequence wrongly. Mistakes happen when someone is in conscious control mode and successfully executes a faulty plan. In a complex system - such as healthcare - slips, lapses and mistakes are inevitable. Violations are a noticeably different type of aberrant behaviour. They are deviations from rules, protocols or norms, and always have an intentional component. Each of the error types requires different strategies for remediation (27;30).

Human problem solving can generally be broken down into three distinct categories: skill-based, rule-based and knowledge-based behaviour which refer to the degree of conscious control exercised by the individual over his or her activities. In the knowledge based mode, the human carries out a task in an almost completely conscious manner. Skill-based behaviour takes place without conscious control. At the rule-based level the level of conscious control is intermediate between that of the knowledge and skill based modes (31).

In aviation, analyses of black box-recordings from airplane crashes in the 1970's and 1980's had provided crucial new insight into communication, teamwork and the importance of also junior crew members to speak up if they believe current actions are compromising safety: In contrast to earlier beliefs, air disasters were found to be caused mainly by human error – not by technological malfunctioning. This eventually led to recommendations of training of all flight personnel in team- and non-technical skills like interpersonal communication, assertion, teamwork, leadership and decision making – called Crew Resource Management (CRM) (32). CRM since became a mandatory part of training for all aviation personnel (33).

Research at nuclear power plants has similarly contributed to the understanding of how strong teams may capture and correct human error when team members are encouraged to provide inputs to each other and their team leader on identifying and mitigating and, in general, learn from near misses (34).

Finally experiences from psychology, aviation, construction, production and other industries have inspired the use of cognitive aids like checklists and reminders in healthcare (35).

Teams and communication

Since the publication of *To Err is Human*, studies of errors in healthcare have surged and observations of healthcare teams and analyses of patient safety incidents indicate, that failures in communication and teamwork underlie many of the events. It is now well established how poor teamwork and communication are correlated to adverse events (36-38), staff performance problems

(39;40), higher patient morbidity (41;42), and mortality (43-45). There are several explanations for this phenomenon: Some of the most influential explanations being differences between the staff groups communicating (46), a complex work environment (36;47;48) and a strong hierarchy that prevent some staff members from speaking up when concerned or in doubt (36;49;50).
So far, most published studies of communication and teamwork are based on observations in highly specialized areas of care: Operating rooms or intensive care units (38;40). Even though these areas can have a higher need for accurate information exchange due to the patients complex and acute condition, all areas in healthcare can possibly benefit from reliable information exchange (23;48;51). Leading institutions advocating safety in health care now recommends building stronger teams (52), introducing communication tools (53;54) and team training (55-57) throughout healthcare.

Danish aspects

Following the increased international focus on adverse events 'The Danish Adverse Event Study' was published in 2001 (58). The study audited 1100 patient records and found that 9% of all hospital admissions were affected by adverse events. Based on these results and requirements for accreditation by Joint Commission International (59), the hospitals in Copenhagen established the first Danish confidential patient safety incident reporting system for hospital staff in 2001 along with methods to analyse severe or frequent incidents, mainly the root cause analysis (RCA) (60).
Most patient safety research publications emanate from American healthcare institutions. They are broadly relevant in the Danish healthcare system. However, the Danish and the US healthcare systems differ on important aspects which can justify research on Danish aspects of patient safety issues:
Denmark has an 85% publicly financed healthcare sector. Danish hospital doctors are employed by the hospitals and affiliated with certain departments and floors. In Denmark bi-professional nurse–doctor rounds are the norm and salaries are relatively uniform. Continuity of care within the hospitals is the responsibility of the team and the organisation – not the individual doctor's. This is in contrast to American physicians and the mainly insurance-based American healthcare system where patients in general select their own doctors, who run their own clinics in the community and admit patients to the hospital of their choice. Doctors care for their own in-patients and often round with a handful of residents without the nurses. Specialized American physicians have a salary of ten times more than a resident and fifteen times more than a nurse (own observations and (61;62)).

Research from other domains confirms that Danish national culture on important aspects differ from the Anglo-Saxon countries. One important aspect is that Denmark is a country with very low authoritarian gradient (63-66). These structural and cultural differences can have impact on how Danes interact, approach authorities and accept hierarchy. This again has direct influence on communication and teamwork, for instance how actions of team leaders are questioned and how new techniques (like checklists and communication structuring) are readily accepted by the learners (63;64).

The above mentioned international recommendations, the international reports of widespread communication challenges in healthcare, the early international reports of results of team communication training interventions (49;67), the reports about adverse events in the Danish healthcare system (58) and the experience that the Danish healthcare system in crucial ways differ from the Anglo-Saxon, formed the idea of not only translating a team training intervention into Danish, but to develop an intervention tailored to the needs of Danish healthcare teams.

Research questions

The overall aim of this thesis is to systematically develop a classroom-based team communication training intervention for Danish hospital staff and evaluate the outcomes.

Four sets of research questions are generated from the overall aim:

The specific research question pertaining to study 1 is:
What do multiprofessional root cause analysis teams describe as the system-level team-communicative causes in a sample of severe in-hospital adverse events?

The specific research question pertaining to study 2 is:
When in a multiprofessional focus group setting, what do Danish hospital staff members describe as the pathways of multiprofessional team communication and what are the promoters and barriers of these pathways?

The specific research question pertaining to study 3 is:

Based on a systematic review, what are the previous international outcomes of classroom-based team communication interventions for multiprofessional hospital staff?

Based on the needs assessment the specific research questions pertaining to study 4 are:

a) To evaluate if communication skills among staff seven months after the initiation of a classroom-based team training intervention in a cardiology department are better than the skills of staff in a similar department receiving no intervention.
b) To evaluate if the level of adverse events harming patients is reduced six months after the initiation of a classroom-based team training intervention when compared to staff in a similar department receiving no intervention.
c) To elicit and analyze the participants' attitudes towards the intervention.

Ethical considerations

Danish law exempts this type of research from ethical board approval. The Danish Data Protection Agency approved the studies. The National Board of Health approved the record audit. Participation in the two questionnaires among staff was voluntary and anonymous. Staff included in the observation study and follow-up interviews gave written informed consent.

Structure of the thesis

After the introduction, which includes the research questions of this thesis, the section 'Theoretical Framework' describes the background for patient safety interventions, the learning theory, and the methods and methodology that this paper is based on.

The research questions of this thesis are subsequently addressed through four individual studies: '**Paper 1**' and '**Paper 2**' constitute the needs assessment that precedes the development of the training intervention. The first paper describes a text analysis of reports from the analysis of severe adverse event in six Danish hospitals. The second describes the main verbal communicative situations and their promoters and barriers as identified by multiprofessional focus groups from four Danish hospitals. '**Paper 3**' is a systematic review of studies evaluating the existing evidence of classroom-based team training for multiprofessional hospital staff.

In order to understand and discuss the intervention three appendices are added to the thesis: An appendix describing the details of how the curriculum was planned based on the needs assessment

(**Appendix 1**), another describes the curriculum itself (**Appendix 2**) and a third describing how the curriculum was tested before establishment of the final curriculum (**Appendix 3**).

'**Paper 4**' describes the evaluation of the team communication training intervention for multiprofessional hospital staff with regard to reactions, learning, behaviour and clinical results. Further it reports the results of a qualitative study exploring why the intervention had the effect it had.

The four papers are followed by a general discussion of the results including a discussion of the limitations of the studies, the perspectives and recommendations for the future and a conclusion. The thesis finally includes summaries in English and Danish.

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Theoretical framework

This section aims at describing the theoretical framework for this thesis: how theories of patient safety, learning, implementation in healthcare, and former empirical studies form the base for development and evaluation of a classroom-based team training intervention for hospital staff. It also describes the paradigms on which the thesis is based and their ontology, epistemology, methodology and methods.

Patient safety interventions

Patient safety researchers use a wide variety of approaches and views to characterise patient safety, study failures and successful performance, and improve safety. This section will account for the views of patient safety fundamental for this thesis.

A patient safety practice can be defined as "a type of process or structure whose application reduces the probability of adverse events resulting from exposure to the health care system across a range of diseases and procedures" (1).

Adverse events in healthcare are – in the nature of things – diverse: From medical adverse events, to wrong-site surgery, to in-hospital patient suicides, to hospital-acquired infections. Interventions aiming at reducing them thus have to target the system at different levels: physical rebuilding, improved medical devices, forcing functions, simplifying or standardising of procedures, software modifications, checklists, enhanced communication, training and guidelines to name a few (2).

Since the publication of 'To Err is Human' (3) patient safety researchers have focused on both how to build physical barriers but also how to strengthen the safety culture among those providing and receiving care (4). 'Safety culture' can be defined as 'the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's health and safety management. Organisations with a positive safety culture are characterised by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventive measures (4). Hence, a strong organisational safety culture is found to be as critical for the level of adverse events as other physical and procedural barriers described above (5).

There are several theories on how to improve the safety culture:

Three of the most frequently cited are (4):

- *High Reliability Organisation Theory*: Humans operating and managing complex systems are not sufficiently complex to sense and anticipate the problems generated by the system. Proper organisations of people, process and technology can handle complex and hazardous activities thus improving reliability (4).
- *Model of Cultural Maturity*: Safety cultures evolve through five levels of maturity, from the least mature (pathological) through to mature (generative). Each level describes the stage of safety culture development. This information can enable organisations to diagnose the current level of maturity, identify areas of strengths and weaknesses, and actions to reach the next level (4).
- *Donabedian's Process-Structure-Outcome Model*: Healthcare organisations can be described in terms of structure, process and outcomes. Structure is defined as the conditions in which care is provided (materials, human resources, organisational characteristics). Process includes activities to provide care. Outcomes are results or changes that can be attributed to care. Each component is dynamic and transactional and may influence safety outcomes (4).

Changing the culture in an organisation takes years and substantial effort at all levels of the organisation (6;7). One of the most comprehensive efforts to improve the safety culture within a system is probably found in The Veterans Health Administration (VHA), the about 184 publicly financed hospital for veterans in the US. The VHA patient safety effort has been a combination of partnering with other safety-related organizations, establishing centres to direct the safety efforts, establishing patient safety incident reporting systems, and providing incentives to health care team members and division leaders constituting the intervention (6;8). The VHA experience is a good example of the complexity of a patient safety intervention aiming at reducing the number of adverse events. One part of the VHA patient safety programme is a comprehensive team training programme aimed at all staff members in the organisation (9). This intervention has recently been related to a reduction in in-patient mortality (10).

Healthcare systems are complex systems implying gaps in continuity of care between people, stages, and processes. Analysis of accidents usually reveals the presence of many gaps, yet only rarely do gaps produce accidents (11). A handover is defined as the transfer of professional responsibility and accountability for some or all aspects of the care of a patient, or group of patients, to another person or professional group on a temporary or permanent basis (12). A handover thereby aims at bridging a gap in the continuity of care.

However, we know little about how practitioners identify handovers and gaps (11;13;14).

In a human factors perspective training in itself is considered a relatively weak barrier to errors, because of the lack of forcing functions. However, if training is a part of a wider patient safety culture programme (8;9), and if training is followed by organizational changes, the ability of the intervention to contribute to preventing errors becomes stronger (15). One technique that has the potential to support the effect of training is a checklist. A checklist is a reminder or cognitive tool that specifies the actions necessary to complete a given task. It serves to improve the quality of care, support the memory of the user and may serve to indicate the necessary communicative steps within a team (16). Preliminary results of checklist-use in healthcare indicate a potential for patient safety, in part due to its ability to structure tasks and define the necessary communicative steps (17). However, no evidence indicates that a checklist in itself is sufficient to obtain clinical results: training and motivating staff, supporting implementation, and conducting follow-up and evaluation are as important as the checklist itself to achieve results (18).
Mnemonics such as the use of the SBAR-technique are other cognitive tools with the potential to aid cognition that has received wide attention in healthcare over the last few years. However, studies of the impact on patient safety of using mnemonics have so far shown very limited results (19).
Another cognitive aid that has received attention, is the procedure of confirming critical verbal information through a 'read-back' (20). Evidence of the impact of this procedure on patient safety is lacking (21) and the read-back has so far been accepted in patient safety because of its face value.

Translational research

Translational research is the science of making the results of basic research applicable in practice (22). In medicine theories and strategies of implementation (23;24) are used to translate the findings in basic research more quickly and efficiently into meaningful physical, mental, or social patient outcomes.
Vast resources are invested in development of new drugs and technologies and comparatively little in improving systems to ensure the delivery of these drugs to all patients in need. The misalignment of priorities is by some seen as driven partly by the commercial interests of industry and by the public's appetite for technological breakthroughs. Health, economic, and moral arguments are

thought to make the case for spending less on technological advances and more on improving systems for delivering care (25).

However, translating evidence into practice is challenged by the fact that most interventions to improve delivery of care are complex and affected by culture and everyday circumstances. In the nature of things, this challenges the usual research methods in medical science of randomizing, controlling and blinding participants. These controls will often have no possible or meaningful role when an intervention is implemented and studied in a complex organisational context. Other methods than the standard randomized controlled trials of biomedicine are therefore necessary: Translational research can therefore benefit from a triangulation of methods including quantitative and qualitative to establish why an intervention provides changes (26).

Complex interventions

A complex intervention is defined as an intervention with several interacting components, a range of possible outcomes and a diverse target population (27). An example is an intervention to improve peri-operative patient handling. Such an intervention could include both a peri-operative checklist, a training programme for staff to learn how and why to use the checklist, and a change in the surgical booking IT-system. Such an intervention does not only entail practical problems but also special challenges regarding standardisation, sensitivity to local context, organisational difficulties and challenges in justifying the causal chain of linking the intervention with the outcomes (27;28).

Due to these challenges, it will be necessary to make adaptation to the local setting and obtain a theoretical understanding of how the intervention causes change. Complex intervention also necessitates a range of outcome measures to evaluate the intervention in order to estimate not only how it works compared to the usual treatment but also why it works (28).

Complex interventions can as such be a lengthy process of identifying the evidence base and theory, modelling the intervention, testing the procedures, estimating recruitment and sample size, assessing effectiveness, understanding the change process, assessing cost effectiveness, disseminating the intervention, monitoring it and follow up (28;29).

Complex interventions are common in patient safety and are becoming increasingly a focus of healthcare in general. Consequently, the British ‘Medical Research Council’ updated its guidelines on how to develop and evaluate complex interventions in 2008 (28). These guidelines are used as a base for this thesis.

Action research

Action research is a research field that involves change experiments aimed at solving particular problems in a system. When an intervention study pursues action and research at the same time, uses an iterative approach of action and critical reflection, continuously refines the methods and involves the participants in the project (as change is usually easier to achieve when those affected by the change are involved) its approach and methods can be labelled as 'action research' (30). Action research often pursues change and understanding by using a cyclic or spiral process of identifying a problem, planning, acting, and evaluating to continuously refine methods, data and interpretation. It is thus an emergent process that takes shape as understanding increases. Evaluation often involves both qualitative and quantitative methods (method triangulation). The researcher is an interventionist who seeks both to promote learning in the system and to contribute to general knowledge (31).

In action research the intended change is typically at the level of norms and values. Action research is intended to contribute simultaneously to basic knowledge in social science and to social action in everyday life. High standards for developing theory and empirically testing this are not to be sacrificed. At the same time relation to every day practice should not be lost (32).

Learning theory

Although learning most often occurs informally through everyday experiences, and competence can be achieved without formal training, the rapid advances and the accumulation of knowledge in the sciences make it unlikely that someone could attain skills and especially achieve full mastery of a domain without undergoing formal training (33).

Similarities in team structure and modes of operation suggest that theories and methods of team communication and team training may be adapted from other domains (for instance aviation, the petro-chemical industry, nuclear power plants and oil rigs) to healthcare teams (34-36). Healthcare is considered more uncertain and complex than most other domains though, due to the necessary individualized relationship with patients and the influence of the professions. This means the usefulness of unedited aviation interventions in healthcare is doubtful (15;37). However, with thorough adjustment healthcare can learn from other domains (38;39).

Several theories of learning are applicable for healthcare team communication interventions:

In order to improve outcomes and limit resistance among adult learners it is recommended to base an intervention on adult learning strategies which include using learners' experiences, preparing

them for what they are going to learn about, providing a relaxed and respectful learning climate and involving learners in developing the programme (40).

Team communication training has behavioural learning elements: Training not only provides participants with concrete tools that tell them how they are expected to communicate but it also includes time to practice these methods (41;42).

However, the dominant paradigm for team communication training is related to the cognitive learning theories. These relate to the aim of providing participants knowledge on patient safety, teams and communication to allow them to understand in order to allow for transfer of what is learned theoretically or conceptually to actual behaviour in the workplace situation (33;43). Where the behaviouristic learning theorists focus on practice and similarity of conditions to support transfer, the cognitive learning theorists find these insufficient to ensure transfer in complex domains. According to cognitive theorists learning transfer depends on adaptability, flexibility, and competence beyond the mere memorization of information to apply knowledge from one known concept to a new concept or from a familiar situation to an unfamiliar new situation. In this view transfer depends on whether learners are allowed to reflect on learning and understand the topic, and whether training includes self-monitoring, feedback on performance and the use of the learner's prior knowledge and experiences (33).

One important cognitive learning theory is the Cognitive Load Theory (CLT). In essence, CLT proposes that since working memory is limited, the complexity of instructional materials has to be managed to prevent cognitive overload, as this will impair the establishment of mental structures serving to organize information in typical ways, resulting in a lower performance (33).

Another cognitive learning theory is the Situative Theory (ST). Where CLT focuses on learning in the individual, the ST views cognition as a property of individuals interacting, and it holds that there is the opportunity for learning in any social organized activity (33, 44).

The Technology Acceptance Model (TAM) is an information systems theory that is relevant when discussing the cognitive processes of the individual's uptake of a new technology as communication structures, mnemonics and checklists. TAM models how users come to accept and use a technology. The model suggests that when users are presented with a new technology, a number of factors influence their decisions about how and when they will use it. These factors include the perceived usefulness and the perceived ease of use (45). The TAM has similarities with the Theory of Planned Behaviour (TPB) which links attitudes (and subjective norms and perceived behavioural control) to behaviour (46).

Team training

With inspiration from other high risk domains healthcare has adopted team training to prevent error influenced by lack of team working knowledge, skills and attitudes (36;47). Team training has mainly been adopted as either Crew Resource Management (CRM) training (48) or non-technical skills training (NTST) (49). Both focus on providing the team member the necessary team working, problem solving, decision making and information gathering competencies. The two approaches have many more similarities than differences. However, CRM put greater emphasis on interaction in the team where NTST put greater emphasis on the skills of the individual.

Team training has been transferred to health care using two teaching techniques: a classroom-based model (50) or a simulation-based (51), or a combination of both (9). Classroom-based interventions use lectures, video demonstrations, discussions and role-plays to strengthen participants knowledge, skills and attitudes (9;52;53). Simulation is an educational technique that allows realistic interaction, typically by the use of high fidelity mannequins and advanced software to recreate a realistic clinical experience without exposing patients to the associated risks (51;54). The choice of classroom-based intervention, at the expense of a simulation-based, was grounded on the opportunities in the classroom-based version for both declarative and procedural learning (55), interprofessional discussions of circumstances and solutions (56) and logistic and economic considerations: as opposed to the high-fidelity simulator-based method the classroom-based method allows for training of a large staff groups at a time and requires no expensive equipment (57).

In order to improve interprofessional teamwork, training itself has to include all the professions of the team (58). This is explained by the benefit of socialization, and of exchange of professional experiences and normative maps that can result in improved ability to reflection and self-reflection and thereby ultimately to an improved ability guide patients (44;56).

Design-based research

Classroom-based iterative and systematic design experiments in naturalistic social and political contexts can be covered by the term ‘design-based research’ (DBR) (59-61). DBR is thereby an empirical research model characterised by theoretical interventions implemented in natural settings in order to test the validity of the theory and to generate new theories and frameworks for conceptualizing learning, instruction, design processes, and educational reform (60). DBR is typically a series of approaches, with the intent of producing new theories, artefacts, and practices that account for and potentially impact learning and teaching in naturalistic settings (61). The aim is

to gain new insight of training in realistic settings and to understand the variation – not to eliminate it. DBR requires a qualitative and inductive component in order to find answers to 'how' and 'why' in addition to 'how many?' (62).

DBR methodologies can be viewed as "non-scientific" from a positivistic view-point due to the ongoing changes of the intervention. However, researchers in DBR argue that DBR goes beyond merely designing and testing particular interventions. The interventions 'reflect a commitment to understanding the relationships among theory, designed artefacts, and practice' and, at the same time, research on specific interventions can contribute to theories of learning and teaching (63).

In DBR the researcher moves beyond simply observing to systematically engineering contexts in ways that allow evidence-based claims about learning: The study of context requires the researcher to be present in the classroom and study more than one variable at a time, including challenges of 'real life' – factors that can't be foreseen but that the research aims at describing. This can provide meaningful insights but can also limit objectivity and make the approach susceptible to bias (62).

The often complex nature of DBR makes the intervention challenging to comprehend for outsiders if not described in detail with emphasis on tools, materials, task structures and participation structures (64) and teacher-student engagement (62).

Transfer of training

Transfer of training may be defined as the degree to which trainees apply the knowledge, skills, behaviours, and attitudes they gained in training to their jobs (22;65). Much of the research on transfer has focused on uncovering the training design factors that influence transfer. However, it has been suggested that several other factors influence transfer: factors in the person and the organization, the opportunity to use training, and motivational influences (43;65;66). It has thus been suggested to consider transfer through all the phases of curriculum planning, training and follow-up (43).

Curriculum development

A systematic approach is useful when planning a curriculum: Conducting a needs assessment; finding the objectives of the curriculum; deciding upon content, the organisation, educational strategies, teaching- and assessment techniques, and how to communicate the curriculum; what educational environment should be fostered and how the process is to be managed (67). Kern adds the importance of acquiring political support and resources to improve implementation (68). Getting support from relevant players (leaders, physicians) is suggested by others (47;69;70).

Needs assessment

In order to determine the needs for training of individuals, teams and organisations, a systematic needs assessment of who the problem affects and how they are affected must be carried out. This can be done through studies of critical incidents, tasks, star performers and existing curricula (33;68;71).

In team training programme development it is recommended to use direct observation, questionnaires, work life diaries, individual or group interviews, system documents and observed job performance to get insight (72). In healthcare it is recommended to use data from event reporting systems to understand errors, look for patterns and develop corrective actions (73), and to use the results of safety attitude questionnaires (SAQ) (35).

The following sections give a brief introduction to the methods used in the needs assessment for this study (more thorough descriptions of methods are found in the included papers):

Critical incident analysis (Text analysis)

There are several methods to analyse safety in medicine (74;75) with focus on investigation of critical incidents (76;77).

A root cause analysis (RCA) is a thorough retrospective analysis of a severe adverse event. RCA is based on the principles of systems theory (16). It is internationally acknowledged for its ability to analyse severe patient safety incidents in a system approach (78;79). However, the RCA is challenged by its retrospective approach that increases the risk of hindsight bias (80).

During the RCA process a multi-professional team analyses the adverse event by asking' What happened?', 'Why?' and 'How is a similar event prevented'. This process results in a consensus report that describes the event, the team, the possible causes, the necessary actions and the process. Copenhagen hospitals have used the RCA-method to analyse the most severe adverse events since 2001(81).

Task analysis, critical incident analysis and description of star performers (Focus group interviews)

The focus group method is used in areas with limited previous knowledge and is well suited for research on group practice, interactions and norms. It relies on the interaction and discussion among participants (as opposed to the individual interviews) and open-ended questions with minimal

interruption by the facilitator. As opposed to questionnaires or field observation, the facilitator can ask for clarification, elaboration and input from other participants (82-84).

Existing experiences (Systematic review)

A systematic review is a literature review focused on identifying, appraising, selecting and synthesizing the existing evidence relevant to one research question. The first step in a systematic review – after formulating the research question – is to conduct a systematic and predefined search of relevant studies in the relevant databases. The latter can be challenging in a field like multi-professional classroom-based hospital team communication training, as the topic has roots in medicine, nursing, training, psychology, sociology and organisational research. Relevant studies can thus be found in many different databases and journals plus in the 'grey literature' – reports, magazines and non-peer review journals. Besides, the terminology is not well-established and relevant studies can be indexed under many different terms. Due to methodological challenges many studies will in addition not live up to the quality standards of traditional medical research (85). However, they can still hold valuable information about the reception of the intervention among the target group. Excluding studies with a risk of bias, like non-randomized studies, will therefore not make sense in a systematic review of the experiences in this field (23;28).

Pilot tests

In accordance with the theories of action research and complex intervention theories (27;28;32), developing complex intervention involves (several rounds of) testing the acceptability of messages, materials and schedules, and estimating compliance, recruitment, retention and sample size. A pilot study need not be a 'scale model' but should address the main uncertainties that have been identified in the development work. Effects in pilot tests should be interpreted cautiously as effects may be smaller or more variable when rolled out across a wider setting (28).

Evaluation

When evaluating complex interventions, a variety of measures are relevant for others to understand the impact: How did the underlying theories and the evidence influence the design? How was the feasibility studied? And how was the intervention implemented (disseminated and monitored)? What were the qualitative and the quantitative results respectively? (28).

Training interventions are recommended evaluated with respect to participants' reactions to the training itself, their learning, the behavioural changes in their daily work life and the clinical results

(86). The use of this 'evaluation-ladder' can aid the process of determining whether a clinical result could be attributed to the intervention or not.
Similarly, it is recommended that action research be evaluated in a cyclical manner so that the results of evaluation may be used to improve the intervention (30;32).

In the following section, the methods used to evaluate the intervention in this thesis are described in brief. The methods are described in more detail in the included papers.

Implementation and feasibility (Semi-structured interviews)

Semi-structured in-depth interview are used to elicit the quality of feelings, experiences, motives and wishes of the person being interviewed. The interviews are based on a common interview protocol, but questions and the language are adapted to the informant, and the course of the interview is determined by the interaction between the interviewer and the informant. As in the focus group interview, the semi-structured interview allows for clarification and elaboration (87).

Outcomes (Record audit)

For patient safety interventions, the ultimate outcome is a reduction in adverse events. A trigger tool is used to systematically identify indicators ('triggers') in patient records of adverse events, such as abnormal laboratory values or the prescription of antidotes. Cases with positive triggers are subjected to further investigation to determine whether an adverse event occurred (88-90).
In complex interventions, the usual research methods such as the randomized controlled trials are unsuitable, due to challenges of randomizing intervention units, and blinding those receiving the intervention. Furthermore, there are issues of controlling the intervention, as all other factors than the intervention itself cannot be left out, as they can in, for instance, testing of new drugs. However, comparing two comparable units where one receives the intervention and the other does not, can still reveal valuable information about the effect (28).
Statistical process control (SPC) is a branch of statistical science that comprises methods for the study of process variation. Common cause variation is inherent in any process and predictable within limits. Special cause variation is unpredictable and indicates change in the process. The run chart is a simple tool for analysis of process variation. Run chart analysis may reveal anomalies that suggest shifts or unusual patterns that are attributable to special cause variation (91-93). While SPC has been applied most frequently to controlling manufacturing lines, it applies equally well to any

process with a measurable output. SPC is a useful method to study the level of adverse events found during systematic record audit using the trigger tool-approach.

Knowledge, skills and attitudes (Questionnaire studies)

A questionnaire is a written series of questions used for collecting data. In order to obtain a quantitative picture of the effect of an intervention, a questionnaire using closed-ended questions and predefined answer categories can be useful. Two major challenges, when using the questionnaire method, are a valid construction of the questionnaire and the possible differences between self-assessed behaviour and observed or real behaviour (94). Method-triangulation and a process of validation and a thorough discussion of internal and external validity are therefore important. Despite the bias, self-assessment often holds valuable information about for instance experiences, knowledge, attitudes and behaviour, which can not be obtained with other methods (94).

Observation

A method to evaluate the effect of a training intervention is the observation of behaviour. Observations can take place as an open (ethnographic) study of behaviour, or as a more quantitative measure of behaviour. Several observational techniques have been validated to measure team communication in an operation room setting before and after team communication training interventions (95-97). The above-mentioned issues of control vs. comparable departments are relevant here as well.

Paradigms and methodology

A paradigm is characterised by its ontology, its epistemology and its methodology. In medicine the traditional paradigm is the objectivity-seeking positivistic paradigm. In contrast, the social sciences aim for the deeper understanding of context and relationships found in the phenomenological paradigm (98;99).

Positivism aims at establishing ‘What is evidence?’ and ‘What is unbiased?’ and strives for neutral or value-free knowledge. The research approach is based on an aim of discovering objective facts through experimentation, prediction and control. Theory is thereby established inductively and tested deductively through verification and falsification (i.e., particular outcomes are deduced from a given theory, and if the outcomes do in fact occur, the theory is – to some extent – verified, and if they do not occur, the theory is in principle falsified) . In the positivistic paradigm quantitative

methods, often including statistical testing of hypotheses (e.g. randomised controlled trials, questionnaires) are prevailing (98).

In phenomenology the quest for inter-subjective truth is abandoned. There are multiple, diverse interpretations of reality. Focus is on understanding and meaning is constructed in the researcher–participant interaction in the natural environment. The methods are qualitative in order to gather rich interpretations of a phenomenon (observations, interviews, narratives) (98;100;101).

In medical education both paradigms can be justified. It has been argued that quality of research is defined by the integrity and transparency of the research philosophy and methods, rather than the superiority of any one paradigm (98).

From theory to practice

After the above description of the research questions and the theories applicable for the thesis, this section will describe how the theories directed the studies, in order to answer the research questions. However, a brief description of the author's pre-understanding is necessary to understand the choices, as the researcher's pre-understanding of the field becomes important when qualitative methods are used.

Pre-understanding

The thesis is based on the author's experiences as a resident in the Danish public healthcare system followed by a fellowship in administrative medicine and patient safety. Both positions formed a picture of how unpredictability, work environment, organisational changes, culture and demands for efficiency challenge patient safety. Along with the insight into reports of patient safety incidents and participation in adverse event analysis, followed an urge to know more and - if possible - to contribute to improving the system.

Use of theories

The theories of human factors and human error, the system perspective, patient safety and team communication were used to develop an intervention aiming at strengthening patient safety by providing the participants knowledge and attitudes to improve the safety culture, skills to optimise team communication and organisational guidelines for staff to aid their memory and signal how they are actually expected to communicate in the team. Theories of checklists and mnemonics in healthcare and theories of transfer and translational research were used to develop the educational materials, cognitive aids and follow-up campaign accompanying the classroom-based training itself.

The theories of action research were used to developing an intervention based on theory and inputs from staff, and running and evaluating it in a setting as close to everyday clinical reality as possible. The theories of complex interventions and action research were used to develop the intervention through a cyclical process of needs assessment, testing, evaluation and re-design. Furthermore, these theories were used to select relevant evaluation parameters. Action research theories and theories of design-based research supported making both the researcher and members of the system active participants in the process, in order to learn more about the effect in practice.

The learning theories were used to justify an intervention including both declarative and procedural learning, in order to support the cognitive processes among the participants, and thereby improve transfer. Theories of transfer were further used to design an intervention that in both planning, training and follow-up considered how staff should be able to transfer learning from the classroom to the workplace.

The theories of curriculum development were used to systematically develop the intervention (**Appendix 1 and 3**) based on a thorough needs assessment which included an analysis of a convenience sample of organisational documents (the RCA-reports) (**Paper 1**) and focus group interviews with a selected group of health care staff members (**Paper 2**). Theories of the importance of review of the existing evidence before running complex interventions justified a systematic literature review (**Paper 3**).

The theories of evaluation of training and complex interventions and considerations of paradigms and methodology were used to include both qualitative and quantitative methods (triangulation) in the evaluation, and to ground the thesis in both an objectivity-seeking positivistic paradigm rooted in medicine, and a phenomenological paradigm rooted in the subjectively-based social sciences. The use of the two different paradigms were justified by an aim of both exploring new knowledge in the field of team communication and training, and the hope of conveying the messages to an audience most familiar with the positivistic paradigm: the decision makers of healthcare. Phenomenology justified an inductive approach to the text and interview analysis and to the intervention itself.

The theories of translational research and complex interventions were used to find a suitable department of comparison for the department, which received the classroom-based team training intervention. As such the study can be considered quazi-experimental.

In this study the pilot tests were - among other things - used to validate the questionnaires through a process of cognitive validation, face validity testing and sensitivity to change.

In accordance with theories of complex interventions individual interviews with staff and leaders in the intervention department took place. Along with the questionnaires, structured observations of team communication and a structured record audit of the level of adverse events over time, this contributed to elicit why the intervention had the effect it had (**Paper 4**).

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BMJ Quality & Safety Online First, published on 5 January 2011 as 10.1136/bmjqs.2010.040238

Descriptions of verbal communication errors between staff. An analysis of 84 root cause analysis-reports from Danish hospitals

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Accepted 4 July 2010

Introduction: Poor teamwork and communication between healthcare staff are correlated to patient safety incidents. However, the organisational factors responsible for these issues are unexplored. Root cause analyses (RCA) use human factors thinking to analyse the systems behind severe patient safety incidents. The objective of this study is to review RCA reports (RCAR) for characteristics of verbal communication errors between hospital staff in an organisational perspective.

Method: Two independent raters analysed 84 RCARs, conducted in six Danish hospitals between 2004 and 2006, for descriptions and characteristics of verbal communication errors such as handover errors and error during teamwork.

Results: Raters found description of verbal communication errors in 44 reports (52%). These included handover errors (35 (86%)), communication errors between different staff groups (19 (43%)), misunderstandings (13 (30%)), communication errors between junior and senior staff members (11 (25%)), hesitance in speaking up (10 (23%)) and communication errors during teamwork (8 (18%)). The kappa values were 0.44–0.78. Unproceduralized communication and information exchange via telephone, related to transfer between units and consults from other specialties, were particularly vulnerable processes.

Conclusion: With the risk of bias in mind, it is concluded that more than half of the RCARs described erroneous verbal communication between staff members as root causes of or contributing factors of severe patient safety incidents. The RCARs rich descriptions of the incidents revealed the organisational factors and needs related to these errors.

INTRODUCTION

Patient safety is still a major problem at many hospitals all over the world. Poor teamwork and communication between healthcare staff are correlated to patient safety and adverse events.[1] Team training[2] and standardising of verbal communication[3] have been suggested as methods to improve staff communication and thereby patient safety. However, the existing descriptive studies of hospital staff communication have been labelled as non-exhaustive and failing to reveal the systemic factors leading to the event. This inhibits the ability to suggest appropriate interventions.[4] It has therefore been recommended to add depth to the studies of communication error by exploring the objectives, communication tools, community affiliations, rules and division of labour for all the individuals involved in the patient care team.[5]

A root cause analysis (RCA) (for definitions, see table 1) uses human factors thinking to analyse the causes of a severe patient safety incident and actions necessary to prevent its recurrence.[7]

The method originates from aviation and was given a platform in healthcare by the Veterans Affairs National Center for Patient Safety[8] and The Joint Commission of Health Care Accreditation.[9] It is a systematic interactive process following a prespecified protocol and performed by a multiprofessional team whereby the sequence of events and the organisational factors that contributed are identified. The result is a detailed report (RCAR) based on the incident report, the pertinent written medical documents, interviews with involved staff members, human factors thinking and consensus that describes communication, environment, training and competencies, equipment, safety barriers, procedures and guidelines

Table 1 Terms used in the article, definitions and examples from root cause analyses reports included in the study

Term	Definition	Examples (no referring to table 3)
Root cause	The most fundamental reason for the failure or inefficiency of a process that—if eliminated—most likely would prevent the event[6]	
Contributing factor	A circumstance, action or influence which is thought to have played a part in the origin or development of an incident or to increase the risk of an incident[6]	
Communication error	Missing or wrong information exchange or misinterpretation or misunderstanding[6]	1
Verbal communication error between staff	Missing, wrong, misinterpreted or misunderstood verbal information between staff members	43
Handover error	Missing, wrong, misinterpreted or misunderstood verbal information between staff members in relation to handover (for instance sign-off or transferral)	23
Communication errors between staff members from different staff groups	Missing, wrong, misinterpreted or misunderstood verbal information between staff members in different staff groups (doctors, nurses, etc)	32
Misunderstanding	Misconception of patient information (for instance because of back ground noise, sound-alikes, language difficulties or speech impediments)	26
Communication error between junior and senior staff members	Missing, wrong, misinterpreted or misunderstood verbal information between staff members at different levels	28
Communication error due to hesitance to speak up	Situations were staff members have concerns or possess information but hesitate or refrain from speaking up due to confusion, respect for authorities or intimidation	2
Communication errors in teams with more than two members	Missing, wrong, misinterpreted or misunderstood verbal information between staff members in a group of more than two more staff members	36

related to the incident.[7] The RCA method can thereby contribute to the broader look at communication factors that is being called for[4 5] and which is lacking from individual interviews and analysis of incident reports, for instance.[10 11] Furthermore, it has the explorative approach that is lacking from observation studies[12] and questionnaires.[13]

Despite the disseminated use of RCAs in American, British and Australian healthcare systems among others,[14–16] there are few indications hereof in the literature.[17] This might have to do with confidentiality issues or the bias-issues related to the RCAs. The latter will be addressed in detail in the Discussion section.

When developing a team training programme, an assessment of the needs at organisational, team and individual level is necessary.[18] We speculated on whether RCARs could be used to explore the organisational needs for verbal communication support. The objective of this article is therefore to review RCARs for descriptions of verbal communication between staff as a part of a needs assessment before developing a team training programme to strengthen patient safety.

METHOD

Accessing and selecting reports for this study

Hospitals in the Capital Region of Denmark began conducting RCAs in 2001.[19] After adjustments, the method was considered stable in 2004. From 2004 to 2006, 94 RCAs were completed at six hospitals in the organisation. Reports conducted after September 2006 were excluded from this study, as they had the risk of being influenced by increasing focus on communication errors in the organisation.

According to Danish law, the reports are considered documents related to organisational development. As the reports do not contain data identifying the patient, involved staff or the RCA team, they can be accessed for patient safety purposes after permission from The Unit for Patient Safety, The Capital Region of Denmark. This permission was obtained before including the reports.

A pilot analysis on 10 RCARs selected at random was conducted to calibrate the data extraction between reviewers. These reports were excluded from the final data set. This left a total of 84 RCARs, which all included

a narrative of the sequence of events, a description of standard operating procedures, root causes and/or contributing factors, as determined by the RCA team and a description of the actions to prevent recurrence.

Extracting data from included reports

Two researchers (LIR and MLA) with substantial experience in rating patient safety incidents independently analysed the event, root causes and contributing factors in the 84 RCARs for descriptions of verbal communication error between staff as causing or contributing to the patient safety incident or near miss. Reports with full inter-rater agreement hereupon were further analysed for the following predefined characteristics:

1. Was there any description of verbal communication errors in relation to handover (eg, sign-off or transferral)?[20]
2. Were there any descriptions of misunderstanding?[21 22]
3. Were there any descriptions of verbal communication errors between staff members in different staff groups?[23 24]
4. Were there any verbal communication errors between junior and senior staff members?[24 25]
5. Was there any failure to speak up?[18 23]
6. Were there any descriptions of verbal communication errors in a group of more than two more staff members?[26 27]

The selection of the above characteristics was based on suggested mechanisms of patient safety incidents and suggested methods to improve verbal communication (see the respective references). After independent analysis, the ratings were disclosed, comparisons were made, and κ coefficients were calculated.[28] This was followed by an exploratory review of the RCARs where characteristics of the above verbal communicative challenges were identified. The excerpts characterising the incidents were extracted and translated from Danish to English and inserted in table 2.

RESULTS

The raters agreed upon a description of verbal communication error between staff in 44 (52%) of the 84 reports (κ 0.56). These reports stated a median of two root causes (range 0–7) and one contributing factor (range 0–5) per case. All teams included leaders competent of implementing the suggested actions and consisted of a minimum of three different staff groups. In 42 (95%) of the RCARs, frontline staff were part of the team.

The two raters found a description of handover errors (loss of information at sign-out or transfer) in 35 reports (86%) (κ 0.66) (table 3), communication errors between different staff groups in 19 reports (43%) (κ 0.71), misunderstandings in 13 reports (30%) (κ 0.61), communication errors between junior and senior staff members in 11 reports (25%) (κ 0.44), hesitance to speak up in 10 reports (23%) (κ 0.78) and communication errors in teams with more than two members in eight reports (18%) (κ 0.73).

The exploratory review revealed that the incidents occurred where the communication was unproceduralised (31 cases (table 2, eg, nos 12, 13, 14, 16)). Communication was particularly vulnerable when transferring patients between departments or hospitals (11 cases, eg, table 2, nos 6, 8, 21, 41) or when involving other specialties (for instance during consults) (10 cases, eg, table 2, nos 14, 19, 23, 24). Exchange of information was challenging when it relied on telephone conversation (17 cases, eg, table 2, nos 8, 30, 44).

DISCUSSION

Error in verbal communication between staff was described in more than half of the cases as a factor causing or contributing to severe patient safety incidents. Communication error in relation to handover was the most frequently described characteristic. This is in agreement with others.[20] Handovers were particularly risky when there were no procedures for communication between staff, when patients were transferred between departments or hospitals, when information was exchanged between specialties or when the information exchange was conducted via telephone. These aspects of staff communication were previously not well described. This might be explained by the fact that other methods used in the field (mainly observation and interviews) often only describe communication related to one group or setting.[10 12 13] The RCA method allows uncovering of communication weaknesses in relation to organisational procedures, barriers, equipment, training and environment, and as such it fills the need for a deeper understanding of healthcare communication.[4 5]

Communication errors between different staff groups were frequent as well. This can indicate that the different staff groups have different agendas for the patient which can lead to misunderstandings or are trained to communicate differently.[29] However, it probably also indicates that communication between nurses and doctors accounts for a large proportion of hospital communication. In any case, our results indicate that the process needs attention during teamwork and communication training.

In contrast to previous findings, our analysis could not confirm a strong hierarchy and failure to speak up as a major cause of communication errors.[24] This can

Table 2 Excerpts from the 44 reports with inter rater agreement on verbal communication error(s) between staff members

No	Event	Excerpt from root cause analyses reports wording (translated from Danish)
1	Inpatient suicide	'Information from the contact person was found in the nursing chart but not in the medical chart. (…) The contact person was not informed when the patient was offered leave.'
2	Unexpected cardiac arrest	'During the procedure, the patient becomes increasingly broncospastic. The nurse asks both doctors several times to withdraw the scope (…) but gets no response.'
3	Call for help to patient in distress	'The technician paged the resident. The resident never returned the call. The technician went for help in the corridor but found no one there. (…) The [other] nurse thought the patient in distress was a patient waiting in the corridor.'
4	Low stock of intravenous fluids	'Because the message about the product being out of stock and new supplies not delivered was verbal (…) the risk of the product being out of stock was increased.'
5	Inpatient suicide	'The patient was transferred from closed to open psychiatric unit which increased the risk of continuity problems (…) The written information was comprehensive and did not describe the staff members concerns about the patients' suicidal risk.'
6	Unexpected cardiac arrest	'At sign-out on the fifth day after admission, it was not made clear that the condition had deteriorated during the night shift. The patient saturated [insufficiently] and was in respiratory distress (…) The sedative treatment was continued.'
7	Unexpected death	'The way the nurse verbally communicated that the patient needed to be seen, made the physician think it could wait.'
8	Medication error	'The treatment plan [for this specific condition] was usually made during morning rounds. The [lab] result was not available until later that day. The night-nurse saw the result and called the resident, but no decision was made and the patient did not receive [this specific] treatment.'
9	Unexpected cardiac arrest	'A patient arrives to the ER after intake of [a high number of] tablets. Normal procedure is that all patients with poisonings are seen by an anaesthetist. The anaesthetist was occupied by another acute procedure. During telephone conversation between the ER nurse and the anaesthetist it was not made clear that the dose was lethal. The patient was transferred to the general medical ward and the anaesthetist expected to be paged if the patient needed further attention.'
10	Patient suicide during furlough	'If the verbal and written communication between the districts had been sufficient, the medication would most likely not have been delayed and cancelled.'
11	Inpatient suicide	'After every [of the numerous] operation[s] the young patient was discharged to the shelter. (…) There was no contact between [staff at] the unit and [staff at] the shelter.'
12	Unexpected cardiac arrest	'[There was] no communication between doctors on duty. (…) No one carried the prescribed tests for anaemia out. (…) There was no joint treatment plan. (…) No one saw the test report as it was sent to another unit.'
13	Wrong-site anaesthesia	'The senior doctor was not in the room during the patient identification process. (…) The two doctors [did] not communicate about the site.'
14	Unexpected cardiac arrest	'The diagnostic procedure was ordered "when opportunity arises." (…) The diagnosis dragged on because of communication errors between the units'
15	Unexpected cardiac arrest	'…this [information] was not heard by the physician. (…) Information was lost, and the involved physicians did not have precise agreements. (…) The team lacked a joint unequivocal plan for the procedure.'
16	Death after elective operation	'The surgeon's handover was too brief. (…) The chart note was too brief to assess the patient's status. (…) There was no consensus in the team about the procedure. (…) Coordination of the procedure relies on good communication. This was absent in this case.'
17	Inpatient suicide	'Because of busyness in the receiving unit there is no verbal communication during handover regarding the patient's status.'
18	Lack of anaesthetic during procedure	'Because there was no clear-cut communication at the beginning of the procedure (…), the risk of misunderstandings was increased.'
19	Delayed treatment	'The communication between [doctor A] and [doctor B] was not optimal. This induced insecurity about the (…) treatment. (…) [Doctor A] misunderstood the purpose of the call.'
20	Delayed treatment	'The resident assumed that the patient would be transferred and did therefore not inform the internist about the patient in the ward'
21	Delayed treatment	'The diagnosis was not described sufficiently in the chart and called for verbal explanation. (…) A combination of work load and communication errors caused the patient to wait for hours before admittance.'
22	Delayed treatment	'There were no uniform guidelines for nurse–doctor communication after a patient fall. (…) This can result in delayed treatment.'

Continued

Table 2 Continued

No	Event	Excerpt from root cause analyses reports wording (translated from Danish)
23	Delayed treatment	'Because of problems with overcrowding, the patient was transferred from one unit to another after admittance (…) but the doctor at [the new] unit was not informed (…) The patient was not mentioned at sign-out as it was expected that the patient could be discharged (…) and (for the same reason) a specialty was not decided for the patient (…) The patient was not registered in the electronic system.'
24	Postoperative cardiac arrest	'The doctors in the team did not agree on the diagnosis, the severity of the condition or the plan.'
25	Delayed treatment	'There was no clear-cut communication path to make sure the decisions from the two medical teams (…) were communicated and documented in all instances and at all times. (…) The decision was only recorded in the nursing record and communicated verbally to the doctor.'
26	Failure during oxygen therapy	'The nurse thought the doctor heard the message, but wasn't sure.'
27	Medication error	'The doctor and the nurse used different criteria for evaluating the condition.'
28	Delayed treatment	'The on call-doctor did not find it necessary to see the patient even after several telephone consultations with the intern.'
29	Medication error	'The factor 10 insulin overdose was not communicated to the doctor on duty (…) as the insulin was not considered a potent drug.'
30	Medication error	'The room was sealed [to reduce risk of infection] and staff therefore had to rely on telephone communication. (…) The nurse and the inexperienced doctor did therefore not ask a senior colleague for help when in doubt about the right dose.'
31	Cancelled operation after anaesthesia	'To save time (to catch up on the operation programme) the anaesthesiologist started the anaesthesia before the surgeon was present to re-evaluate the indication.'
32	Error during preadmission evaluation	'The information about the patient provided by the ambulance staff left the receiving doctor with the impression that the patient wasn't critically ill.'
33	Delayed treatment	'Because there were no established procedures for communication between the two units, the x-ray report was not discussed.'
34	Suicide during leave	'During readmission the patient was admitted to another unit. (…) By admitting the patient to a different unit, there is a risk of loss of information between the two staff groups. (…) The doctor at the second unit was unaware of this specific information.'
35	Complications after use of medical device	'Because there were no procedures or communicative pathways for discussion of routines or quality and safety, the risks of initiating or continuing potentially hazardous treatments were increased.'
36	Complications during CPR	'[When the alarm sounded] approximately 15 people showed up in the relatively small room. For some of the staff members present it was unclear who was in charge of the resuscitation. (…) There were five doctors present (…) However this did not lead to any discussion of who was in charge.'
37	Delayed treatment	'The involved parties did not know who was responsible for the procedure. New team members were thus not informed about the [important clinical information]. (…) If communication about trauma patients isn't systematic and there is no apparent team leader, the risk of loss of valuable information is increased and diagnosis can be delayed.'
38	Suicide during leave	'When transferring patients to lower levels of care, there is a risk of loss of relevant information and downplay of symptoms. (…) During the meeting the nurse expressed concern for the patient and the transfer. This concern was not documented in the chart.'
39	EMR-recovery error	'The dispatcher could not call all the users. (…) If communication routines are established after a pilot test with few users and not from a test including the full number of users, the risk of establishing insufficient communication pathways is imminent.'
40	Complications to treatment	'The condition was not immediately recognised, as there was no systematic communication or documentation of information regarding the problem.'
41	Postoperative complications	'The [procedure] was ordered electronically but not executed before the patient died as there was no communication between the ordering doctor and the radiologist. The procedure could therefore not be completed as an urgent case.'
42	Failure to resuscitate	'The nurse aid was late for the briefing and did not hear that [she/he] was the contact person for the patient. (…) The patient was thus not observed until lunch time'
43	Errors during preadmission evaluation and transfer	'Several professionals were involved [in the transfer]. This increased the risk of no final decision being made. It was furthermore unclear who the team leader was during trauma-handling. This increased the risk of internal and external misunderstandings of information.'
44	Delayed diagnosis	'[During telephone communication] the doctor got the impression that the patient could be transferred to and admitted at the [other] hospital. [This was not the case].'

Table 3 Eighty-four root cause analyses reports (RCARs) where analysed

RCARs describing verbal communication errors (N=44)	Frequency	Percentage	Kappa (CI)
Handover errors	35	86	0.66 (0.43 to 0.90)
Communication errors between different staff groups	19	43	0.71 (0.49 to 0.92)
Misunderstandings of verbal orders	13	30	0.61 (0.33 to 0.89)
Communication errors between junior and senior staff members	11	25	0.44 (0.09 to 0.79)
Failure to speak up	10	23	0.78 (0.55 to 1.00)
Communication errors in teams with more than two members	8	18	0.73 (0.44 to 1.00)

The two raters agreed on verbal communication errors in 44 RCARs. The table shows the frequency of the non-exclusive verbal communication error subcategories and kappa values.

indicate a different culture in Danish hospitals compared with other cultures. As this could mean a limited effect of assertions tools, which aims at enabling staff to speak up, further analysis is needed to confirm this.[18]

The study has helped to clarify the need for intervention. In order to support teamwork and communication, the organisations need to provide staff knowledge, skills and attitudes about safe information exchange especially during handover, information exchange via telephone, between staff groups and specialties. In a human factors perspective, this will have a larger effect if supported by standardised techniques and checklists.[21 30 31] However, targeting staff alone will be insufficient: as these data indicate, a lack of organisational procedures and guidelines establishing who communicates what to whom and when affects patient safety. Establishing and implementing such procedures will increase the chance of team and communication training success.

Except for the findings about hierarchy, which might be a mainly Scandinavian phenomenon, the findings might be applicable to hospitals in general. Healthcare is becoming more complex, and few organisations have the necessary procedures in place to account for this.[32]

The validity of the review is underscored by the fact that all RCA-teams were multiprofessional, all teams included local leaders, and nearly all had frontline staff members in the teams.

Based on these results, and the fact that RCARs are widely available in many healthcare organisations, we recommend including RCARs in needs assessments for communication and team training curricula and—where necessary—review organisational procedures and guidelines.

Methodological considerations

Hindsight bias is the major risk factor when working with RCARs: the RCA team focuses on understanding the systemic factors leading to the decisions and actions of the staff members involved but has no direct observations of the event. The analysis relies on frontline staff's memory and written records. And because the analyses are uncontrolled, a verification of the conclusion is difficult.[33] The conclusions can further be influenced by leading team members. In this study we therefore excluded studies from late 2006 and onwards, as these had a risk of being influenced by new communication tool agendas.

A second important bias is the risk of confirmation bias: it is easy for both RCA team and reviewers to conclude that an incident could have been prevented with improved communication.[4] In this study, this effect was attempted limited by letting two independent reviewers rate the RCARs and select relevant excerpts for others to interpret (table 2). Kappa values between 0.44 and 0.78 show moderate to substantial agreement between the raters extracting the data. However, the 'less-than-perfect' value can be explained by the fact that the original purpose of the RCARs was local use: the exact nature of some involved units and the experience of involved staff members were often described knowingly. Furthermore, details about ancillary services and paraclinical specialties were often excluded. If RCARs are to be systematically reviewed for quality and research purposes, thorough descriptions of organisational details must be included, along with a description of the discussions that took place in the team: what causal relations were considered by the team but rejected, and why? This will increase the validity of RCARs.

Finally, there is the problem of selection bias: the selected RCARs are not representative of all patient safety incidents. In the Capital Region, approximately 1% of the reported incidents are considered severe or frequent enough to consider a RCA. Of these, approximately 50% undergo RCA. The numbers are therefore not absolute but can serve as input to a priority list for future patient safety interventions.

The most important strategy to limit the influence of all three bias types, to uncover needs at individual, team and organisational level, and reveal both quantitative and qualitative aspects, is the use of the mixed method design.[34] In this case, the RCAR review can for instance be supplied by staff interviews, direct observation and analysis of cultural surveys.

CONCLUSION

More than half of the included RCARs described erroneous verbal communication between staff members as root causes or contributing factors. Loss of information during handover and between staff groups was described as the most frequent characteristic of the incidents. The related organisational factors were lack of communicative procedures during transfer, telephone communication and involvement of other specialties. With the risk of bias in mind, it is concluded that RCARs holds rich descriptions of patient safety incidents that allows outsiders to gain insight into organisational factors leading to the events.

Funding Det Kommunale MomsfondBredgade 54—Postboks 21811017 København K, The Pharmacy Foundation of 1991.

Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

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Promoters and Barriers in Hospital Team Communication. A Focus Group Study.

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Funding: This work was supported by The Pharmacy Foundation of 1991 and *Det Kommunale Momsfond*.

Abstract

Purpose: Poor teamwork and communication in healthcare teams have been correlated to adverse events and higher patient morbidity and mortality. However, detailed insight into the link between interprofessional communication and medical error is still lacking. The objective of this study is to identify the common characteristics of team communication among multiprofessional teams at four acute care university hospitals.

Method: Four focus group interviews with Danish multiprofessional hospital teams (N= 23).

Results: Communication is particularly vulnerable during handover of patient information between shifts or units, when a team has to establish skills and roles during teamwork and when staff has to await and combine information from different chart systems. Established frameworks for communication, mutual knowledge, ease of speaking up, experience in getting the message through, and focus on teamwork and communication, promote safe information exchange. Lack of standard assignments and procedures, a flat hierarchy that leaves responsibility unclear, different agendas for the treatment of the patient, interruptions and multitasking, inhibit safe information exchange.

Conclusion: Power distance, team structure and hospital organization influence team communication and vary between settings and national cultures. These factors must be accounted for before developing or adapting team communication interventions to improve patient safety.

Introduction

Poor teamwork and communication (for definitions, see **table 1**) between health care staff has been found to be correlated to adverse events and higher patient morbidity and mortality[1-3]. Especially handover of information during shifts or transfer[4], different professional languages between staff groups[5] and a steep hierarchy that hinder free speech[6], have been found to inhibit safe information exchange. Improving both electronic[7] and verbal team communication[8-10] are methods suggested to improve the quality of patient care. However, so far the results have been limited[11] and adverse events related to information exchange remain common, with little evidence of widespread improvement[12]. Further studies of the details of the link between interprofessional communication and medical error[13, 14] have been called for in order to develop appropriate interventions.

The objective of this study is to identify the common characteristics of team communication among multiprofessional teams at four acute care university hospitals.

Method

The focus group method is used in areas with limited previous knowledge and is well suited for research on group practice, interactions and norms. Like individual interviews, it is based on open-ended questions with minimal interruption by the facilitator. As opposed to individual interviews, it relies on the interaction and discussion among informants. As opposed to questionnaires or field observation, the facilitator can ask for clarification, elaboration and inputs from other informants[15].

We conducted four multiprofessional focus group interviews among clinical staff members from four Danish hospitals between November 2006 and September 2007. Interviews took place within day shifts and lasted 1.5 to 2 hours each.

The questions explored the main verbal multiprofessional team communication pathways concerning patient treatment, and factors supporting (promoters) and inhibiting these (barriers):

- In which situations do you exchange patient information?
- When does team communication function at its best?
- When does team communication work less well?
- In which situations do you experience loss of patient information?
- What are the consequences of this loss?
- Which teams do you work in?
- When does teamwork function at its best?
- When does teamwork not function well?
- How will you describe the hierarchy in your unit?
- What do you do when you are in doubt or see something unsafe?

This focus group interview protocol was developed after thorough review of the communication error, team training and focus group method literature, and a review of root cause analysis-reports for descriptions of circumstances concerning severe patient safety incidents in six Danish hospitals[3]. Furthermore, the questions were based on a study of theories of appreciative inquiry[16] and critical incident technique[17].

The method was iterative and inductive: each of the four interviews where part of a needs assessment-planning-testing-evaluation cycle[18] towards improved team communication. Each interview was based on the same protocol, but the facilitator used experiences from previous cycles of action to guide the questions and ask for elaboration.

Recruitment and sample

A convenience sample of four acute care hospitals representative for Denmark (different regions, rural & non-rural) were included. The hospitals selected the departments, and the physician or nursing managers at the departments selected the informants who met the following criteria: no

leadership assignments, employed for more than three months in the ward, exchanging clinical information about patients in their daily work, and engaged in multiprofessional teamwork. Each focus group consisted of at least a doctor, a nurse and a nurse aid. The multiprofessional set-up was chosen to encourage system-level discussions in favour of discussions regarding particular individuals or staff groups. Each group consisted of both experienced and less experienced staff members. For each interview, between four and nine staff members were invited depending on the number of relevant staff groups in the respective settings. The participating departments were selected in order to establish traits of multiprofessional acute care somatic hospital staff. The interviews took place in private conference rooms outside the respective Departments, to assure candor. Informants received written and verbal information about their interview, voluntary participation and anonymity of their statements, and signed informed consent forms. Danish law exempts this kind of descriptive research from ethical board approval. Data were handled in agreement with regulations of the Danish Data Protection Agency. The interviews were facilitated by LIR.

Data collection and analysis

The interviews were recorded and transcribed verbatim by LIR followed by assigning of codes, deletion of all information identifying staff members, units or hospitals. LIR and MAM subsequently conducted individual data-reduction (where the content of transcripts was arranged in tables to indicate relationships and patterns) and extraction of main findings. Hereafter the data were shared among the research team before final categorization, extraction of conclusions and translation from Danish to English.

Danish law exempts this type of research from ethical board approval. The Danish Data Protection Agency approved the studies.

Results

Twenty-three informants (see **table 2**) from five different specialities, at four teaching hospitals, in three hospital regions in Denmark participated at their respective hospitals. None of the informants (except one resident in anaesthesiology) had received any training regarding team communication practices. **Table 3** holds the excerpts regarding main communicative pathways, **table 4** hold excerpts regarding promoters of verbal communication and **table 5** holds excerpts regarding barriers to optimal verbal communication. In each table the right column holds the authors' interpretation of the quote(s).

Main communicative pathways

Informants described that even though asynchronous communication like handwritten and electronic patient records (EPR), electronic medical records (EMR) and handwritten nursing charts account for an important part of the exchange of clinical information, the synchronous verbal communication between staff members is indispensable in team communication in hospitals. This has to do with the fine nuances that the written information can not communicate. It is also a matter of urgency, as the majority of doctors in Danish hospitals still dictate their chart notes to tapes, that are transcribed to paper charts by medical secretaries. This leaves the nurses waiting for new orders, unless they are communicated verbally. Further, the written information is often immense and unstructured and staff therefore have to rely on verbal peer-guidance and verbal orders. Electronic medical records (EMRs) are common in the Danish healthcare system, but they are (still) too slow to handle hyper-acute standard or acute non-standard orders and the EMRs are not integrated with the health records. Further, university hospitals have a large flow of staff members on rotation (mainly internists, residents and fellows) who rarely spend more than 12 months in the same

department. This means that a substantial part of acute care teams consist of staff members, who have never worked together before.

These findings are reflected in the excerpts in table 3, #1-5.

All together informants described the following verbal communicative structures as the most common:

1. Face-to-face communication:
    a. Between two staff members:
        i. Mono-professional: Handover between shift or units, or supervision.
        ii. Bi-professional: Handover between shift, units, during rounds or supervision.
    b. In teams of more than two staff members:
        i. Mono-professional teams: Patient conferences or handover between shifts.
        ii. Multi-professional: Surgery, deliveries or (bedside) care for an acutely ill patient.
2. Non-face-to-face communication: Mono- or bi-professional telephone communication (typically supervision regarding patient transfer or verbal orders)

Informants described the following situations as particularly vulnerable:

1. Handing over critical, detailed and comprehensive patient information between shifts or units either face-to-face or on the phone (table 3, #3 and 4),
2. Establishing skills and roles during multiprofessional teamwork in larger acute care teams (table 3, # 5),
3. Dividing tasks and establishing a plan for communication and teamwork during teamwork – with particular focus on multiprofessional rounds (table 3, # 5 and table 5, #2).

Promoters of safe verbal communication

When asked ‘When does team communication function at its best? ’ the informants could mention several promoters of safe verbal communication:

- *Frameworks:* The informants spontaneously mentioned the importance of established time to communicate, agreements upon how to proceed, and confirmations of agreements after a task, for instance during problem solving in larger emergency teams (deliveries, codes) or before and after rounds (Table 4, #1 & 2).
- *Knowing each other:* The informants expressed appreciation of working with team members they knew beforehand, as this gave them an idea of their experience-level and skills. They explained this with the large turn over of especially rotating junior doctors, whose personality, experience and clinical skills other staff members had to decode in order to optimize teamwork (table 3, # 2 & 4).
- *A flat hierarchy:* When asked about ease of speaking up between professional groups the informants expressed that the power distance in general is very low in Danish hospital departments: Nurses usually have ease of speaking up to doctors when in doubt or when having concerns. The hierarchy is not absent, though, but to a greater extent based on experience. This is particularly evident between the junior doctors and the experienced nurses: Given that the residents change work place over and over, they repeatedly and swiftly have to adjust to completely new team structures, lay-outs, devices and logistics. In these situations they often rely on the more steady nurses’ or nursing assistants’ help, who then become an even more valuable and indispensable resource for the residents (table 4, #3 and table 5, # 1).

Barriers to safe verbal communication

The staff members were asked to identify situations where communication was challenging or less safe and identified the following:

- *Lack of standard assignments or procedures:* The informants expressed a tendency to confusion about 'who does what?' when procedures and policies are not in place or unknown. This was explained by a flat hierarchy between especially junior doctors and experienced nurses, which results in some tasks becoming 'no-ones-tasks' (for instance informing patients of changes in treatment plans, sending referrals etc). This induces a risk of tasks falling through the cracks. The informants expressed this as an important cause of delayed treatment (table 5, #2)).
- *Diverging agendas:* It seems like doctors and nurses understand each other well and to a large extend speak the same professional language. However, due to different professional backgrounds, the staff groups have diverging agendas regarding for instance care. This can result in talk of cross-purposes (for instance "Is the patient ready for discharge?") and give rise to tension (table 5, #3).
- *Interruptions or many similar tasks:* Informants described how a high workload, multitasking and interruptions are common working conditions and how these situations often result in loss of information or misunderstanding (table 5, #4).

Discussion

In this study we used focus groups to identify the common characteristics of verbal communication in multiprofessional teams at four acute care hospitals, and the factors influencing them. The informants described the main verbal communicative pathways as face-to-face communication in mono- bi- or multiprofessional teams of two or more than two, and non-face-to-face communication, typically via telephone. This will not be surprising for anyone familiar with clinical hospital life. However, detailed descriptions of communication outside the OR are limited[13].

The most challenging communicative situations described by the informants were awaiting and combining information from the different chart systems, handing over information and

responsibility between units and shifts as well as getting sufficient information through when calling someone, or establishing an acute care team during for instance rounds or acute care. These results confirm the previous findings of the causes of errors during handover[1, 4]. However, the issues of establishing mutual agreement before and after the multiprofessional rounds are new. This can have to do with the mainly bi-professional doctor-nurse rounds in Danish healthcare settings. Our results can not confirm that communication errors are results of nurses being trained to 'paint the big picture' and doctors being trained to be concise, as previously suggested[5]. Instead, our data indicate that the two staff groups have differing agendas, which the staff groups are aware of. In most instances, this is beneficial to the patient - as long as divergences are resolved, for instance after rounds. Techniques suitable for this purpose are pre- and postoperative debriefings[19].

The informants described the main promoters of safe team communication as well-established frameworks (time, guidelines and structures) for communication as important. This is previously described, and the use of communicative structures (like the 'SBAR'-technique) to support team communication has been suggested[5]. Lack of knowledge of other team members' skills is a known risk factor from the surgical environment. Together with the perceived lack of standard assignments and procedures to establish 'who does what', and the perceived differing agendas for the treatment of the patient, this confirms a need for a tool to ensure communication and mutual agreement before a task. A method that has been successful in this situation, is a checklist-aided perioperative briefing procedure, which includes a brief presentation of team members and division of tasks[20].

The perception of a flat hierarchy, which allows everyone to speak up, differs from previous findings. This probably has to do with both the national culture in Denmark and the organisational structure in Danish hospitals: Denmark is a fairly egalitarian society both economically and culturally. The Danish national culture is based on a social democratic welfare model and an ideal of economic redistribution[21, 22]. The Danish universal health care system is 85% publicly financed.

Hospital doctors are employed by the public hospitals and affiliated with a department – not with private clinics in the community[23]. Bi-professional nurse–doctor rounds are the norm and salaries are relatively uniform.

This differs from the descriptions of culture and organisation in American hospitals, where a higher degree of private funding and the affiliation of independent private physicians and surgeons who tend to their own patients result in a more distinct hierarchical team structure. This team structure is considered an important source of miscommunication, because intimidation is thought to inhibit free speech[6, 24]. Comparative studies of safety cultures in hospital environments are rare, but a recent publication supports our findings[25]. The cultural element in team communication is plausible as communication is influenced by context, environment and culture[22, 26].

These and our results justify adaptation of interventions to improve team communication. A culture similar to the Danish is found throughout Scandinavia and in some European countries [22]. Patient safety curriculum planners in these systems have to consider the above characteristics before implementing American-based patient safety solutions into their own hospitals.

Limitations

The multiprofessional focus group method was chosen to allow informants with different backgrounds and agendas to discuss team communication from a system-perspective, and allow the moderator to ask for elaboration or clarification. Individual interviews could have resulted in focus on particular inadequacies of other (non-present) staff groups. By selecting multiprofessional focus groups, the focus was directed to the system and the organisation. The study was preceded by a text analysis of a sample of root causes analyses, that served to generate questions to informants[3]. However, an observation of nurse-physician teamwork could have aided in confirming results and in providing additional insight.

The informants were picked by their unit leaders and not randomly. This model holds a risk of selection bias, as unit leaders might have selected more frank nurses, whom they knew would speak up during the interviews. This could give rise to an impression of a more flat hierarchy than in reality. However, the results were in agreement with results from other domains[22, 26] and a large-scale simultaneous patient safety culture survey[27]. A bias that draws in the other direction is the multiprofessional set-up, which might have inhibited free speech and made some informants confirm opinion of others[15].

We aimed at including a representative sample of professions and disciplines with varying degrees of experience from somatic acute care university hospitals in Denmark. Although the results might not account for every unit and every hospital in the country, we found the statements consistent. As the interviews were to some extend inductive, we did not reach data-saturation on all matters. However, the replies were consistent here as well.

As seen in table 2, the unpredictable every-day clinical life prevented optimal composition of all four groups. This is probably not easy to prevent. The way to leave out the effect of too small and too large groups is to include more focus groups in a future study. Other authors have used even smaller samples [28, 29] though and our results are confirmed by the other sources mentioned above that draws in the same direction.

There is a general risk of confirmation bias when interpreting interview statements. However, we aimed at limiting bias by letting two independent researchers with differing pre-understandings of healthcare (an M.D. and a sociology master) review and extract trends.

CONCLUSION

The informants described the main promoters of safe team communication as well-established frameworks for communication, knowledge of other team members' skills and experience in

combination with a flat hierarchy, which allows everyone to speak up. These factors should be accounted for when developing new or adapting existing interventions to improve team communication and patient safety.

Acknowledgements: The authors wish to thank staff members at the participating sites for their time and willingness to share insight.

Funding/Support: This work was supported by The Pharmacy Foundation of 1991 and *Det Kommunale Momsfond.*

Other disclosures: None.

Ethical approval: Not applicable.

Disclaimer: None.

Previous presentations: None.

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Table 1: Definitions of main terms.

Term	**Definition**
Asynchronous communication	Communication occurring at different times via another media (medical records, e-mail, voicemail)
Communication	The activity of transmitting information.[31]
Error	The failure of a planned action to be completed as intended or use of a wrong, inappropriate, or incorrect plan to achieve an aim.[31]
Handover	The transference of patient information and responsibility between team members
Hierarchy	The organization of people at different ranks in an administrative body
Power distance	The extent to which the less powerful members of an organisation expect and accept that power is distributed unevenly
Synchronous communication	Two-way communication with no time delay
Team	A group of two or more staff members
Verbal	Something expressed in spoken words

Table 2: Individual focus group characteristics with regard to staff group, specialties and gender.

	Group 1	**Group 2**	**Group 3**	**Group 4**	**Total**
Informants	4	8	9	3	23
Staff group					
Senior doctors (> 10 years clinical experience)	1	1	1		3
Junior doctors (< 10 years clinical experience)		2	3	1	6
Registered nurses	2	3	3	1	8
Nurse aids	1	1	1	1	4
Clerks		1	1		2
Specialty					
Internal medicine	4				4
Paediatrics		8	1		9
OBGYN			4		4
Anaesthesia			2		2
Surgical staff			2		1
Cardiology				3	3
Gender					
Female	3	6	8	3	19
Male	1	2	1		4

Table 3: Selected excerpts from four focus group interviews with multiprofessional hospital staff regarding *main communicative pathways*. EMR: Electronic medical record. FGC: Focus group code.

#	Excerpts	Interpretation
1	"*We have two separate chart systems. They should match but they do not always do that. There are observations and orders in the wrong place. I have the overview and [the doctor] goes to see the patients. We supply the [missing] information*." (Nurse, FGC20) "*It can take hours before we have the chart and we have shifts where we have no time to look into it*." (Nurse, FGC35) "*It is frustrating, because we put a lot of effort in writing the charts and they hold valuable information. And it can lead to adverse events when this information is lost. What I do is… I spend a lot of time finding the right nurse and then say: 'This is the plan' etc. To initiate a dialogue. In that way we try to make the ends meet*." (Physician, FGC34)	Written patient information account for an important part of the clinical information. However, most hospitals have separate chart systems for nurses and doctors and the written information is delayed. This makes verbal communication between staff members indispensable.
2	"*We had a very sick patient in septic shock and he needed two different drugs. We had to give it [after verbal order] because it took two hours to enter it in the EMR since the drugs were not standard. And we couldn't wait for that*." (Physician, FGC68) "*If a patient needs an antibiotic then the standard administration time is set to 8 PM. But if it is 5 PM you need to call the doctor to make a single-dose verbal order to get the antibiotics going."* (Nurse, FGC79) "*They are very much routine [the drugs] given after verbal order in my opinion. Except if we have hyper acute situations with severely ill children. But then you just have to go ahead and give it." (Nurse, FGC 391)* *"I have tried giving a double dose of Furosemide. I probably misunderstood [the verbal order]"* (Nurse, FGC115) "*We had an adverse event where a medical lab-assistant called with a potassium-result. She said 5,2. We then treated the patient for hyperkalemia. But later it turned out that it was the other way round: it was 2,5. That it was too low*." (Nurse, FGC116)	Electronic medical records (EMR's) are now an integrated part of the Danish healthcare system. However, EMR's still cannot handle hyper-acute standard or acute non-standard orders. Verbal orders are necessary in these situations.
3	"*Information is lost from one department to the other. Especially nursing information, because (…) it is so chaotic when it comes from a different ward. We don't have time to read that. A lot of information is lost in this way*." (Nurse, FGC33) "*I think a lot of information is lost between shifts. I had a patient who needed a stomach tube for feeding. And I told the nurse that the tube was for feeding and I wrote it in the chart. But the next day I met a colleague who said: 'I have removed the tube. There was no blood in it.'(…) That was very frustrating*." (Physician, FGC90) "*A doctor admits a patient and dumps the chart on my desk with 10 blood samples on top of it and then leaves. Then two hours later I find them and realize he ordered three antibiotics to start immediately. Why didn't he say so?"* (Nurse, FGC 217)	Handover of patient information between departments, shifts and staff members can lead to loss of information, patient safety incidents and delays.
4	"*If a nurse calls you – I have tried this so many times - and just say: 'You have to come. The patient looks queasy' and then they have a hard time explaining it. Then I have to consider: Do I know this nurse. And [often] if I hear something so vague, then I can just as well go up there because then they are not in control of the situation*." (Physician, FGC 200) "*When someone calls you for an emergent case at the delivery ward it's like: 'It's room 8, now!'. 'But, what is wrong with the child?' 'I don't know. They just told me to*	Phone calls pose a particular challenge to information exchange. Especially when communicating with team members one has not worked with before or during acute

	call you!'." (Physician, FGC537)	situations.
5	"*I went to a code today (…) and I started CPR (…) and then I asked out in the room – there were 15 people including three nurses looking on – if someone could get me an oxygen tube. But no one reacted. I should perhaps have said it again, but I was counting [compressions]. So when anaesthesia arrived [and took over] I ran myself to get the tube down the hallway*" (Nurse, FGC56) "*Sometime in the delivery ward if they have just delivered a sick baby, and things go fast and we arrive after the OBGYN has started CPR and the anaesthesiologists arrive simultaneously, then it can take us a few minutes to figure out who does what. That is not ideal. But that's reality.*" (Physician, FGC 396-402)	Information exchange during acute teamwork in larger teams possesses a challenge especially when it comes to task sharing.

Table 4: Selected excerpts from four focus group interviews with multiprofessional hospital staff regarding *promoters* of safe information exchange. EMR: Electronic medical record. FGC: Focus group code.

#	Excerpts	Interpretation
1	*"It is about having time to communicate verbally. Messages delivered on the run are often not interpreted as they were meant. It leads to misunderstandings if you don't have a forum for exchange of information*." (Nurse assistant, FGC96) "*Communication is essential. I mean, sometimes it is in the air, but then you realise the perception wasn't consistent [among the team members]. It is a learning process to get it right and we must keep on practicing how to say: 'I hear this and we divide the roles like this' so that everyone gets on the same page*" (Physician FGC400) "*It would be really great if those going on rounds together agreed upon: How to do this?' (…) and 'When is the round actually over?'*" (Resident, FGC 1070, 1097) "*Yes! 'Can we agree on doing this?' and 'I just ordered this' or 'I haven't ordered this' and 'Please, remember to order this'*." (Nurse, FGC 1071)	Frameworks like sufficient time, confirmations and feedback are important for reliable information exchange.
2	"*Except the last year group of internists, then I know all the doctors. So, when I say something, then they know what I mean*" (Nurse, FGC198) "*The best grease is to know each other and each others competencies. (…) [If it is someone I don't know] then I can get my doubts about what I encounter when I arrive. Because I didn't get exact information [on the phone]. That's what happens when you work in the periphery [of the staff group] and with other departments*." (Physician, FGC446)	Personal knowledge of the other team members makes their information easier to interpret
3	"*If I forget something, then I know [the nurse] will say: 'Didn't we have an agreement?*'" (Physician FGC65) "*I think it is important to communicate with the nurse about her opinion on ending the treatment. I often turn to the nurses on their assessment*." (Physician, FGC167) "*Basically, if what you hear from the person in charge is correct, then you listen. But if what they are saying sounds wrong, then I am obliged to say: 'Hey, did you really mean that? Did you say 2000 mg?' hoping they will realize it wasn't completely right (…) However, it isn't easy. It takes a backbone to speak up*." (Nurse FGC406) "*Yes, they listen to what we say (chuckles). Especially the new residents. They can feel insecure*." (Nurse, FGC 466) "*If we have to take care of other things before we can go to the ward [to see a new patient], then the nurses have already observed something [when we arrive]. It is good to know what they think when we are examining a child. Do we need to admit [the child]? What to order? And what tests should be carried out? We couldn't work without their inputs. We help each other a lot*." (resident, FGC467) "*I have no problem saying to the doctors: 'Listen, I have my doubts here. Can you help me? I haven't tried this before'. Then we always get positive response and help. In that situation the doctors are amazing in taking care of the nurses*." (Nurse, FGC471)	Staff express that there usually is a flat hierarchy between team members. Nurses offer advice without invitation to speak when they hold knowledge or have more experience.
4	"*I think that sometimes the young residents are put in a dilemma, when we say: 'We would give this' or 'We usually do this'. You overwhelm them. Because in the end it is their responsibility. So I try not to do that*." (Nurse FGC 1023) "*It is both a question of personality and experience. I was in the ward for quite a while, so I went from being completely new to being in a position where I could say [to the nurses]: 'I know we could do that, but we wont because I want to do something else'. Now I dare take charge. But in the beginning I relied on [the nurses] to say: 'Shouldn't you call your senior resident now?' (…) It is a question of personality if you like someone else taking charge or not. I don't mind them helping me or that we help each other*." (Resident, FGC 1025)	Knowing the way through the system can make a team member an authority – regardless of professional background

Table 5: Selected excerpts from four focus group interviews with multiprofessional hospital staff regarding *barriers* to safe information exchange. EMR: Electronic medical record. FGC: Focus group code.

#	Excerpts	Interpretation
1	"*There is a large degree of equalizing among the staff groups (…) However; sometimes you must be aware of not letting everyone do everything. For instance it is very frustrating if I refer someone to something and then they return [for at control visit] (…) after three months and you realize the referral landed somewhere in no mans land, because someone assumed the doctor handled the paperwork. That is very unsatisfying for the patients*." (Resident, FGC475) "*So the hierarchy becomes so flat, that confusion arises on who takes care of…*?" (Interviewer, FGC480) "*As a matter of fact, yes. There are actually tasks that are foolish to leave to the doctor. It is outrageous to make a doctor mail something. Talk about patient safety incidents*!" (Resident, FGC 481) "*I would like to hear inputs on this from other staff groups." (Interviewer, FGC 482)* *"The problem arises when you omit to communicate. If the doctor says: 'I'll write a referral'. Then I think to my self: 'Very well, then that's done'. And then later I might wonder: 'Was it actually send? Do I have to do it or did he do it? And when I look in the chart it just says: 'Referral written'. And if it is a busy day then I don't have time to check if the referral is send as well. And then you realise – perhaps the next day - that it wasn't. If the doctor just said: 'I'll write the referral. Will you handle the paperwork?' Then I would of course do it*" (Nurse, FGC483) "*To use a common headline then I guess it is that the staff groups have become more blurred on the basis of 'no tasks are finer than others what so ever'. And to prove that, everyone has to do everything'*." (Physician, FGC 490) "*The doctor who wants to order [something] himself, he can order away. And if he won't then we would love to help you (laughs)" (Nurse, FGC 491)*	A flat hierarchy makes task sharing blurred and can result in patient safety incidents if the team does not agree on how to share tasks from case to case.
2	"*Sometimes the two worlds clash (…) because we have different agendas even though we have this flat structure. [As a nurse] I have to choose: Do I want to spend ten minutes weighing the patient – which is important – or do I want to spend ten minutes on communicating [with the doctors before their rounds]. There our two worlds are different after all. But there are no established procedures on how to do things in this unit. It is very intuitive and we run it our own way."* (Nurse, FGC531) "*Some doctors say: 'Is the blood pressure okay? [If so] the patient is ready for discharge' But we have a different agenda which includes: Can the patient go to the bathroom and manage themselves at home? And sometimes I think the [doctors] lack a little understanding… that we talk on cross-purposes. I mean (to the doctor): You believe the patient can manage. And then you say to me: 'Oh, so you don't want to discharge? That costs so and so much'*." (Nurse, FGC1044)	Even though the hierarchy is flat there are still different agendas between staff members. This can result in confusion, talk on cross-purposes and patient safety incidents where there are no guidelines for the teamwork.
3	"*In our unit (…) we get interrupted all the time. You have a lot on our plate and get more all the time and someone comes and interferes with what you are doing (…) There can be three people talking to you at the same time. That's how the days go by."* (Nurse, FGC97)	Simultaneous tasks and interruptions challenge communication.

Outcomes of classroom-based team training interventions for multiprofessional hospital staff. A systematic review

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Accepted 30 April 2010

ABSTRACT

Context Several studies show that communication errors in healthcare teams are frequent and can lead to adverse events. Team training has been suggested as a way to safer communication and has been implemented in healthcare as classroom-based or simulation-based team training or a combination of both. The objective of this paper is to systematically review studies evaluating the outcomes of classroom-based multiprofessional team training for hospital staff.

Method The authors searched PubMed, EMBASE, ERIC, PsycInfo, Cinahl and the Cochrane Reviews database and selected 18 studies for description and comparison of learners and setting, objective, design, intervention, evaluation methods (reaction, learning, behaviour and results), intervention time before evaluation, outcomes and risk of bias.

Results Participant reactions were positive. Learning and behaviour were positive in all studies, but for some only partially. The effect on clinical processes was in most instances positive. Results at patient level were limited. Only one study reported results at all four evaluation levels. Fifteen studies were uncontrolled, and 17 studies had a moderate or high risk of bias. More than half of the studies ended evaluation within 6 months. No studies reported qualitative measures that could have provided an insight as to why the interventions had the effect they had.

Conclusion Classroom-based team training for multiprofessional hospital staff is recommended as a way to improve patient safety. This review shows mainly positive effects of the intervention on participant reaction, learning and behaviour. The results at clinical level are still very limited.

INTRODUCTION

Poor teamwork and verbal communication between healthcare staff have been found to be correlated with adverse events, staff performance problems and higher patient morbidity and mortality.[1] There could be several reasons for this problem; some of the most influential might be differences between staff groups[2] and a complex work environment.[3] Team training is recommended as a method to improve communication and coordination in high-reliability organisations.[4 5] Team training for healthcare staff came on the agenda after IOM's 'To err is human,' and a critical analysis suggested that the medical field introduced Crew Resource Management (CRM) as one of 79 practices to reduce the number of adverse events.[6 7] Increased specialisation, more acute and complicated procedures and shorter hospital stays call for more communication in shorter time. Institutions advocating safety in healthcare now recommend hospitals to introduce communication tools[8 9] or team training.[10 11]

Team training has been transferred to healthcare as classroom-based or simulation-based team training or a combination of both. Simulation is an educational technique that allows realistic interaction by recreating a clinical experience without exposing patients to the associated risks.[11 12] This is often accomplished through the use of mannequins and advanced software.[13] Classroom-based interventions uses lectures, video demonstrations, discussions and role plays[11 14 15] to strengthen participants teamwork, communication and coordination knowledge, skills and attitudes. For organisations aiming at training larger groups of staff members the classroom-based model is tempting, as it allows many to train at one time at lower costs than the equipment- and instructor-demanding simulation-based method. The question is, however, whether this type of training is effective. The objective of this paper is to systematically review studies evaluating the outcomes of classroom-based team training for multiprofessional hospital staff.

METHODOLOGY

Literature search

The following sources were searched for results of classroom-based team training interventions for multiprofessional hospital staff published in peer-reviewed journals through March 2010: PubMed (including MeSH), EMBASE, ERIC, PsycInfo, Cinahl and the Cochrane Reviews-database (figure 1 shows the combination of search terms).

The following MeSH-terms were used: 'Patient Care Team', 'Interdisciplinary Communication' and 'Outcome Assessment.' Articles in the following languages were considered: English, German, French, Italian and the Scandinavian languages. A 'hand search' was conducted by reviewing the reference lists of relevant articles. Eligible articles included in the review described classroom-based team/non-technical skills/crew resource management training interventions focused on communication and coordination training using didactical and interactive methods to improve the participants' knowledge, skills and attitudes of teamwork skills and the clinical outcome. Articles alone referring the development or implementation of programmes, pregraduate programmes, extra-hospital, web-based, mono-disciplinary, patient or relative-centred or mainly simulator-based

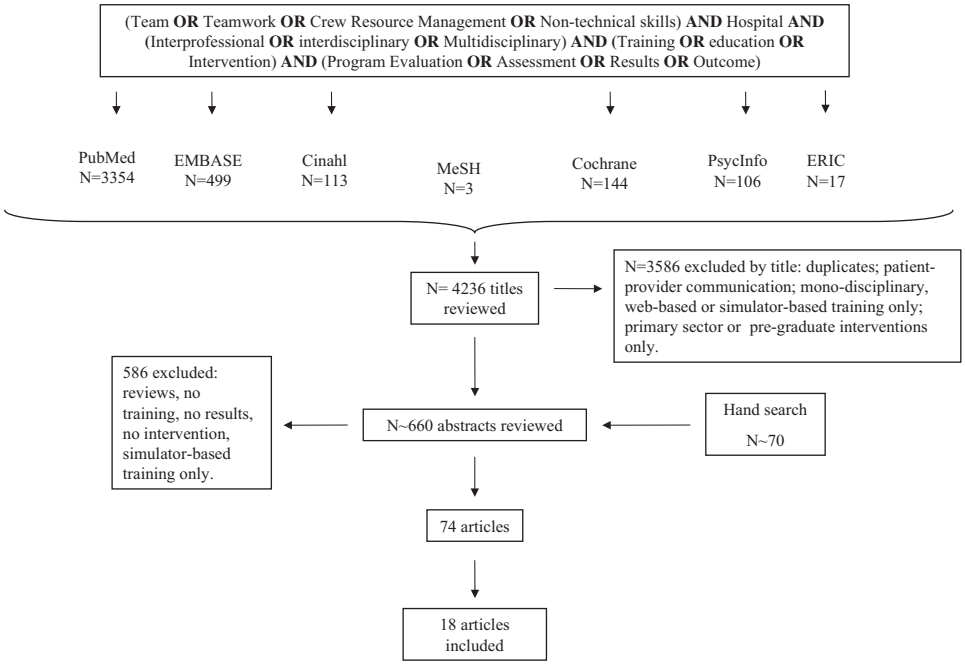

Figure 1 Literature search and study selection process.

interventions were excluded. Articles describing the effect of brief instructions before the use of preoperative briefing checklists were excluded, as the instruction was not considered training.

Data extraction and analysis

The selected studies were reviewed with focus on the following parameters: 'Learners,' 'Setting,' 'Programme,' 'Objective' and 'Design.' The 'Intervention' was reviewed for duration, methods and contents of the course,[16] extent of a needs assessment[17] and how training transfer was supported (table 1).[40] We specifically analysed the 'Evaluation and level of evaluation' based on Kirkpatrick and Freeth: (1) What was the participants' reaction to the course? (2) What did they learn? (knowledge (2a), skills (2b) and attitudes (2c)). (3) Did training make individuals change behaviour? (4) What results were obtained regarding wider change in clinical processes? (4a) and clinical outcomes (4b)?[41 42] It should be noted that self-rated behaviour was categorised as 'learning' of skills whereas observed behaviour and other more objective data (including self-reporting from patients) were categorised as behaviour or results respectively.[43] 'Time from intervention to evaluation' and 'Risk of bias' based on (1) study design (controlled/uncontrolled; randomised/not randomised; prospective/retrospective), (2) loss of participants to follow-up and (3) blinding of observers was also reviewed. Based on this assessment, we assigned each study a quality rating: 'High' (high risk of bias), 'Moderate' (moderate risk of bias) and 'Low' (low risk of bias)[44] (table 2).

RESULTS

Out of 4236 citations studied, a total of 18 studies[18–21 24 26–30 32–39] met the inclusion criteria. All studies were published in English. One study was Swiss,[24] one was Australian,[37] and two were British.[28 38] The rest were American. One study was a cluster randomised controlled trial.[30] Two were prospective controlled.[29 39] The rest were prospective uncontrolled,[18 21 24 26 28 32–38] retrospective controlled,[19] retrospective uncontrolled[20] or a case study.[27] The learners were multiprofessional hospital staff members. The objectives by and large focused on evaluating the outcomes. All studies except two[19 36] described a process of training needs assessment, the main method being a safety or teamwork attitude questionnaire (SAQ/TAQ), use of patient safety data and inputs from staff. The duration of the course varied from 4 h to 3 days (a few also described longer train-the-trainer courses).[26 31 37 39] All interventions focused on teamwork, coordination and communication.

Six studies reported participant reactions, and all described very positive responses.[21 24 34 36] Fourteen studies evaluated the effect on learning[18 19 21 24 26 28 29 32–35 37–39]: All studies used before–after SAQ or TAQ and reported positive outcomes on some or most items. However, one subgroup analysis revealed a significantly improved score for one of two intervention sites but not for the other.[28] Another study found significantly improved scores for surgeons and anaesthetists but not for nurses.[18] A third found perceived benefit of briefings higher among nurses than among anaesthetists and surgeons.[26] Two studies assessed knowledge: one found a significant increase from before to after.[37] Another found high overall knowledge after.[39]

Nine studies evaluated the effect of the intervention at the individual observed behavioural level.[18 20 26–29 35 37 39] Behavioural change was measured through the use of perioperative briefings and was mostly positive: in one study, compliance increased from 0% to 86% after training, but decreased to 66% after 6 months.[26] Another found 64% compliance after 1 month but 100% compliance after four. Another reported significantly more briefings but no absolute numbers.[39] Three studies measured behaviour as use of communicative frameworks and found improved teamwork scores.[29 37 39] One study found teams compliant with 60% of the recommended practices after a year (after brief retraining).[20] Another only found an increase in team non-technical skills at one of two intervention sites.[28] Behaviour was in yet another study reported as staffs' increasing willingness to report incidents.[35]

Seven studies evaluated the effect on process measures: four found improvement,[18 29 34 37] two found partial improvement,[28 31] and one found no improvement.[26]

Four studies reported outcome measures at the patient level: two found no effect on patient satisfaction[29] and on an Adverse Outcome Index, AOI (defined as the percentage of women who

Table 1 Studies evaluating classroom-based multiprofessional team training for hospital staff. Outline of setting, objective, design and intervention from published studies

				Intervention		
Source	**Learners and Setting* (programme)***	**Objective**	**Design**	**Needs assessment**	**Course (duration, methods and content)**	**Training transfer**
Awad *et al*[18]	Nurses, surgeons and anaesthesiologists, Surgical Services, Veterans Affairs Hospital, USA. (The VA NCPS Medical Team Training Program)	Improvement of communication in the operating room	Prospective uncontrolled	SAQ.	Day long course with didactic instruction, interactive participation, role play, video and clinical cases on CRM principles and 'Change management training'[14]	Representatives from surgery, nursing and anaesthesiology formed a work group. Implementation of preoperative briefing policy and -guide.
Fisher *et al*[19]	700 Crew members of Air Medical-services, USA	To compare responses between participants who received training and those who did not	Retrospective controlled	Not described	CRM-training, team building and communication training	Not described
France *et al*[20]	89 members of cardiac- and neurosurgery teams at Vanderbilt University Medical Center, Nashville, Tennessee, USA. (LifeWings)	To evaluate the impact of CRM-training on team compliance with safety practices	Prospective uncontrolled	TAQ.	8 h of lectures, case studies and role playing on managing fatigue, creating and managing a team, recognising adverse situations, cross-checking and communication, decision-making and performance feedback[21] or E-learning module[22]	Approval of CRM-policy at departmental level. Work group, monthly meetings, customised tools and role models. Development of e-learning module, checklists, briefing script. Communication whiteboards. Feedback on performance. Support by commercial vendor.[23]
Grogan *et al*[21]	489 staff members from Vanderbilt University Medical Center, Nashville, Tennessee, USA. (LifeWings)	To evaluate participant reactions and attitudes	Prospective uncontrolled	TAQ.	8 h of lectures, case studies and role playing on managing fatigue, creating and managing a team, recognising adverse situations, cross-checking and communication, decision-making and performance feedback	Not relevant for objective
Haller *et al*[24 25]	239 nurses, physicians, midwives, technicians and administrators from labour-and-delivery unit at Geneva University Hospital, Switzerland. (Ensemble)	To assess the effect of a a specifically designed CRM-programme	Prospective uncontrolled	Analysis of a sentinel event in the ward and TAQ.	2-day seminar of lectures, film, discussions, role plays and selection of team improvement strategies to be implemented in the unit	All specialities represented in work group. Follow-up: 165 workshops aiming at improving participants' communication skills.
Halverson *et al*[26]	1150 operating room-physicians, -nurses, -technicians, pre-, and postoperative care staff, pharmacy, radiology, sterile supply and house keeping staff, Northwestern Memorial Hospital, Chicago, Illinois, USA	To develop and implement a team-training curriculum	Prospective uncontrolled	TAQ.	Train-the-trainer. 20 h course to peer trainers and 4 h course to trainees including lectures, videos, case scenarios, interactive communication exercise on teams, teamwork, communication and implementation of surgical briefings and debriefings	'Coaches' and 'Teamwork leadership group' handled implementation challenges. Training sessions for new staff members.
Leonard *et al*[27]	12 clinical teams, Kaiser Permanente, USA. Numerical data from 72 patients.	To discuss tools and experiences in implementation in successful areas	Case study	SAQ.	3-day training programme in human factors, standardised communication tools and behaviours to ensure effective communication	Tools adapted to local needs. Site visits, monthly conference calls and education for leaders. Each team worked on how to apply the techniques in their own clinical setting.

Continued

Table 1 Continued

Source	Learners and Setting* (programme)*	Objective	Design	Intervention		
				Needs assessment	Course (duration, methods and content)	Training transfer
McCulloch *et al*[28]	54 nurses, surgeons and anaesthetists of two (a laparoscopic (A) and a carotid surgical (B)) teams, Oxford Radcliffe Hospital Trust, UK	To reduce the number of potentially significant errors and to observe improvement in clinical outcome measures	Prospective uncontrolled	SAQ	9 h didactic and interactive: safety, situation awareness and error management; self-awareness, communication and assertiveness; decision-making, briefings and debriefings	3 months of twice weekly coaching and feedback in operating room by instructors
Morey *et al*[29]	684 physicians, nurses, clerks and technicians at six case ED's 374 staff members at three control ED's, military and civilian teaching and community hospitals, USA. (ETCC/ MedTeams)	To evaluate the effectiveness of training and institutionalising teamwork behaviours	Prospective controlled	Observation of ED teamwork and analysis of closed claims	8 h of case review, practical exercises, analysis and discussions on maintaining team structure and climate, apply problem-solving strategies, communicate with the team, manage workload and improve team skills	Physician and nurse from case-units part of work group. Creation of team-based staffing pattern. Four hrs of practicum in teamwork behaviours critiqued by instructor. Coaching and mentoring of teams for 6 months.
Nielsen *et al*[30 31]	1307 obstetricians, nurses and anaesthetists at seven intervention and eight control units at military and civilian hospitals, USA (MedTeams Labor & Delivery)	To evaluate the effect of teamwork training on adverse outcomes and process of care	Prospective cluster randomised controlled	Analysis of a significant adverse event and research on teams including experiences from Morey *et al.*[29] Inputs from local patient safety groups.	Standardised teamwork training curriculum. Local trainers trained staff for 4 h in safety culture, communication, situation monitoring, mutual support and leadership.	Local trainers received 12 h centralised didactic and interactive training on team structure and processes, planning and problem solving, communication, workload management, team skills, conflict resolution and implementation, and assisted in creation of 'core work teams,' 'coordinating teams' and 'contingency teams'
Pettker[32]	289 physicians, nurses and ancillary staff, Department of Obstetrics, Gynaecology and Reproductive Science, Yale New Haven Hospital, Connecticut, USA	To implement a comprehensive strategy to track and reduce adverse events	Prospective uncontrolled	SAQ, organisational risk and patient safety review by two outside consultants using staff interviews and review of policies and protocols	4 h. of CRM-based video, lectures and role playing led by patient safety nurse in shared mental model, structured communication, handover, debriefing techniques, assertion, conflict resolution and chain of command	Development of protocols and guidelines, creating of a patient safety position, anonymous event reporting, in-house on-call attending obstetrician service, obstetric patient safety committee, training, testing and certification of fetal monitoring standards
Pratt *et al*[33]	220 staff members (staff groups of participants not described), Labour and Delivery, Beth Israel Deaconess Medical Center, Boston, USA	To develop, implement and sustain a CRM-based team training process	Prospective and retrospective uncontrolled	Analysis of a significant adverse event and experiences from implementation of similar programme[30 31]	Standardised teamwork training curriculum in safety culture, teamwork, communication, situation monitoring, mutual support and leadership[31]	Multiprofessional steering committee, core team, coordinating team and contingency team supervised the process. Assignment of coaches to each shift, development of communication templates, information campaign, provision of feedback to staff, team meetings, introduction of new teamwork behaviours every 1–2 weeks and refresher training.

Continued

Table 1 Continued

Source	Learners and Setting* (programme)*	Objective	Design	Intervention		
				Needs assessment	Course (duration, methods and content)	Training transfer
Rivers *et al*[34]	164 surgical staff members at Methodist University Hospital, Memphis, Tennessee, USA (commercial vendor)	To evaluate if safety techniques used in aviation could be applied in healthcare	Prospective uncontrolled	Observation of surgical procedures and environment, interviews with staff	12 h of case studies, interactive team activities, videos and knowledge testing on teambuilding, recognising adverse situations, conflict resolution, feedback, stress handling, decision-making and fatigue management	Development of perioperative OR checklist
Sax *et al*[35]	509 multiprofessional staff members, Strong Memorial Hospital, Rochester, Rhode Island and 349 multiprofessional staff members at The Miriam Hospital, Providence, New York, USA (Indelta Learning Systems LLC)	To quantify effects of aviation-based CRM training on patient-safety-related behaviours and perceived personal empowerment	Prospective uncontrolled	Patient safety incident reports and root causes analyses hereof	6 h. interactive CRM-based course, using videos, teambuilding exercises and open forums. No further details included about content.	Development of perioperative OR checklist. Empowerment of nurses to halt procedure until briefing completed. Counselling of surgeons unwilling to participate. Executive safety walk rounds and patient safety symposia.
Sehgal *et al*[36]	225 physicians, nurses, pharmacists, clerks, therapists and social workers, UCSF Medical Center, San Francisco, California, USA. (Teamwork for Optimal Patient Safety (TOPS))	To develop a teamwork training programme	Prospective uncontrolled	Conducted by multiprofessional planning team. Details not described.	4 h of didactic presentations, discussions, videos and small group exercises on effective communication skills and team behaviours	Multiprofessional planning and teaching team
Stead *et al*[37]	~226* nurses and doctors at five healthcare sites, South Australia. Australia. Evaluation focused on mental health site (TeamSTEPPS)[11] *Number not directly indicated in article. Estimate based on evaluation-survey sample size.	To evaluate the effectiveness of implementation of a TeamSTEPPS programme at an Australian mental health facility	Prospective uncontrolled	Willingness to participate, amenability to cultural change and availability of multidisciplinary clinical staff	Train-the-trainer model: 2.5 days of training to local senior clinical staff on evidence base, tools and strategies to support teamwork and communication, coaching and development of site-specific action plans. Local 4 h. course on teamwork competencies, tools and strategies.	Peer-trainers formed local change teams to guide implementation. Sustaining phase included refresher training, review of data and support of implementation. Introduction of huddles and team approach to resolve aggression of patients.
Watts *et al*[38]	79 physicians, nurses, pharmacists, physiotherapists, technicians and others from nine clinical hospital teams, UK	To evaluate an interprofessional learning programme offered to establishes clinical teams	Prospective uncontrolled	Discussion of programme goals among participants in the first session	2 h session with facilitator every month for 4 months discussing team performance and communication in interprofessional teams and establishing goals for team development	Local work groups. Two-hour follow-up-meeting after another 4 months.
Weaver *et al*[39]	Cases: 29 members of three OR-teams including anaesthesiologists at 112-bed community hospital, USA. Controls: 26 members of OR-teams including anaesthesiologists at 297-bed hospital, USA (TeamSTEPPS)[11]	To describe the results of an evaluation study conducted as part of a quality improvement project aimed at optimising teamwork behaviour	Prospective controlled	SAQ and root cause analysis. Planning team received inputs to training and checklist from frontline providers. Participants selected by administrators.	Train-the-trainer model. The three trained teams received 4 h of didactic training including interactive role-playing and tools and strategies to improve teamwork: communication, leadership, mutual support and situation monitoring	Multiprofessional intervention planning team

CRM, Crew Resource Management; ED, Emergency Department; SAQ, Safety Attitude Questionnaire; TAQ, Teamwork attitude questionnaire.

Table 2 Evaluation methods and outcomes of studies evaluating class-room based multiprofessional team training in hospitals

Source	Evaluation*	Time of evaluation	Outcome	Comments	Risk of bias†
Awad *et al*[18]	2c. SAQ. 3. Counting of operations preceded by briefings. Method not indicated. 4a. Before—after preoperative antibiotic administration.	2c. 4 months after. 3. 1 and 4 months after. 4a. 4 months after	2c. Significantly better for anaesthetists and surgeons but not for nurses. 3. 64% after 1 month, 100% after 4 months. 4a. Significant increase in prophylaxis administration.	No of participants who underwent training or responded to SAQ is not indicated. 3. Method for assessment of briefings not indicated.	High
Fisher *et al*[19]	2c. SAQ to all crew members. 144 crew members who had or had not participated in CRM training returned surveys.	Not stated	2c. Participants of intervention had significantly better scores	Limited information on training and survey. Low response rate (21%).	High
France *et al*[20]	3. Observation after training of participants' skills during 30 surgical cases	One year after training (weeks after brief retraining)	3. Teams were compliant with 60% of practices enforced in the training programme	3. No information of blinding of observers. No before-measures.	High
Grogan *et al*[21]	1. 11-item Likert scale end-of-course critique 2c. 23-item before—after Likert scale TAQ.	1. Immediately after. 2. Before and immediately after.	1. Positive evaluation of course content: Scores on 3.91 to 4.58 (max. 5). 2c. Training had significant positive impact on 20 items.	1. 95% response rate 2c. 69% response rate.	High
Haller *et al*[24 25]	1. 10-item Likert scale end-of-course critique. 2a. Before—after 36-item Likert scale TAQ. 2c. 57-item Likert scale before—after SAQ.	1. Immediately after. 2c1. Immediately after. 2c2. One year after.	1. 90% positive of course organisation, 63.5—71% positive of content, 79—81% positive of teaching methods and 69—79% positive of group dynamics. 2c1. 35 of 36 items with improved scores (27 significantly). 2c2. Positive changes in safety climate: 2.9 [CI 1.3—6.3] to 4.7 [1.2—17.2].	2a. 74% response rate. 2c. 95% response rate.	High
Halverson *et al*[26]	2c1. TAQ. 2c2. Questionnaire on utility of briefings among 156 'selected individuals.' 3. Before—after observation of briefings. 4a. Wrong site surgery events, timely antibiotic administration, cases starting on time, turnover time between cases.	2c1. Immediately after. 2c2. Not stated. 3. Up to 6 months after. 4a. Not indicated.	2c. Improved perception of teamwork on 19 out of 19 items (14 significantly). 2c. 37% reported useful information shared at briefing, 75% reported greater sense of teamwork (higher among nurses than among anaesthetists and surgeons). 3. Compliance with formal briefings before intervention: 0%. 2 weeks after: 86%. 6 months after: 66%. Compliance with all required elements of briefing increased from 47% before to 86% after 6 months. 4a. No significant change in prophylaxis administration or operation time (no further information about this evaluation included in the article).	2c1. No response rate indicated. 2c2. No response rate indicated. 3. No information of blinding of observers.	High
Leonard *et al*[27]	3. Numerical results from one site on use of checklists.	3 months after.	3. Two checklists made information from hospital to skilled nursing facility (on important data like anticoagulants, code status and preferred intensity of care) available 44—100% of the time.	The article mainly describes qualitative effects and critical aspects of implementation at three sites	High

Continued

Table 2 Continued

Source	Evaluation*	Time of evaluation	Outcome	Comments	Risk of bias†
McCulloch *et al*[28]	2c. SAQ 3. Observation of teamwork skills during 48 surgical procedures before and 55 procedures after training 4a. Before—after technical errors, procedural errors, complications, operating time and length of stay.	2c. Before training and 3 months after. 3. Not stated. 4a. Not stated.	2c. Significantly improved teamwork climate score for B but not A. No effect on other SAQ-components. 3. Significant increase in team non-technical skills: for A but not B; For nurses but not for anaesthetists and surgeons; on teamwork/cooperation and problem-solving/decision-making but not on leadership and management or situation awareness. 4a. Mean technical error rate reduced significantly for A but not for B. Procedural errors reduced significantly for A and B. No significant affection of operating time, length of stay or number of complications.	2c. Response rate not indicated. 3. Two observers were not blinded but a third observer was independent/uninvolved.	High
Morey *et al*[29]	1. End-of-course critique 2b1. Before—after 3 item staff perception of support 2b2. Before—after evaluation of handover to unit by unit nurse 2c1. Before—after 15 item TAQ 2c2. Before—after 6-item individual subjective workload experience 3. Before—after 5-item team dimension-rating 4a. Before—after clinical error rate. 4b. Before—after 12 item patient satisfaction survey.	Up to 8 months after	1. Results not included in article. 2b1. Significantly higher perception of support at case units. No change at control units. 2b2. No significant before—after difference in quality of handover at case or control units. 2c1. Significant higher teamwork perception score among cases. No change among controls. 2c2. No significant before—after difference at case or control units. 3. Significant increase in score among cases. No change among controls. 4a. Significant reduction in clinical error rate for cases: 30.9% before intervention to 4.4% after intervention. No significant change for controls (16.8% to 12.1%). 4b. No significant before—after difference in patient satisfaction at case or control units.	Six out of 16 contacted sites immediately agreed to participate (cases). Three agreed later and were assigned as controls. Counting of patient safety incidents and team dimension rating conducted by unblinded unit staff but re-evaluated by blinded raters (kappa: 0.69). No indication of response rates to any of the questionnaires.	Moderate
Nielsen *et al*[30]	4a. Cluster analysis of 11 clinical process measures at case and control units before and after implementation. 4b. Before—after cluster analysis of adverse outcomes of 28.536 deliveries at case and control units.	Up to 5 months after	4a. One out of 11 additional process measures had significant better score among cases. 4b. No significant before—after difference in Adverse Outcome Index at case or control units.		Low
Pettker *et al*[32]	2c. SAQ 4b. AOI	2c. Two years before and 1 year after. 4b. Three years before, during and after training.	2c. The percentage of respondents reporting a 'good teamwork climate' and a 'good safety climate' improved from 38.5% before to 55.4% after and 33.3% before and 55.4% after respectively. 4b. From initiation of intervention the AOI showed a significant decrease.	2c. No indication of response rate. 4b. No information about trend in AOI before intervention.	High

Continued

Table 2 Continued

Source	Evaluation*	Time of evaluation	Outcome	Comments	Risk of bias†
Pratt *et al*[33]	2c. Hospital level SAQ. 4b. AOI, WAOS and SI 4b. Malpractice claims and cases	2b. Four years after training. 4b. Three years before and 4 years after training. 4b. Before—after. No indication of period.	2b. A higher percentage of staff from the intervention department strongly agreed to five items from the SAQ compared with the rest of the hospital. 4b. Before intervention: AOI: 5.9%, WAOS: 1.15, SI 19.59. After intervention: AOI: 4.6%, WAOS: decreased 33.2%, SI: decreased 13.2% (no absolute numbers reported). 4b. Before: 21 cases, 13 of high severity. After: 16 cases, 5 of high severity.	2c. No indication of response rate	High
Rivers *et al*[34]	1. Five point Likert scale end-of-course critique. 2c. Before—after TAQ. 4a. Before—after analyses of surgical count-errors.	1. Immediately after. 2c. Immediately after. 4a. 6 months after.	1. 75% perceived knowledge obtained in course as useful or very useful. 81% perceived that the course strongly or very strongly would increase their effectiveness. 2c. 'The surveys revealed that the training had a significant effect on desired behaviours'[34] (no further information included in article). 4a. 50% reduction in surgical count errors.	Limited description of methods and results including response rates	High
Sax *et al*[35]	2c. 10-item SAQ (Rhode Island site). 3a. Reporting of incidents by staff (New York site). 3b. Use of checklist (New York site) Training took place from 2003 to 2006 (New York) and 2005 to 2006 (Rhode Island).	2c. Immediately before, immediately after and 2 months after course. 3a. Difference from 2002 to 2008. 3b. Difference from 2002 to 2007.	2c. Significant increase from before to immediately after. Remained stable at 2 months except for one item which further improved significantly. 3a. Upward trend on 28-point run chart from 709 incidents per quarter in 2002 to 1481 per quarter in 2008. Reporting of near misses (as indication of stronger safety culture) increased from 15.9% to 20.3%. 3b. From 75% in 2003, 86% in 2004, 94% in 2005 to 100%.	The reported evaluations stem from two different interventions. SAQ 80% immediately after course and 40% 2 months after.	High
Sehgal *et al*[36]	1. 21-item five point Likert scale and open-ended questions end-of-course critique	Immediately after	1. Overall training rating: 4.49 (±0.79) ((nurses 4.71 (±0.52), pharmacists 4.64 (±0.49), physicians 4.31 (±0.61)). 99% would recommend course to peers. Course likely to change the way the participant communicate: 4.37 (±0.71) and participate in teamwork 4.31 (±0.56).	No other results from the end-of-course critique reported	High

Continued

Table 2 Continued

Source	Evaluation*	Time of evaluation	Outcome	Comments	Risk of bias†
Stead *et al*[37]	1. End-of-course critique 2abc. 23-item knowledge, skills and attitudes questionnaire. 2c. 42-item SAQ. 3. Use of SBAR and observation of team behaviours and performance. 4a. Seclusion (∼isolation of patients) rates.	1. Immediately after. 2abc. Not indicated. 2c. Not indicated. 3. SBAR: 1 month after. Team: Before–after. 4a. 9 months after.	1. 'Virtually all' participants found that training was appropriate, would improve patient safety, facilitate leadership and improve communication. 2abc. Significant increase. 2c. Significant improvement in 2 of 12 domains. 3. Multidisciplinary use of SBAR in 'practically all' patient presentations and writing. Improved team structure and process of meetings, improved role clarity and reduced unnecessary team membership. 4a. Significantly reduced seclusion rates after implementation.	1. No quantitative measures indicated. 2c and 2abc. No information about response rate. 3. External observers. No quantitative data on observations.	High
Watts *et al*[38]	2c. 53-item TAQ.	Before, 4 months after and 8 months after	2c. TAQ-score increased significantly after 4 months. Rating by 42 participants after 8 months showed sustained results.	90% response rate before, 81% after 4 months and 53 after 8 months	High
Weaver *et al*[39]	1. 11-item Likert scale end-of course critique. 2a. 23-item knowledge questionnaire. 2c1. TAQ (controlled) 2c2. Operating room management questionnaire (ORMAQ) (controlled). 3. Surgical team observation of 10 procedures per team before and after (total 60) (controlled).	1. Immediately after training. 2a. Immediately after training. 2c1. One month before and 1 month after training. 2c2. 1 month before and 1 month after training. 3. 1 month before and 1 month after training.	1. 52–94% of respondents reacted positively to items. 2a. Respondents had an average of 92% correct answers. 2c1. Both cases and controls improved significantly from before to after. 2c2. Attitude to teamwork improved significantly among cases after training. 3. Trained teams engaged in significantly more precase briefings than controls. Trained team members were significantly more willing to speak up and engage in contingency plan discussions. Trained staff improved significantly on communication and mutual support but not on leadership and situation monitoring. The proportion of team members who received training was significantly correlated to debriefing participation ratio. Two out of three trained teams demonstrated a significant increase in perception of teamwork after training.	2c1. and 2c2. A very low number of controls (N=7) answered the questionnaire after training of cases. 3. No information about blinding or neutrality of observers.	Moderate to High

*Evaluation level: (1) reactions to course, (2) learning (a) knowledge, (b) skills and (c) attitudes, (3) observed change in individuals' behaviour, (4) results: (a) Changes in organisational processes and (b) results for patients.
†Risk of bias: 'high' for high risk of bias, 'moderate' for moderate risk of bias and 'low' for low high risk of bias based on (1) study design (controlled/uncontrolled; randomized/not randomised; prospective/retrospective), (2) loss of participants to follow-up and (3) blinding of observers.[44]
AOI, Adverse Outcome Index; SAQ, Safety Attitude Questionnaire; SBAR, the Situation-Background-Assessment-Recommendation communicative framework; SI, Severety Index; TAQ, Teamwork attitude questionnaire; WAOS, Weighted Adverse Outcome Score.

experience one or more of a number of prespecified adverse events).[31] However, two studies found an improvement in patient safety through a significant reduction in AOI.[32 33]

There was a tendency towards a positive effect of a local multiprofessional work group conducting or participating in an intense follow-up-phase after the intervention.[23 32 33 37] However, the descriptions of follow-up in the studies (and their related published curriculum descriptions) are limited.

DISCUSSION

This review shows that the field of classroom-based team training is still new with few published studies and limited proof of clinical results. However, participants overall reacted positively to training and improved their knowledge and attitudes. The participants in most instances improved professional behaviour, and most studies of process measures showed an improvement. As such—before describing the reservations to these results—at least we know that the concept is well received by hospital staff. This is an important primary indicator for the intervention in healthcare.

One relevant Cochrane review was identified.[45] However, this 2008 review contained only six studies, and only one of these was relevant for this review.[29] The Cochrane review concludes that the small number and the heterogeneity of studies make it impossible to generalise on the clinical effect of interprofessional education, and more rigorous research is needed.

This is possible due to the substantial challenges for this kind of intervention:

First, except for three studies,[29 30 39] the studies (N=15) had very weak designs. The uncontrolled before–after studies have a great risk of unwanted time-related effects on the outcome of interest: staffing problems, patient issues and change in the economic situation of the unit or hospital. Controlled designs are preferred, but standardisation can be hard in the complex settings. Triangulation (use of both qualitative and quantitative measures) and methods such as statistical process control can strengthen the before–after design.[46 47]

Second, as readers, we still do not know much why an intervention was effective and another less effective, as the studies often were brief on descriptions of needs assessment, planning, training and follow-up. The internet gives authors the option of presenting (and sharing) course curricula, follow-up plans, questionnaires and observation tools as e-appendixes (as done in a few cases).[11 28 36] Further, we found no reports of qualitative measures as interviews with staff focussing on why the intervention had the effect it had. Such measures could contribute to a deeper insight and should be encouraged.

Third, in most cases, the evaluation took place at only one, two or three levels. This is too limited to provide the reasoning that is the rationale for the many evaluation levels: in order to render demonstrated clinical results probable presentation of outcomes at behaviour, learning and reaction levels are necessary. This evaluation burden is significant but can be reduced if sharing is encouraged. Evaluations by outside observers and other more objective data are also important, as experiences show a tendency to over-reporting in self-rating of behaviour.[43]

Fourth, more than half of the studies were evaluated within 6 months. For interventions aiming at improvement in clinical outcomes, this is too soon: Experiences from other fields show that it takes a sustained effort and thorough follow-up after training for a new teamwork culture to root in the organisation.[48–50] This includes structural changes, changes in policies and procedures, retraining, training of new staff members, support of practise, role modelling, feedback and development of well-functioning checklists.

Further research is necessary before giving the intervention a general recommendation.

Limitations

We included the studies after a thorough search of relevant, mainly medical, databases, but other educational, sociological and psychological databases may contain relevant references.

At the same time, the terminology is imprecise and changing (for instance, the terms 'team training'/'crew resource management' (as used in mainly American literature) and 'non-technical skills training' (as used in the British literature) are somewhat synonymous). This leads to heterogeneous indexing in bibliographic databases. To compensate for this, we conducted a thorough hand search. However, the result of the search might still be incomplete.

Our categorisation of the evaluation parameters into the four evaluation levels might be faulty, especially with regard to 'behaviour,' 'process measure' and 'outcome measure.' It is based on often brief descriptions. The aim was to standardise the often varying categorisation in the papers, not to devaluate the results achieved.

CONCLUSION

Classroom-based team training for multiprofessional hospital staff is recommended as a way to improve patient safety. This review shows mainly positive effects of the intervention on participant reaction, learning and behaviour. The results at the clinical level are still very limited.

Funding The Pharmacy Foundation of 1991 and Det Kommunale Momsfond funded this study.

Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

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Outcomes of a classroom-based team training intervention for multi-professional hospital staff

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Key words: team training, patient safety, curriculum planning, evaluation, complex intervention, design-based research

Word count, abstract: 247

Word count: 2966

Funding: This work was supported by The Pharmacy Foundation of 1991, *Det Kommunale Momsfond* and the philanthropic foundation *TrygFonden*

Abstract

Introduction: The literature, analyses of patient safety incidents and interviews with staff indicate a need for improved teamwork in healthcare. The objective of this paper is to describe the outcomes of a classroom-based team training intervention in a 35-bed cardiology department in a Danish university hospital.

Method: The curriculum was systematically planned, based on a needs assessment involving staff and leaders from the intervention site. Eight hours of training was given to 132 staff members. A seven-month follow-up campaign focused on transfer of the intervention to daily work situations. Outcomes were assessed at various levels: a) Participant reactions b) Self-assessed knowledge of the tools and change of behaviour c) Observed quality of communication compared to a site which received no intervention d) Adverse events before and after the intervention compared to a site which received no intervention and e) Semi-structured interviews with participants about the effect.

Results: a) The immediate reactions were very positive, b) A large majority of staff knew about and used the tools, and stated that training had improved patient safety, c) There was no indication of higher quality of information exchange among trained staff compared to untrained staff, d) the systematic record audit showed no impact on the adverse event rate and e) staff called for further follow-up.

Conclusion: A systematically developed intervention that reached a large proportion of staff resulted in positive staff reactions and self-rated change in knowledge and behaviour but no change in observed behaviour or clinical results.

INTRODUCTION

Patient safety is a challenge at hospitals all over the world. One of the important causes of adverse events is poor team communication[1], apparently influenced by context and culture[2]. Inspired by other high-risk domains[3], team training and cognitive support[4] have been suggested to improve team communication and thereby patient safety.

Team training has been transferred to health care using two teaching techniques: a classroom-based model or a simulation-based, or a combination of both. Classroom-based interventions use lectures, video demonstrations, discussions and role-plays to strengthen knowledge, skills and attitudes on patient safety culture, reliable communication exchange and cognitive support[5]. A systematic review of the literature indicated mainly positive effects of multi-professional classroom-based team training interventions in healthcare. However, few studies reported evaluations that sufficiently provided insight into why the intervention had the effect it had, and clinical results are few[5].

Research on classroom-based team training interventions is grounded in theories of design-based research[6], action research[7], method triangulation in evaluation of training[8], and complex interventions[9].

The objective of this paper is to describe the outcomes of a classroom-based team communication intervention for multi-professional hospital staff within a seven-month evaluation period.

METHOD

The intervention took place in Department of Cardiology and Pulmonary Diseases, University Hospital Hvidovre, Capital Region of Denmark, after a thorough needs assessment[10, 11]. A 35-bed cardiology department at the neighbouring Roskilde Hospital, where no team communication training took place during the intervention or follow-up period, was selected for comparison.

Neither in the intervention department nor in the department of comparison did staff have any previous experience with team communication training. The details of the intervention itself, the planning of the curriculum, and how it was pilot tested and the course content plan are described in an accompanying **e-appendix**.

Planning of the intervention (June – September 2007) took place in a project-group consisting of the medical and nursing leaders from the department and an outside supervisor. Staff was involved through a focus group interview[10], a local patient safety attitude questionnaire[12] and analysis of local patient safety incidents[11]. The hospital CMO endorsed the intervention and provided financial support. The needs assessment revealed an overall high degree of trust, support and openness and a low authoritarian gradient. Only three percent of staff indicated they had difficulty with expressing patient safety concerns, but one fourth experienced loss of information between shifts and more than half experienced loss of information between units[10,12].

Training was given to 132 participants in groups of about 35 each having a full-day session from September to December 2007.In each session participants were involved in deciding on a strategy for action. This resulted in selection of cognitive tools to support handover of information and focus on telephone information exchange, shift change and multiprofessional rounds.

The *follow-up campaign* from September 2007 to April 2008 included cognitive support (pocket-size checklist handbook to all staff members[13]), posting of checklists, stickers and note pads at all work stations, engagement of mid-level leaders, introduction of new staff and integration in other clinical training activities.

Evaluation

Reactions were evaluated using an anonymous 14-item 4-point Likert-type scale questionnaire.

Learning and behaviour were evaluated using a 28-item Likert-type questionnaire distributed by internal mail to all staff members in January 2008 that focused on the self-assessed use of the methods taught during training and the perceived influence of training on culture.

Team behaviour was determined during post-intervention field observations of patient information exchange (IE) situations between eight quasi-randomized trained doctors and nurses and seven quasi-randomized untrained doctors and nurses from the department of comparison in March and April 2008. Observations took place during four-hour periods on business days. To reduce bias the exact aim of the observation was disguised from the non-involved observer and observees. All IE between observees and colleagues involving exchange of patient data were audio-recorded and mode of communication (face-to-face or phone conversation), size of team and staff group noted. The audio-recordings were analyzed by LIR and a rater not otherwise involved in the study. Based on the objectives of the curriculum, each audible IE where the observed staff member was *the origin* of information was rated for: a) coherence of speech, b) structure of information and c) agreement on the plan (for the patient or teamwork) on a 3-point scale (14). Each IE where the observed staff member *received* information was rated on a 3-point scale for a) coherence of speech, b) confirmations (read back or other) and c) agreement on the plan (for the patient or teamwork). Each IE was thereby assigned a total 'communication score' from 3 to 9. Interrater-agreement (same value or +/- 1) was tested on a random sample of 20% of the IE's.

The clinical results of the intervention were studied in a structured record audit[15, 16] to estimate the level and severity of patient harm on a random sample[17] of patients in the intervention department. This method has been suggested as a method to evaluate patient safety interventions with broad impact[18, 19]. To ensure that any change in the adverse event rate was not due to seasonal variation we compared the results to a similar sample from the department of comparison. Ten randomly selected records from each department from every 2-week period from six months before the

intervention to six months after were audited (2 departments x 10 records x 27 two-week periods: 540 records). Eligible cases and controls were ≥ 18 years of age, admitted for a minimum of 24 hours and had available records. Two blinded, systematically trained reviewers, not otherwise involved in the study, reached agreement on categorization of findings or consulted an unaffiliated physician supervisor with particular experience in rating of adverse events. Reviews alternated between the two hospitals to control for possible effects of increasing experience of the reviewers.

Semi-structured interviews in April 2008 aimed at evaluating any intervention effect **(Table 1)**. Seven of eight invited staff members and all three senior leaders (six physicians, four registered nurses) participated. Interviews, which took place in quiet rooms outside the participant's ward, were facilitated by LR, audio recorded and transcribed verbatim by an independent affiliate. Data-reduction and extraction of main findings were subsequently conducted individually by LIR and MAM before discussion and extraction of conclusions by the research team.

Data processing, statistics and ethics

Data were analyzed using SPSS v. 17 and Excel 2003. Students' t-test for staff observation data of averages of the communication scores for each observe; and the R Statistical Software v. 2.8.1. and qcc v. 1.3 for the results of the record audit.

Danish law exempts this type of research from ethical board approval. The Danish Data Protection Agency approved the studies. The National Board of Health approved the record audit. The records were reviewed at the respective hospitals to ensure data security. Interviewees and observees signed written consent forms after being informed in writing and verbally about the respective studies. Staff included in the observation study and follow-up interviews gave written informed consent after verbal and written information.

RESULTS

A total of 132 (31 junior and senior doctors, 61 junior and senior nurses, 13 nurse aids, 13 medical secretaries and 14 other staff members) (87% of all staff members exchanging patient information) participated in the four training sessions.

The course reactions questionnaire was filled out by 125 participants (95%) immediately after training. On average 95%, 96%, 93% and 93%, respectively, rated the contents of module 1, 2, 3 and 4 very good or good. In self-rating 12% and 74% of participants respectively rated themselves as very good or good communicators before the intervention. Asked about their skills after the intervention, participants provided ratings of 34% and 64%, respectively. Eighty-two percent rated the course as very relevant or relevant for their daily work. Ninety-six percent indicated that the course to a great or to some extent had provided knowledge of the link between communication and patient safety. Ninety-six percent indicated that the course to a great or to some extent had made them able to use the tools and strategies from training.

The self-assessment questionnaire was returned by 60% of participants. Knowledge of the cognitive tools selected by staff during training (among others the 'SBAR' and the 'read back' technique) was very high (98%, 97% and 87%, respectively). The three tools were indicated as being used 'often' or 'always' by 47%, 85% and 18%, respectively. Respondents in general rated influence in their department as very high.

Clinical behaviour was observed in eight intervention-department staff members and seven un-trained staff members from the comparison department (an eighth intended observee had to be excluded, having previously been exposed to the test programme). Observation captured 197 patient information exchanges (IE's), 20 of which were excluded due to incomplete or inaudible recordings. Of the remaining 177 recordings 119 included two participants (32 telephone conversations and 81 face-to-face) and 58 more than two participants (54 sign-outs/shift changes,

one acute patient care team and three others). No significant difference was found when an average score of the quality of information exchange for each participant was compared between staff in the two departments (**Table 2**). Interrater agreement was high (80%).

Clinical results: As seen in **figure 1a and 1b** we found no indication of a reduced frequency of incidents harming patients when we compared the rate of adverse events before and after the intervention. The level of patient harm also remained stable in the department of comparison. A test of reduced severity of harm in either department was negative as well.

Interviews lasted from 20 to 47 minutes (mean 32 minutes). **Table 3** contains excerpts of staff's descriptions of *application*: Exchange of verbal orders and patient data during transfers and information exchange over phone were some of the elements that staff described as having improved after training. Teamwork had improved because handover was more systematic: team members divided tasks more often, used each others' names, spoke loudly and clearly, used read-backs and spoke up when relevant. There was no systematic use of briefings, debriefings or the checklist handbook. Staff described how training had an effect, because the whole staff group became aware of patient safety issues and communication during teamwork and handover. The read-back and the ISBAR were the cognitive tools used most frequently. Inexperienced staff members were more motivated. Overall the effect of training was fading after an initial phase of high enthusiasm. **Table 4** contains excerpts of staff's descriptions of *promoters* of application: In the first months after training the tools and strategies became 'trendy' and colleagues would remind each other to use them and would show recognition to those who did so. In addition, the checklists, stickers, posters and notepads reminded them to use it. Training had a social effect and the multidisciplinary set-up was well received. **Table 5** contains excerpts of staff's descriptions of *barriers* of application: Both frontline staff and leaders pointed out that there was lack of follow-up. Transfer was inhibited by a lack of resources and accompanying organizational changes. Staff

expressed how their expectation of using the tools at was not matched by new and suitable standard operating procedures or policies. Staff also described how other initiatives (for instance accreditation and an 8-week national strike among nurses) inhibited use. Three structural problems diluting the effect were (i) the extensive semi-annual rotation of junior doctors three months after training, (ii) the fact that staff outside this department did not receive training, and thus did not recognize the methods, and (iii) the fact that the nurses had limited time for sign-outs where the tools could have been practiced and discussed. The cognitive tools were in some instances insufficient. Leadership back-up, which was considered important by staff, was invisible. There was a lack of integration with other training activities. Training of new staff was unsuccessful for doctors. Refresher courses laid out to mid-level managers did not take place, and no one could point to role-models.

DISCUSSION

The study shows how a classroom-based team training intervention resulted in highly positive immediate participant reactions, indicating substantial endorsement by participants of the concept and improved self-rated communication knowledge and skills after the intervention. After a follow-up campaign, staff indicated through self-rating that training had strengthened communication, patient safety, and teamwork. However, a post-intervention observation of staff behaviour showed no significantly higher communication scores among trained staff members compared to untrained staff. A structured before-after record audit of patient harm showed no improvement in clinical outcomes. An additional evaluation of qualitative parameters, however, revealed insight into why a highly-rated classroom-based team training intervention, which staff described as having a high impact, did not lead to higher communication scores among the participants of the intervention, or provide improvement in the adverse event rate: There was individual acceptance and uptake of the

methods and cognitive tools. However, change of culture is hard without sustained and substantial organisational support, including back-up from close leaders or role models, formal guidelines and policies, structural changes and constant reinforcement. These perceived barriers - lack of follow-up, leadership support and accompanying structural changes - are however common issues of 'transfer' in implementation research in general[20, 21].

Positive reactions and high self-assessed impact on behaviour are seen in several previous studies of classroom-based team training interventions[5]. A recent large-scale study has shown a reduced mortality (18% one year after training) among surgical patients in hospitals that participated in a complex multi-professional classroom-based team training intervention compared to hospitals that did not conduct training (a 7% decrease in mortality)[22]. The study includes more than 182.000 from 108 hospitals, who trained all staff. The lack of clinical results in the present study might therefore be a question of a high 'signal to noise ratio'. The unchanged rate of patient harm is thus consistent with the findings of others[23, 24]. A Cochrane review of outcomes of inter-professional education was inconclusive due to heterogeneity among the few published studies[25].

Engagement of local staff who can act as local project leaders and role models is a critical factor for a successful transfer[26, 27]. Unfortunately, organisations and curriculum developers rarely recognize this. Consequently, follow-up efforts are inadequately planned and budgeted. However, given that follow-up and sustaining the intervention are critical, training itself (whether classroom-based or otherwise) might be briefer - as long as it is considered useful and the methods are easy to use[28]. A spread-model that could have yielded this active involvement is the train-the-trainer approach ('Cascade model') where local staff members plan a training process in their own department with help from an outside educator. Hereby, the locals become experts capable of training, networking, coaching and sustaining an intervention. Moreover, this model has the potential to provide a

speedier dissemination in a large organization[29]. A critical element for this approach is however the engagement and coaching of the local trainers.

Further research should establish how to support transfer and implementation by the use of the cascade model, aligning of policies and guidelines and integration with other clinical educational initiatives[30, 31].

Strengths and limitations

The study has some important weaknesses: The post-intervention observation study was (in hindsight) of too a small scale to assess significant differences. However, the reliability of this study was high with respect to interrater agreement scores, and in a multi-method perspective, the way in which the quality of information exchanges use is rated is a useful and robust technique to determine the level of implementation.

The evaluation was in part based on self-assessment of skills and behaviour. However, self-assessment imposes challenges. Some results indicate that practical skills usually are better self-assessed than knowledge. However, a solid evidence base for effective self-assessment is lacking[32]. In this study this was encountered by using several tools to assess the impact of the intervention.

Finding a suitable department of comparison was challenging, as two departments rarely are alike on all parameters. In this study, a comparison department that had the same specialty, the same staff groups, same size, and that had not participated in team communication training was therefore selected. However, in contrast with the intervention site, the comparison department had not undergone an accreditation process and might therefore have a different safety culture. Further, the two departments differed slightly in patient population.

Seeking to establish the clinical results in terms of patient outcomes (based on a patient record audit) may seem too ambitious, considering that this was relatively modest intervention and that the

adverse event level is influenced by numerous factors ('Signal to noise-ratio'). However, while a reduction in the level of patient harm is a relevant ultimate clinical result, more specific measures such as length of stay and patients readmitted within 30 days should be considered for future trials. Our evaluation took place after a maximum of seven months. This is sufficient to see how local follow-up is taken up. However, had we found local follow-up, seven months had been too soon to determine the full effects, as the change process from awareness to sustained change would not yet have been completed[33].

Due to the still relatively limited experiences in the field of classroom-based team training interventions, the intervention was limited to a single department. However, in the nature of things, patient information is exchanged with staff in other departments. Staff in these departments did not receive the intervention. This might have limited the outcomes.

The intervention was further challenged by a hospital accreditation process and a concurrent 8-week national strike among nurses. Such are the conditions for clinical interventions of this kind[33], but studying training in naturalistic settings allows us the best opportunity to understand and generate new knowledge[35].

CONCLUSION

We conducted a classroom-based team communication training intervention in a cardiology department in Denmark. The intervention revealed highly positive reactions and during a seven months follow-up phase, we found high self-rated use of tools and influence on patient safety culture in the department. However, field observations showed no significant improvement in communication quality, and there was no reduction in the level of patient harm. Based on these findings and the results of semi-structured interviews with staff and leaders, a strategy involving

sustained and substantial organisational focus and a higher degree of involvement of local staff are suggested for future classroom-based team communication interventions in healthcare.

Acknowledgements: We would like to thank leaders and staff members at the Department of Cardiology and Pulmonary Diseases, Hvidovre Hospital and The Department of Internal Medicine, Amager Hospital, both Capital Region of Denmark, Paediatric Ward, Viborg Hospital, Central Denmark Region, Paediatric, Anaesthesiology and Obstetrical Wards at Roskilde Hospital, Region Zealand, for participation in the different versions of our team training programme.
Special thanks to Dr. Michael Leonard, Physician Leader for Patient Safety Kaiser Permanente, Dr. Allan Frankel, Principal, Pascal Metrics and Dr. Andrew Gaffney, Vanderbilt University Medical Centre, Nashville, Tennessee and Dr. Beth Lilja, Unit for Patient Safety, Capital Region of Denmark for expert advice during the process.
We would like to thank The Pharmacy Foundation of 1991 and *Det Kommunale Momsfond* for funding this study.
Funding/Support: This work was supported by The Pharmacy Foundation of 1991, *Det Kommunale Momsfond* and *TrygFonden*.
Other disclosures: None.
Ethical approval: Not applicable.
Disclaimer: None.
Previous presentations: None.

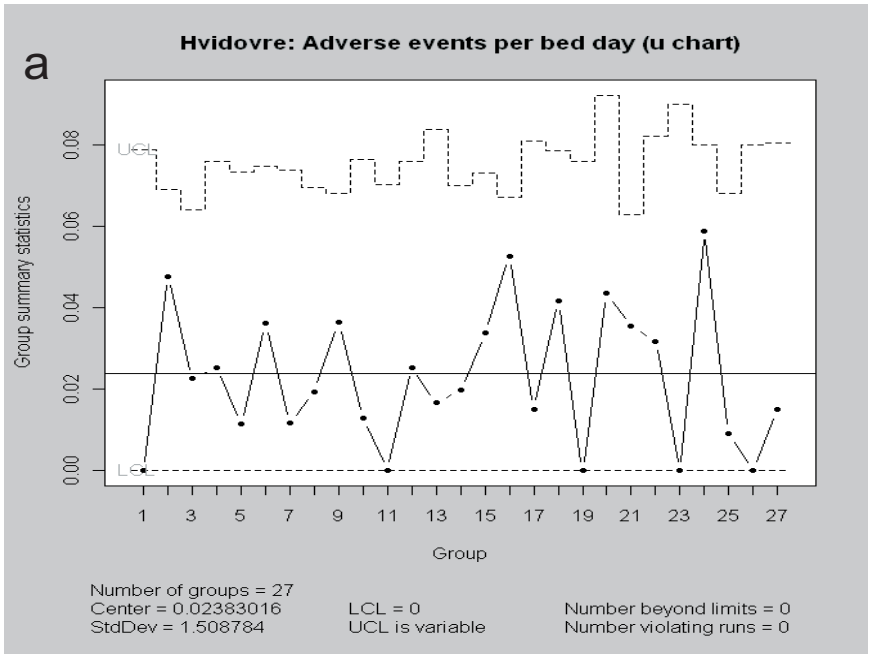
Table 1: Questions to staff members and leaders during the semi-structured interviews. The term 'tools' is related to all the methods and cognitive support elements included in training.

What effect has training had (for you yourself and for your department)?
What was the most useful part of the intervention?
What were the problems and barriers?
What determines if you use the tools in a concrete situation?
What did it mean to you that training was multidisciplinary? Why?
Who have used the tools the most?
Do your leaders use the tools? (To the leaders: Do you use the tools yourself?)
What does that [refers to the leaders' use or non-use of the tool] mean to you?

Table 2: Field observation study of staff behaviour among doctors and nurses in the intervention department compared ('Intervention') to doctors and nurses in the department of comparison (Comparable site'). P-value (t-test): Intervention vs. control: 0.23

Hospital	Staff group	Shift	Observations (No.)	Communication score (Total)	Average (communication score/No. of observations)
Intervention	doctor1	Morning	8	21	2,6
Intervention	nurse1	Morning	11	37	3,4
Intervention	doctor2	Afternoon	20	74	3,7
Intervention	nurse2	Afternoon	10	31	3,1
Intervention	doctor3	Evening	27	151	5,6
Intervention	doctor4	Night	4	19	4,8
Intervention	nurse3	Evening	15	57	3,8
Intervention	nurse4	Night	15	39	2,6
Comparable site	nurse5	Morning	8	22	2,8
Comparable site	doctor5	Morning	8	21	2,6
Comparable site	nurse6	Afternoon	8	21	2,6
Comparable site	doctor6	Afternoon	12	28	2,3
Comparable site	nurse7	Evening	11	37	3,4
Comparable site	doctor7	Evening	8	31	3,9
Comparable site	nurse8	Night	12	50	4,2

Figure 1a and 1b: Frequency of patient harm per bed day among patients in the intervention department (a) and patients in the department of comparison (b) from six month before the intervention ('1' on the x-axis) to the onset of intervention ('13' on the x-axis) to six months after ('27' on the x-axis). Every unit on the x-axis represents a 2-week period.



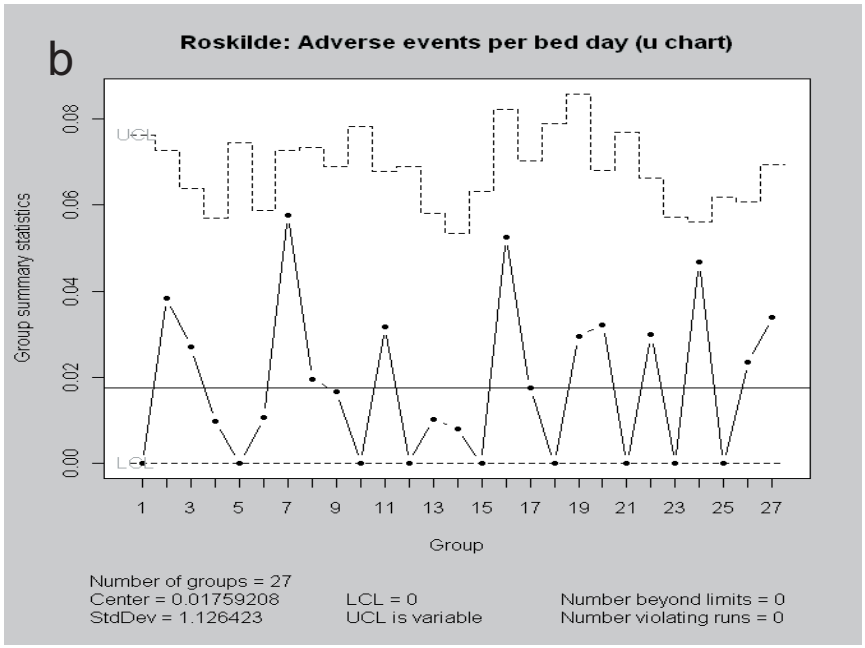


Table 3: The first column shows excerpts from the interviews with intervention department staff and leaders with respect to *application* of the intervention. The second column shows the research team's interpretation of the excerpts. TC = transcript code.

Excerpt	**Interpretation**
"I think it has the effect that people think when they communicate." (Experienced doctor, TC 0214) "I think the doctors of this unit have become more systematic at communicating during conferences". (experienced doctor, TC 0532) "I have used the 'read back' a lot myself when I discuss patients during a handover" (experienced doctor, TC 0565) "We talked a great deal about it in the beginning. There was this broad interest and people joked about the SBAR. That has waned though. However, it is still there as a common reference" (experienced doctor, TC 0588) 'I still think about it… I mean, if I have to make a phone call and ask a colleague [something], then I get the information in order [before calling]." (Inexperienced nurse, TC 0021) "We have used briefings before. [Training] has made us aware of how important this is. And since training I have reported an adverse event. Because now I know how important it is". (Experienced doctor, TC 0461) "You can feel the effect in specific areas: Safety checks of patient identification during transfer for instance. However, doctor-to-doctor phone conversation is more variable. Sometimes I recognise an 'SBAR'. But there are numerous times where I can't tell the difference" (experienced doctor, TC 0522)	Training increased awareness of patient safety issues and communication, and gave every one the same basis of knowledge.
"[After training] I have overheard how [other staff members] repeat information they have received over the phone'. (Experienced doctor, TC 0217) 'To me, it has brought the importance of staff communication and patient safety into focus. I have learned some concrete tools, which I can use. For instance how we rarely form exactly the same team twice. And how important it is to use names and communicate directly when you work with a team around a patient. (…) I like that when we talk about something now, it has to be crystal clear what we are talking about. It's the same on the phone: You have to get the order 100% right when the margins of error are narrow. I have asked others to repeat orders because I have become more aware. My own orders are more concrete so that they are not mistaken. (Experienced doctor, TC 0430 and 0463)	The read-back was relatively easy to apply and ask others to use.
"Now, we say it out loud when we draw up i.v.'s and inject them: 'I'm giving epinephrine' (…). That means only *one* nurse will draw up and inject – not 17. And we are much better at getting rid of those who are not supposed to be [in the room]. (…) And we use names more often. It actually has a big effect, to use each other's names. (…) I am better myself at saying: 'What can I do here?' Instead of just standing there waiting for someone to talk to me. I am better now at speaking up: 'This is not my competency. We need a doctor or a rapid response team'. That has become more legal in a way. (…) To speak up when you are insecure or concerned." (Young nurse, TC 0098)	Teamwork improved because communication became clear, the team members became aware of the team work situation and they spoke up with less hesitation.
"The new and inexperienced nurses used it. I think you will find several among them saying they found it helpful. They put the checklists up themselves and I encouraged them to use it when they called me. So they were good. For my part, actually, I thought about it too." (experienced doctor 0934)	Inexperienced staff members were more motivated and more willing to take up the tools.
'I still think we use it. However, it was more to begin with. I think we are going back to our old habits, right?' (Young nurse, TC 0013) "I don't think it has had a big effect if you look at the department. It is hard to turn a super tanker, and team communication is something that doesn't have a high priority among doctors. It isn't prioritized. You have to make sure that it won't end with this and get labelled intolerable bureaucratic…" (Experienced doctor,	The effect of training was fading after an initial phase of high enthusiasm

TC 0562) ”We talked a lot about it in the beginning. There was a broad interest. People were joking with the mnemonics etc. That has faded now, I think” (Experienced doctor, TC 0588) ”I think it was vague how we were supposed to implement it” (Experienced doctor, 0930) ”Follow-up in the department? I don’t think there has been any. I haven’t been part of it at least.” (Experienced nurse, TC 1192)	

Table 4: The first column shows excerpts from the interviews with intervention department staff and leaders with respect to *promoters* of the intervention. The second column shows the research team's interpretation of the excerpts. TC = transcript code.

Excerpt	**Interpretation**
”It became trendy to run around and say ’ISBAR’ and ’SALSA’ all the time to remind each other. I liked that. However, habits are hard to break. But we are trying. I still think about it if I call someone about a patient or if I am going to ask a colleague… to have the data in place.” (Young nurse, TC 0021)	The tools became trendy. After a while the effect faded but staff was still conscious about it.
“I think we gained from those training sessions. At the multidisciplinary level, too: laughing with the people you don’t meet so often. That was fine.” (experienced doctor, TC 0363)	Training had a social effect as well and the multidisciplinary set-up was well received.
”The [checklists and notepads] were great because they reminded one to use it.” (young nurse, TC 0011) ”It is easier when everyone has the same guidelines for communication. And it helps one not to forget something. I did that a lot before. If I was in a hurry and then handed off at the end of the shift, then you could have forgotten to tell [a colleague] at least 117 important things.” (Young nurse, TC 0047) ”The notepads, they are a great tool. (…) They help me remember and I find them everywhere. I imagine that they are used a lot.” (experienced doctor, TC 0560)	The different cognitive tools (checklists, note pads etc.) worked as reminders and guidelines

Table 5: The first column shows excerpts from the interviews with intervention department staff and leaders with respect to *barriers* of the intervention. The second column shows the research team's interpretation of the excerpts. TC = transcript code.

Excerpt	**Interpretation**
”If [our physician leader] gave an ’ISBAR’ then of course [it would mean something else than] if it was a young 21-year-old newly graduated nurse. I don’t know if I would use it. But I would say to myself: ’Now they are up and running! If [my leader] can break [the habit] then it can be broken’. Right?” (experienced nurse TC 0778) ”My [leaders] haven’t talked about it, and I can’t say that I think they have changed their way of communicating” (experienced doctor TC 0942)	Leadership back-up was important for staff
”Every Monday the new internal medicine residents meet for acute care clinics at the ER. Integrate it there!” (Experienced doctor, TC 0302) ”I think you should add simulation [during follow-up]. To let us get to together and act as a team”. (Experienced nurse, TC 0760) “The new residents should learn about it during their introduction.” (Experienced nurse, TC 0651)	Lack of integration with other training activities and methods inhibited implementation
”These projects are fine. However… the odds are low when you think about all the [other] things you have to do, right? Extensive paperwork, nutrition forms and who-knows-what a nurse has to deal with. And then I think the energy to learn something new and shift focus is gone. And it does take energy. And when you have someone calling in sick and overcrowding on the floors… Then this is the first to go”. (Experienced nurse, 0851) ”I got the point. However, I also understand my colleagues [who haven’t taken it up]: We are so busy and then suddenly you [want us to] put a lot of effort into communication. We hardly have time for rounds! Do you get me? Then I get the impression that this is an administrative thing with no chance of realisation (…) because we don’t get the [sufficient] resources to learn it and use it properly and implement it.” (Experienced doctor, TC 0919) ”But you have to provide follow-up, you have to give it some time. I mean this is a task like all other tasks in a department where you appoint a workgroup and provide some extra resources to implement it” (Experienced doctor, 0956) ”I think you should appoint the work group. It’s always better to appoint people. (…) You have to find those who are interested, but also push those who don’t volunteer… It is important to get their inputs [as well].” (experienced doctor, TC 0961)	Lack of resources inhibited implementation
”I mean, we won’t get a refresher course, right? You assume that when we have been through training, then we know how to use it or?” (Young nurse, TC 0117) “It is like when we instruct the patients to use new devices or change their own dressings they have to show us how to do it. We can’t just tell them: You have to remember to do it!” (Experienced doctor, TC 0259) ”If you made a refresher course then we could have the tools [that we haven’t spontaneously taken up after training] repeated and then we would perhaps start using them.” (experienced doctor, TC 0545) ”Your blood pressure will rise again if you stop taking medication. I mean, I don’t think we should be afraid of saying: ’If this is what we want then [we have to] spend the necessary time, space and a few resources and do the follow-up’. It could also be drip by drip like the code-training we repeat regularly.” (Experienced doctor, TC 0614)	Lack of refresher courses inhibited implementation
”It was only our department which received training right?” [the interviewer confirms] “That explains why doctors from the other units do not communicate as systematically as we do now.” (experienced doctor, TC 0532)	Lack of spread in the organisation

”It’s not just about staff in our department. We work crosswise and the others haven’t received any training… That’s a challenge too, right?” (Experienced doctor, 0475)	inhibited implementation
”[During follow-up] you could have given rounds or other things a higher priority. I think [attention to] the whole process around rounds and communication with staff, patients and specialists from other departments would be [a] clear-cut [focus area]. And then [it should be] measured if things changed” (experienced doctor, TC 0922)	Lack of focus points and visible outcomes inhibited implementation
”The most reliable [enforcement tool] is the whip. In this situation [the whip is a] a tick-box on a form that forces you to do a briefing before any procedure. We already use that when checking for contraindications” (Experienced doctor, TC 0550)	Lack of forcing functions inhibited implementation
”I think it should be mandatory and not just an option. I don’t know if it is possible but couldn’t we get written policies for this?” (Experienced nurse, TC 0651) ”I think it was vague how we were supposed to implement it”. (experienced doctor, 0930)	Lack of formal guidelines inhibited implementation
”I am thinking: What would have happened if we had taken the [midlevel-]leaders aside first and discussed it thoroughly with them? Had gotten their inputs on what to do when everyone have received training?” (DO 1041)	Lack of mid-level manager involvement inhibited implementation
”In my world this [kind of training] is something you joke about. And that is hard to change” (experienced doctor, TC 0912)	Cultural barriers inhibited implementation
”To be honest, I don’t think it has had much of an impact yet. Training was interesting and the background information about aviation and safety is still on my mind. However, I have honestly not benefitted much from it myself. It is still a joke because of the funny [mnemonics]. However, it seems like it is something that will take a long time to integrate. It is on its way. It just takes time because you have to get used to it.” (experienced nurse, 0638)	Lack of time to adapt to the new methods inhibited implementation
“Perhaps I would have benefitted from this when I was newly qualified… I mean [back then] I sat there quivering when calling, [thinking] ‘Is this really relevant?’ and ‘Do I make myself clear?’” (Experienced nurse, TC 0663) ”Unfortunately we already have our habits… during residency you [learn how to] do some things by heart, right? It is hard to change habits. It really is. (Young doctor, TC 0805)	Old habits inhibited implementation
”It is because they think it works well [already]. And I will say that it does… for 95% of them” (Experienced doctor, TC 0340) ”The senior residents are stressed. So they opt out if I give them too many details like who I am and the number of the unit. They know from the phone number, we know each other and they know the patient. I think it is too elaborate. It makes me say: ‘Phew, I’ll just do what I usually do’”. (Experienced nurse, TC 0695 and TC 0784) ”I’ll say a whole day [of training] it too much. I think it – with advantage – could be shortened – in my opinion – to half a day. I mean there is a cost-benefit relationship here, right. It is mega-expensive to pull staff out for a whole day (…) I would put less focus on team building (…) and more on real life, the professional issues” (Experienced doctor, TC 1120) ”If you follow the steps slavishly then it feels forced. I think that’s a reason. And they think they do it well already and that there is no reason to change their behaviour” (Experienced nurse, 1144)	Lack of sense of urgency inhibited implementation
”Our challenge is that every 3 or 6 months we renew our junior medical staff group. [If we want to keep focus on this program] we have to maintain [it] in another way than we have done [so far]: By mentioning it in parenthesis at the introduction. That’s definitely not enough. Then it will disappear.” (Experienced nurse, TC 1049) ”This huge replacement of the junior doctors means that (…) you don’t know who is working here in two	Structural problems inhibited implementation.

months from now“ (Experienced doctor, TC 0292) ”Shift changes are really busy. I have heard from other nurses that [in their departments] they have 15 minutes for shift change. (…) We don’t have that. That means that information is lost during handover. There is no overlap. If you are really busy, then you hand over quickly. And when you get home, you remember 117 things you should have told them...” (Young nurse, TC 0123) ”I mean, the posters were fine, but they were not placed where we conduct our handover. So, they were invisible, I would say. (…) The stickers got old and fell off. (…) I don’t use the handbook very often for a matter of fact. There is a lot of other stuff in my pockets.” (Young nurse, 0023)	

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Discussion

This chapter is a discussion of the research papers. The first part of the chapter is a review of the conclusions from the four research papers. The second part is a discussion of the results. The third part discusses some of the methodological aspects and limitations related to the studies. Finally, the last part outlines the perspectives and recommendations following the above.

Review of the conclusions from the four research papers

The overall aim of this thesis was to systematically develop a classroom-based team communication training intervention for Danish hospital staff and evaluate the outcomes.

The research question pertaining to study 1 was:
What do multi-professional root cause analysis teams describe as the system-level team-communicative causes in a sample of severe in-hospital adverse events?

This study demonstrated that in more than half of the included root causes analysis reports (RCARs) erroneous verbal communication between staff members was described as a root cause or a contributing factor. Loss of information during handover and between staff groups was described as the most frequent characteristic of the incidents. The related organizational factors were lack of communicative procedures during transfer, telephone communication, and involvement of other specialties. With the risk of hindsight bias in mind, it was concluded that RCARs hold rich descriptions of patient safety incidents, which allow outsiders to gain insight into organizational factors leading to the events.

The research question pertaining to study 2 was:
When in a multi-professional focus group setting, what do Danish hospital staff members describe as the pathways of multi-professional team communication, and what are the promoters and barriers of these pathways?

In this study we used focus groups to identify the main verbal communicative structures common for multi-professional teams at four acute care hospitals, and the factors influencing them.

The informants described the main verbal communicative pathways as face-to-face communication in mono- bi- or multi-professional teams of two or more than two, and non-face-to-face communication, typically via telephone.
The most challenging communicative situations described by the informants were awaiting and combining information from the different chart systems, handing over information between units and shifts, and getting sufficient information through when calling someone, or when establishing an acute care team during for instance rounds or acute care.
The informants described the main barriers of safe team communication as lack of standard assignments and procedures, a flat hierarchy that leaves responsibility unclear, the staff groups' different agendas for the treatment of the patient, interruptions and many tasks at the same time.
The informants described the main promoters of safe team communication as well-established frameworks for communication, knowledge of other team members' skills and experience, and a flat hierarchy, which allows everyone to speak up.
These factors should be accounted for when developing new or adapting existing interventions to improve team communication and patient safety.

The research question pertaining to study 3 was:
Based on a systematic review, what are the previous international outcomes of classroom-based team communication interventions for multi-professional hospital staff?

Classroom-based team training for multi-professional hospital staff is recommended as a way to improve patient safety. This review showed that the field of classroom-based team training is still new with few published studies and limited proof of clinical results. However, participants overall reacted positively to training, and improved their knowledge and attitudes. In most cases, the participants improved professional behaviour, and most process measures showed improvement. As such, at least we know that the concept is well received by hospital staff. This is an important primary indicator for the intervention in healthcare. The results at clinical level were very limited.

The research questions pertaining to study 4 were:
a) To evaluate if communication skills among staff seven months after the initiation of a classroom-based team training intervention in a cardiology department are better than the skills of staff in a similar department receiving no intervention.

b) To evaluate if the level of adverse events harming patients is reduced six months after the initiation of a classroom-based team training intervention, when compared to staff in a similar department receiving no intervention.
c) To elicit and analyze the participants' attitudes towards the intervention.

The immediate participant reactions-survey indicated substantial endorsement of training itself and improved communication skills. The survey administered to all staff one to four months after the intervention indicated high self-rated knowledge of communication tools and substantial use of the tools. Staff self-rated, that training had strengthened communication, patient safety, and teamwork. However, a controlled post-intervention observation of staff behaviour five to seven months after the intervention, could not show a significantly higher communication score among trained staff members compared to untrained staff. A structured before-after record audit of patient harm did not show improved clinical outcomes.
Interviews with staff provided some explanation of why a highly rated intervention - which staff described as having a high impact - did not lead to higher communication scores among trained staff compared to untrained, or provide improvement in the adverse event rate: change of old habits is hard without leadership support, formal guidelines, structural changes supporting the process, and constant reinforcement. The effect of the intervention faded after initial high enthusiasm, due to lack of local follow-up, which confused and disappointed the staff members.

Discussion of results

This section will discuss the main findings of the four studies. The individual papers hold more detailed discussions of the individual studies.

Use of patient safety incident data to learn about organisational weaknesses

This study appears to be the first to use root cause analysis reports (RCARs) to learn more about team communication in healthcare. The data are particularly interesting, because they provide the view of the whole multi-professional team including frontline staff, and focus on the inadequacies of the system – not individuals. This view can add to the findings from field observation (1), malpractice claims (2) and staff interviews (3) to provide a richer picture of communications errors (4;5). However, in American hospitals, where RCAs are conducted widely, considerations of liability and confidentiality limit use of the reports for a wider audience. Using the Danish reports is therefore a unique way to exploit this important information.

The results describing teamwork and handover of patient information as risky is not new (6-8). But the study appears to be the first to discuss how communication errors in healthcare can be a result of lack of organisational procedures concerning exchange of information.
In recent decades, hospital organisations have developed clinical guidelines for almost any clinical condition (9). However, this analysis shows how staff need guidelines for organisational procedures as well (10). We used this in our intervention to emphasise the use of structure in the form of checklists and mnemonics to support communication. It was therefore surprising that the informants in the individual interviews asked for even further guidance, to stress that using safe team communication procedures is not voluntary but 'how we do it here'.

Verbal team communication errors in hospitals

The focus group study in this thesis ads new knowledge because it points directly to how professional and national cultural differences should lead to adaptation of healthcare team communication interventions. It is recommended in theory (11;12) and described in other domains (13;14) but seems not to be described for healthcare. The focus group studies also cemented that healthcare staff in general are novices on both patient safety- and human error thinking, and staff-to-staff communication training.
The previous studies of team communication in healthcare have all been from cultures with a steeper authoritarian gradient like the American hospitals. However, several countries in especially Scandinavia and some other western European countries have a less steep authoritarian gradient (14). Hospitals in these cultures need to consider adaptation of team communication training interventions developed abroad.
The first studies of communication in healthcare have all focused on highly specialized teams like OR-teams (1), intensive care (15) or neonatology (16). However, this study is among the first pointing to how team training is relevant for all staff members exchanging patient data (17).

Choice of intervention to improve team communication

The review of existing classroom-based team training intervention outcomes seems to be the first of its kind. The results indicated positive reception among those who received training. A large majority of the studies had a high risk of bias though. This is typical among studies published in the first years after initiation of the patient safety research effort: The field is still young and struggling to find its feet between the positivistic medical research field and the richer phenomenological

paradigm that allows for discussions of sociology, psychology, organisational structures and human factors.

After the analysis of patient safety data and interviews with staff had shown how communication errors are involved in the majority of severe patient safety incidents, we looked to the patient safety literature to find a solution. We found no results indicating that high fidelity simulation for our purpose should provide better results when it comes to providing the participants knowledge, skills and attitudes. Compared to high-fidelity simulation the classroom-based team training intervention fulfilled a need of both favourable logistics (training more staff at one time) and economy (no use of expensive equipment). This is favourable for hospitals aiming at training the whole staff group. Compared to e-learning, the classroom-based intervention was favourable with regard to the social element (18). Compared to outreach training (academic detailing), the classroom-based method was favourable, as it left time and room for inter-professional discussions (19), role plays (20;21) and feedback (22).

Training at large fulfils a need to do something quickly and at limited costs: A national electronic patient record (23), hiring more staff (24) to prevent the use of substitutes (25) and changing schedules to allow more time to handover information (24) are interventions that are probably relevant. However, they take much more time and much more resources to realise.

Why the intervention had the effect it had

The fourth study is among the first team communication training interventions to evaluate reactions, learning, behaviour and clinical results, and to compare it with a department that received no intervention. And it is the first to evaluate the intervention by asking the participants why the interventions had the effect it had. This qualitative aspect has been absent from the literature so far.

This thorough evaluation method revealed how the intervention initially received a lot of attention among all staff groups (reactions survey, self-rated knowledge and behaviour survey) but also highlights how this attention faded when follow-up was missing (observation study and individual interviews).

In the individual interviews, staff pointed to several factors to improve transfer which are all in accordance with theories in the field: the need for local project leaders (11;22), refresher courses (26), leadership support(22;27), formal guidelines (9) and structural changes (24).

Strengths and limitations

This section describes the strengths and limitations of the study as a whole. The individual papers hold further discussions of the methods used.

Focus of the studies

The focus on communication errors in healthcare teams was specified from the beginning, based on the high frequency of communication errors in healthcare: In several RCA-report studies, team communication errors have been described as the most frequent and significant cause of adverse events (28;29). However, the labelling of communication errors as the most frequent cause of adverse events has been described as too shallow and further research has been called for (4;5;30). These suggestions justified the studies. By specifically looking at team communication we might have hindered staff in defining a possible usable safety agenda. This could have been achieved by using methods of 'grounded theory'(31) where the researcher from the starting point to a higher extent is un-biased (11;12).

The studies did not directly evaluate the economic implications for the intervention even though this will be of interest to stake holders considering team training in their organisation. However, the choice of training-mode (classroom-based team training intervention) was picked on the basis of logistic considerations: Given that team communication is a general problem in healthcare which affects all staff groups whom exchange patient data, and given that there is a special gain from training the staff groups together (19) then all staff members in hospital organisations need to be trained. This makes a classroom-based intervention favourable.

Methodology and design

The design and selection of methods for this study have several insufficiencies:

Needs assessment

As described above, the study methods did not leave much room for a focus outside the 'team communication box'. This was aggravated by using relatively focused research questions for the needs assessment. A more open approach to what causes the adverse events in healthcare - for instance by using ethnographic methods like field observations and including observers from other domains (for instance sociology or psychology) – could have revealed new and more important issues. However, patient safety incidents are relatively rare and issues leading to them are complex.

This makes them hard to observe (32). This explains why a direct observation was de-selected in the first place.

However, within the framework of solving the apparent team communication challenge, we conducted a thorough data-collection for both the needs assessment (text analysis of organisational documents from multi-professional analysis of severe adverse events as well as focus group interviews) and the evaluation (questionnaire surveys with predefined response categories after training and after implementation, an observation study, a record audit, and staff and leader interviews). These methods investigate different aspects of team training needs and team training implementation and altogether provide a broader view of the situation than if only one method had been used. This strengthens the study.

The needs assessment was a general assessment of team communication weaknesses in hospital teams in general: The RCA-data stemmed from various departments at somatic and mental hospitals. The focus group interviews took place at four different somatic hospitals. However, the intervention only took place in one department of cardiology and pulmonary diseases after local adaptation of a standard intervention. The culture in this department can not speak for how the intervention would be received in all departments: other departments with a larger or smaller degree of acute care, other staff groups, other patient categories or other leaders. This will affect their need for team communication and thereby their reception of classroom-based team training intervention. The varying needs from department to department or even unit to unit should be encountered by involving local staff in planning, training and follow-up to a much larger extend than it was the case in this study.

The four focus group interviews were considered sufficient to get insight into general tendencies in the Danish healthcare system, as it included all relevant hospital staff groups and as the culture among university hospitals is considered fairly homogenous. However, further interviews could have provided richer descriptions on certain issues. This could again have strengthened the link from staff experiences to intervention. However, considering the complexity of the setting and participants a true needs assessment is hard to obtain (33). This can be accounted for by acknowledging that an intervention is never completed but has to be refined and adjusted repeatedly (11;34).

Intervention

Even though the follow-up campaign was comprehensive, the results indicated that it was undersized for clinical results. Where the training sessions had been pilot tested extensively, the

follow-up campaign was a first. As the evaluation indicates and in accordance with theories of social and organisational learning, the use of local project leaders and role models might serve the purpose (35-38). Further studies should establish what interventions are necessary to support transfer of training and provide the desired results in a Danish health care setting.

Evaluation

There are special aspects of patient safety in relation to choice of evaluation parameters: The relatively low adverse event rate combined with voluntary incident reporting (which leave out the possibility of using incident reports to evaluate an effect of an intervention) exclude the use of reported incidents as measure of effect (32). This means that the same data that indicate a patient safety problem, cannot be used to evaluate the effect of the intervention. Evaluation is also complicated by the fact that in a complex intervention, the effect is in the synergy between the parts – not in individual parts (32;39). Further, complex interventions - generally speaking - have the potential to change a lot of things a little instead of few things a lot (40). These challenges resulted in the selection of overall patient harm as the ultimate outcome measure. But patient factors that are affected by organisational interventions are also influenced by many other factors ('signal to noise ratio') (41). This makes extrapolation from intervention to results challenging and induce a risk of type II error.

Randomisation of the intervention and a comparable department was considered. However, except for the pilot tests preceding the study, this kind of team communication intervention including the follow-up campaign, had never been tested before in a Danish setting. A study comparing results in an intervention and no-intervention department was thus considered the next relevant level. With the results of this study in mind, future classroom-based team training interventions should use a randomised approach; for instance the 'stepped wedge' design that allow all departments to train in turn and thereby act as control units for each other (12;42).

Our intervention was evaluated after a maximum of seven months. This was sufficient to see initial effects like follow-up tendencies. For organisational changes to become 'what we do' the effort in itself can take years with a continual need for implementation and sustaining the methods (43;44).

Internal validity

The validity of a study is about whether it investigates what it aims to investigate. Validation should be considered at every stage in a study (45). The focus of the study, as well as both the chosen methodology and its design, has been discussed in the previous sections. Below, the validation of the interview methods and the risk of selection, information and researcher bias are described.

Validation of focus group and individual interviews

The focus group interviews were transcribed by LIR, as the many voices on the tapes made them hard to transcribe for others. Reading the text, while listening to the tapes again, validated the transcription. After selecting the relevant excerpts, these excerpts were translated to English by LIR, and the English translation was verified by an outside researcher and discussed in the research team. The individual interviews were transcribed by an assistant, but the validation of transcription and translation took place in the same way as with the focus group interviews.

Validation of questionnaires

Two different questionnaires with pre-specified answer-categories were developed for this study and used for evaluation of the intervention: A questionnaire evaluating participants' reactions to training ('reactions survey') and a questionnaire evaluating their knowledge and self rated use and impact of the tools ('evaluation survey').

The reaction survey initially underwent cognitive validation by asking staff members from five different staff groups (doctor, nurse, nurse aid, medical secretary and physiotherapist) to fill out the survey, while listening to their comments about how they understood the questions. After this initial cognitive validation process, the survey was included in the three pilot tests and staff members were asked to express any insecurity in how to fill out the surveys or understand the questions. After being filled out, the surveys were analysed and compared to the researchers' own impression of training, to see if the surveys could reflect differences in training quality.

The evaluation survey underwent cognitive validation by asking the same five staff groups to fill out the questionnaire while thinking aloud.

There are many more ways to validate questionnaires. However, due to the large number of evaluation strategies in this study, further validation was ruled out. This limits the validity of the individual methods. However, the triangulation process adds to the overall validity of the result.

Validation of team communication observation scoring and RCA-report text analysis

In order to secure valid interpretation of texts (Paper 1) and observation of teamwork (Paper 4) two independent raters evaluated the data in both instances. This took place after defining a detailed protocol and after reaching agreement between raters on a random sample of 10% of the texts/recordings. The 10%-test sample was subsequently excluded from the final dataset.

Validation of the record audit method is described in detail elsewhere (46).

Selection bias

The RCARs sampled for the analysis all originated in one hospital organisation (six hospitals) in Copenhagen. Their descriptions of team communication might be influenced by the analysis model and the culture in these hospitals. Other patient safety analysis methods and analysis teams from other hospitals settings could have revealed other results. However, the results are in agreement with analysis of teamwork in other settings (8) and the structured and multi-professional consensus approach increase validity (47).

The team communication intervention was mandatory and 87% of all staff members in the department participated. There was a slight under-representation of doctors and nurses (as opposed to nurse aids, medical secretaries, physiotherapists, lab technicians and hospital porters) among the participants when compared to the department background staff population. If those with the longer education backgrounds are considered more critical, then this might have favoured more positive reactions to training.

Due to the two bi-annual rotations, none of the junior doctors who participated in training were available for post-intervention observation or interview. This favoured selection of more experienced doctors in the intervention department compared to the department of comparison. However, experience is not a certain indicator of communication abilities (48) and the influence of this bias is therefore uncertain.

Patient records for the record audit (Paper 4) were selected randomly after pre-specified criteria described in detail elsewhere (46).

The department of comparison was selected to be comparable with the intervention department with respect to patient categories, previous experience with team communication training, staff groups,

accept from hospital and department leaders, risk of merger in a process of hospital-restructuring and geography for easy access for raters. We found no perfect department of comparison. However, we found a next-to-perfect department. The department was sub-optimal because of the following: The department of comparison was situated in a more rural area than the intervention department. This could influence culture and duration of staff employment. The patient profile was slightly different with respect to minor surgical heart procedures. This could mean shorter length of stay and a different adverse event profile. The department of comparison was previously un-accredited contrary to the department of intervention. This could affect the safety culture, and thereby communication, among staff.

Information bias

The focus group interviews were multi-professional. This was intentional, as the aim was to receive more general descriptions of team communication – not fruitless generalisations of the inadequacies of other (absent) staff groups. However, this set up might have resulted in information bias regarding for instance the true hierarchy in a department. An information bias that draws in the same direction was the selection of participants: Department leaders were asked to find participants that were willing to speak up. This could hide a more traditional hierarchy, as this may have favoured selection of more frank nurses than nurses in general. Together these two factors might have given an impression of a low authoritarian gradient in Danish hospitals. This tendency is previously not well described for healthcare. However, it is described with respect to aviation (13), commerce (14) and national culture (49).

The staff members interviewed for the evaluation interviews were quazi-randomised: They were selected based on who had the shift on the particular day the independent observer chose to observe in the department. These staff members where also asked to participate in follow-up interviews. The informants could be unwilling to share critique of the intervention, because they knew it was developed by the interviewer. However, they were informed about their voluntary participation and how their inputs could help improve future versions of the intervention.

Researcher bias

The researcher's employment in the Danish Society for Patient Safety and the researcher's evaluation of an intervention that she herself had developed, could potentially lead to researcher bias, as the researcher could be tempted to omit results evaluating the intervention unfavourably

from the analysis. This was one of the reasons why two independent researchers analysed interviews and text analyses independently.

External validity

Hospital team transferability

The intervention took place in a department for cardiology and pulmonary diseases. The degree of acute care, the number of staff groups and the need for coordination with other hospital departments, primary care teams and other hospitals makes the department a typical Danish hospital department. The results are thus to a large degree transferable to other somatic hospital departments. The RCA-reports stemmed from both somatic and psychiatric hospitals and the intervention is thus probably of relevance in psychiatric hospitals as well.

Healthcare system transferability

Handovers from primary to secondary care, and vice versa, and from pre-hospital care (ambulance services etc.) to hospital care are found to be highly risky when it comes to loss of information (50;51). However, compared to teamwork in primary care (for instance long term care homes, home care, pharmacies and general practice) hospital teams are characterised by a higher degree of acute care and teamwork with unfamiliar team members. The low degree of highly acute care makes the team communication training intervention less directly transferable to primary care. However, the new national reporting system for patient safety incidents, which encourages reports from primary care as well (52), will show if there is a need for team communication interventions in primary care too.

Pre-hospital care teams are in many ways more comparable to hospital teams particularly with concern to the variability of tasks, unfamiliar team members, handover to hospital teams and use of telephone communication. The many similarities with pre-hospital services make team communication training interventions highly relevant here as well.

International transferability

The Danish health-care system is characterised by a high level of public financing and is influenced by Danish national culture (13;14;49). The results are therefore not generalizable for all healthcare teams, but particularly to hospital teams in cultures with an authoritarian gradient similar to the Danish. In general, this means Scandinavia and some western European countries.

Perspectives and recommendations

Healthcare staff team communication competencies

In the years to come, clinical hospital staff will have to process a heavier information load as well as more detailed and more acute information. This information will have to be processed in less time, as patients live with their co-morbidity, opportunities for acute interventions will increase, more complex therapies are introduced, and departments merge into larger and sometimes geographically divided units. These factors increase the need for data exchange. Together with the results from the focus group interviews, which described how staff in general were novices on both patient safety- and human error thinking as well as staff-to-staff communication training, this augment the face validity of team communication interventions (30;53). Considering the costs of adverse events, this gives hospital organisations a great incentive to support team communication (54).

Relying on the existing learning-by-doing- and apprenticeship methods to provide staff with the relevant verbal communicative behaviours is problematic: Optimal communication skills are needed from the first day the staff member is responsible for continuity of care. Since bed-side training is challenged by expansion of the knowledge pool, time pressure and interruptions, formal training is needed (55).

For an intervention aiming at providing the participants basic communication skills, one must pose the question of whether the intervention is necessary for all staff members including those with many years of clinical experience. However, first of all, no evidence supports that more experienced clinicians are better at communication in general (48). Secondly, the more experienced team members should work as role models for the less experienced (56). Finally, leadership and physician back-up is very important for such interventions (22;57). Together these factors speak for involving all staff members in these interventions. However, a differentiated intervention should be considered (58).

Classroom-based team training as one part of the intervention

It is tempting to try to solve all problems in a hospital organisation with one-shot training sessions in a setting away from the bed-side, where there the whole team together can discuss, practice, and receive feedback. But as seen above, improving team training is a complex tasks which requires training, cognitive tools, organisational back-up and follow-up in order to improve patient safety. Classroom-based team training interventions should therefore act as an appetizer and provider of

cognitive inputs to the staff members. Organisational follow-up including guidelines, involvement of key staff members and training of new staff, should account for the majority of the intervention (33).

Adaptation of standard interventions

It is also tempting to copy interventions developed by others as this saves time in the first place. However, as the results in this thesis shows, standard interventions aiming at changing culture have to be adapted (13). The classroom-based learning approach is favourable in this context, because it can be shared electronically in an adjustable version. If the core of the intervention - for instance the structure and mnemonics for communication like ISBAR and read-back - are preserved, this can moreover contribute to uniform communication practises across organisational borders and sectors.

Overcoming logistical challenges of classroom-based team training and evaluation

As some staff pointed out in the evaluation interviews, training of staff in one department is insufficient: Patients and their data cross departmental, hospital, and care sector borders. Focusing on team communication should thus be the aim of the whole healthcare system. What is probably more important, though, is involving staff in – or entrusting them with – the responsibility of selecting the methods they as clinicians find most valuable, finding ways to implement these methods, and evaluating them - with the support of skilled experts and their leaders. This can be done through the use of the 'Improvement model' (59), which is an accelerated version of action research, where focus is on testing possible beneficial interventions and spreading them in the organisation.

The logistical challenges of team communication training follow-up uncovered by this thesis, point to a model of team training which involves local staff members as role models and project leaders: The model is a 'Cascade model' ('Train the Trainer-model') where a few selected team members from each unit are trained to become local experts whom then again adapt the intervention to local needs and train their peers (60). This model has been tested at a Copenhagen hospital in 2009 (61). The favourable experiences point to a future larger scale study, involving the statistical advantages of the 'Stepped Wedge' model (12;42) to evaluate the effect of a hospital wide intervention.

Prolonged evaluation in a richer methodology

As stated above, the evaluation of this intervention was too brief. Future interventions should therefore consider more prolonged evaluation in order to understand the consequences. Changing safety culture takes up to five years, in order to become 'What we do around here' and more prolonged evaluations are therefore recommended (43).

In order to be able to explain why the intervention had effect, the intervention was evaluated using both qualitative and quantitative measures and prospective and retrospective methods (62). This approach provided a deeper understanding of why the learners responded very positively to the intervention, while the clinical results were absent. Using both qualitative and quantitative measures is thus recommended (12;42).

Evaluating all four levels (reactions, learning, behaviour and results) is recommended in order to conclude, that a certain effect stems from a training intervention (63). By following recommendations of using both qualitative and quantitative measures (40;42) and recommendations of measuring over time (44), evaluation becomes cumbersome. For future interventions, this can be mitigated by sharing validated evaluation tools electronically (64), and by using data obtained from patient administrative systems (30-day readmission rate) as process measures. This will allow researchers to focus on adaptation, training, follow-up and data-collection and -analysis.

Finally, the evaluation of this project was hidden from the participants in an attempt to 'blind' them: they were expected to take up the tools, because of their intrinsic value – not because of a goal of changing certain evaluation parameters. This philosophy was probably inexpedient, as a more exposed goal would have provided attention to the project and the goal (65).

With the limitation of the needs assessment, intervention, and evaluation in mind, this thesis can conclude that strengthening team communication in healthcare is needed, that classroom-based team communication training should make up a part of the effort, and that evaluating both quantitative and qualitative parameters of such intervention can add to the picture of why an intervention achieved the results it did.

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Summary

The number of patient safety incidents in healthcare is alarmingly high. This was documented in the report 'To err is human' in USA in 1999. A comparable Danish study revealed that the problem is of equivalent size in Denmark. 'To err is human' recommended establishing interdisciplinary team training programmes for providers in order to strengthen patient safety. This recommendation has since been endorsed by other important healthcare organisations. From other fields it is known that training curricula should be based on local culture and context.

This study was established to uncover the needs and characteristics of a Danish curriculum to improve hospital team communication and patient safety. The needs assessment was an analysis of the most severe patient safety incidents in Copenhagen hospitals from 2004-2006, four focus group interviews with multi-professional hospital staff and a systematic literature review.

The analysis of patient safety incidents concluded that insufficient communication during handover is a main cause of these incidents in hospitals.

The interviews uncovered a less steep authoritarian gradient and subsequent unclear responsibility boundaries at Danish hospitals compared to hospitals in USA and Great Britain, making reliable communication to divide tasks and prevent information loss particularly necessary.

The literature described positive results of classroom-based team training interventions. However, the study designs were weak and few interventions where evaluated after training itself.

Three cycles of systematic curriculum planning, testing, analysis and revision of a classroom-based team training intervention were carried out in a pre-implementation phase. The tests made clear that there is a need for customization to speciality and that all staff groups and specialties had a need for training. The result was a multi-professional curriculum consisting of the modules: 'An introduction to patient safety', 'The human factor', 'Communication', 'Teamwork' and 'Implementation and evaluation' plus methods to support clinical use: Checklists and follow-up.

This curriculum was tested in a Danish internal medicine department in the fall 2007 and the participants' reactions to training, participants' self-rating of own and peers' use of tools and strategies (questionnaire and individual semi-structured interview), team communication in the department after the intervention and the level of patient safety incidents six months before and six months after the study, were evaluated.

'Reactions' were positive. In self-rating one month after the intervention staff expressed that training had strengthened patient safety, teamwork, communication, assertion, listening skills and patient transfer safety. A post-intervention observation study, however, could not confirm

significantly higher communication quality among the intervention department staff compared to staff in a department of comparison. A before-after record audit of patient harm did not demonstrate significant improvement in the intervention department compared to the department of comparison. In semi-structured interviews, staff endorsed the concept but criticized the lack of follow-up. This thesis concludes that the training programme was well received, but was challenging to implement regardless of the common interest in avoiding patient safety incidents.

Dansk resume

Omfanget af utilsigtede hændelser i sundhedsvæsnet er alarmerende og blev kendt af offentligheden ved publiceringen af rapporten 'To err is human' i USA i 1999. En tilsvarende dansk undersøgelse viste, at problemet havde lignende omfang i Danmark. 'To err is human' anbefalede at etablere tværfaglig team træning for sundhedspersonale for at styrke patientsikkerheden. Denne anbefaling er siden blevet støttet af andre vigtige sundheds- og kvalitetsorganisationer.

Fra andre faglige områder er det kendt, at et uddannelsesprogram skal tage udgangspunkt i egen kultur og kontekst. Nærværende forskningsprojekt blev etableret for at afdække behovet for et dansk undervisningsprogram til styrkelse af kommunikation mellem sundhedspersonale. Grundlaget for undervisningsprogrammet var en gennemgang af analyser af de mest alvorlige utilsigtede hændelser fra københavnske sygehuse i perioden 2004-2006, fire fokusgruppeinterview med dansk sundhedspersonale samt en systematisk litteraturgennemgang:

Analyserne påviste at brist i kommunikation - særligt ved overflytninger og vagtskifte - var en hovedårsag ved alvorlige fejl, der medførte patientskade. Interviewene afdækkede et mere fladt hierarki på danske hospitalsafdelinger end på amerikanske og engelske afdelinger, med et deraf følgende behov for en mere udtalt opgavefordeling, da denne ikke altid er selvindlysende.

Litteraturen beskrev positive evalueringer af klasseværelse-baserede undervisningsprogrammer af sundhedspersonale, men studiernes udformning gav i de fleste tilfælde høj risiko for bias og meget få interventioner var evalueret efter selve undervisningen.

Den systematiske planlægning, afprøvning, analyse og revision af et klasseværelse-baseret undervisningsprogram synliggjorde et behov for individualisering af undervisningen til personalets behov samt at alle faggrupper og specialer, der håndterede patientinformation oplevede et behov for styrket kommunikation. Resultatet var en tværfaglig undervisningsintervention bestående af modulerne 'Introduktion til Patientsikkerhed', 'Den menneskelige faktor', 'Kommunikation', 'Teamsamarbejde' og 'Implementering og evaluering' samt metoder til støtte af anvendelse af strategier og redskaber (tjeklister og opfølgning).

Interventionen blev tilpasset til og afprøvet på en dansk hospitalsafdeling i 2007 og evalueret på flere niveauer: Deltagernes reaktioner på undervisningen, deltagernes vurdering af egne og kollegers anvendelse af metoderne (spørgeskema og interview), en observation af personalets kommunikation efter interventionen samt en journal-auditbaseret analyse af niveauet af utilsigtede hændelser seks måneder før og seks måneder efter interventionen.

Evalueringen viste, at deltagerne vurderede undervisningens relevans og kvalitet som høj. Ved observationen kunne der ikke påvises en højere kvalitet af kommunikation i interventionsafdelingen sammenlignet med en tilsvarende afdeling, hvor ingen intervention havde fundet sted. Spørgeskemaet afdækkede højt kendskab, og nogen, men ikke betydelig, brug af metoderne. Der kunne ikke påvises en reduktion i forekomsten af utilsigtede hændelser. I interviews gav personalet deres opbakning til metoderne, men kritiserede manglende opfølgning.
Afhandlingen konkluderer, at interventionen blev godt modtaget, men var udfordrende at implementere på trods af en fælles interesse i at styrke patientsikkerheden.

Appendix 1: Curriculum modelling

Based on Hardens principles for curriculum planning the different elements was considered as described below.

Element	Handling
Needs assessment	The needs assessment is described in detail in Paper 1(66), Paper 2(67) and Paper 3(68). A general adaptable curriculum for all Danish hospital staff exchanging patient data was constructed based on this overall needs assessment(64). Further detailed adaptation to local needs was thereafter conducted in order to run the team training program in the intervention department. This consisted of an analysis of a local patient safety attitude questionnaire,(69) reports from local staff to the incident reporting system and needs expressed by leaders and staff. The findings from the general needs assessment underscored that the culture and needs in a Danish hospital setting were somewhat different than the needs described in the mainly American curricula in the field. This insight was used to strengthen the focus on communication during handover and on providing tools for establishing a plan for the teamwork.
Learning objectives, Course content, Teaching Methods and Course material	We sought inspiration in theories and programmes from other high-risk industries (70;71) and international classroom-based health care team training tools (72-75).The course content was selected based on the needs assessment and with guidance from an international expert group. Most existing programmes used participant-engaging teaching methods (lectures, discussions, role plays and video instruction)(20;72;74;75) to capture participant attention and improve outcome. Appendix 3 holds a description of learning objectives, content, teaching methods and course material for the individual modules. The *introductory module* aimed at introducing the basic notions of patient safety, and motivating learners (76;77) by describing local patient safety incidents where communication or teamwork was a factor, and have participants share their experiences(19). The *human factor module* focused on the fact that all humans make mistakes and that communication and teamwork are ways to prevent these errors to harming patients (71;78). The third module focused on strengthening *communicative skills* during handover and establishing a plan for the team or the patient. This was done through the use of communicative frameworks(73;79), checklists (80;81) and role plays (20). The fourth module focused on *teamwork* communication tools and included an exercise that put all the tools and skills together. The last module was a discussion of local *follow-up* (33) and an *evaluation* at Kirkpatrick's 'reaction' and 'learning' level.(63)
Organization of content	The course was established as a classroom-based intervention (82-86) with a full day-program in an off-department setting to avoid interruptions and leave time for discussions (19), practise and feedback (87). It was the conclusion of interviews with staff during the planning phase (67) that they in general were novices on both patient safety- and human error thinking, and staff-to-staff communication training. The course therefore had an introduction to these themes as starting point with time for discussions in small groups.
Educational strategies	We chose a multi-professional strategy to inter-professional learning based on a theoretical approach (19;88) and empirical data (68;89). We build the curriculum on adult learning principles: learners' active contribution in the educational process, solving real life problems, the use of learners' experience, and opportunities for practice and feedback (77). This was made a reality through group and plenum discussions, participant's selection of relevant tools to implement, role plays and their suggestions for and support of implementation.
Communicating the details to participants	The objective, themes and timeframe of the course were communicated to the participants through the printed invitation which included a description of the background and a request for considering relevant patient safety incidents to share during discussions. During training all participants received a course folder (79) and various forms of checklists to support use at the work site. Following training the checklists were placed at all participants' work stations as well. The main points were further communicated by displaying posters and by developing a brief slide show to enable mid-level managers to discuss the issues with their employees, and a refresher-curriculum that could also serve as an introduction of future staff members.

Educational environment and climate	A climate of active participant involvement was realized through introductory module discussions of participant's expectations, experiences and needs. The trainer asked participants to help establish a non-competitive, confidential, reflective atmosphere with room for practice during the role-plays, and receptiveness of experiences of other staff groups. Confidentiality was established by setting tables for multi-professional small group discussions.
Management of process	With the aim of training larger staff groups with varying needs the curriculum was published in a highly customizable form: Adjustments to own needs were encouraged and all slides, checklists and cases were in formats that allowed changes. The curriculum suggested establishment of a local steering committee including both medical and nursing staff to plan and conduct the training and implementation. Local administrative staff members were suggested involved in handling of logistics, invitations, evaluation and follow-up.
Testing	Before establishing the final curriculum, the program was run at three test-sites (Appendix 2). The aims of these pilot tests were to receive inputs on relevance and lay-out from participants in different clinical settings (acute and less acute care patients, medical and surgical units, experienced and less experienced staff members) and to validate evaluation methods through training of, discussions with, observation of and feedback from participants. The overall results of the pilot tests were: - The need for further focus on communicative frameworks to establish a plan for the teamwork at the expense of assertion tools; - Thorough adaptation of cases, photos, notions and films to local conditions, national culture and specialty: The American curricula could not be used directly: phrasing, photos, videos, cases and tools had to be thoroughly adapted to Danish language, communicative pathways and culture in order to gain acceptance. Further, the Danish standard curriculum could only serve as a scaffold: Detailed individualization and in-course participant discussions were necessary to make participants from different specialties and staff groups accept tools and strategies and increase the likelihood of application during daily work. This is consistent with theories in the field.(13;90) - Introduction of methods at organizational level instead of unit level as communication and patients often crosses unit boarders - The need for follow-up to increase use - The need to talk about the awkwardness but necessity of role-plays - The use of participant experience, small group discussions, humour, videos and short breaks increased attention and reduced resistance.

Appendix 2: Pilot tests

Overview of pilot tests: Objective, setting, intervention, participants, setting, evaluation methods and results of the three pilot tests conducted before defining the intervention. SAQ: Safety Attitude Questionnaire.

Pilot test # and period	Objective	Setting, intervention and participants	Evaluation methods	Results
1: August-December 2006	Immediate response from participants on concept. Feedback on checklists and evaluation methods as part of validation.	A department of internal medicine: Three one-day courses for staff, N=46 (junior and senior doctors, nurses, medical clerks, nursing assistants, hospital porter).	11-item 4-point Likert-like scale end-of-course critique	45/46 (98%) rated the course content useful or very useful. 30/44 (68%) assessed their communicating skills good or very good before the course. 39/43 (91%) assessed them good or very good after the course.
2: January-September 2007	Train-the-trainer-version of programme. Feedback on checklists and evaluation methods as part of validation.	A paediatric ward 1) One two-day course for midlevel-managers, N=10 (doctors, nurses and a physiotherapist with managerial responsibilities). 2) Eight one-day courses for staff trained by the above midlevel managers. N=120 (senior and junior doctors, nurses, nursing assistants and medical clerks)	1) 10-item 4-point Likert-like scale end-of-course critique with 4-item qualitative section. 2) Before-after 52-item SAQ to 138 staff members 1-7 months after training. SAQ's returned: Before: 97/138 (70%). After: 90/138 (65%)	1) Train-the-trainers: 10/10 (100%) rated all 10 items (course material, each of the five modules, acquiring new skills and relevance for own staff group) good or very good. 1) Training of staff: 114/120 (95%) rated all modules and their own learning very good or good. 6/120 (5%) rated maximum one element (mainly the 'evaluation module) less good. 8/117 (7%) assessed their communicating skills very good before the course. 49/117 (42%) assessed them very good after the course. 2) Training of staff: SAQ: Significant improved outcomes on 3 items: 'Mutual trust', 'Lack of support for inexperienced staff' and 'We do more for safety now than a year ago'. Significantly aggravated outcome on 1 item: 'Involved units do a good job when coordinating patient care'.
3: April-May 2007	Train-the-trainer-version of the programme. Evaluation of programme including checklists in a surgical setting. Feedback on checklists and evaluation methods as part of validation.	Three specialties involved in teamwork around caesarean sections: One two-day course for midlevel-managers, N=20 (senior and junior doctors, nurses, midwifes and nurse assistant)	1) 11-item 4-point Likert-like scale end-of-course critique Further evaluation went unsuccessful due to unforeseen events.	1) 19/20 (95%) returned. Except for the module 'Implementation and evaluation' and a question on hypothetic motivation of own staff group to receive a similar course (3/19 (16%) rated 'some' motivation) all items were rated good or very good.

Appendix 3: Overview over training

Learning objectives, Content, Teaching Methods and Course material for the course. L: Lecture. SG: Small group. SGDP: Small group discussion with follow-up in plenum. PD: Plenum discussion. SGPF: Small group practise and feedback (64).

	Learning objectives	**Course Content and teaching methods**	**Course material**
Module 1: Introduction to patient safety 120 minutes	Introduction to - Patient safety including patient safety incidents and adverse events - System perspective - Team, team leader, teamwork and communication. - working conditions of 'the other' staff groups.	Introduction including presentation of 'Educational environment' (L)(. Participant presentation/ice breaker (SG). Participants expectations (SGDP). Patient safety, legal aspects, reporting and case handling of patient safety incidents, system vs. individual perspective (L). Background knowledge of health care staff communication and teamwork. Local incidents and own cases (SGDP). Experiences from other high risk industries (L). Suggestions for Safe communication and teamwork competencies (SGDP). Different staff groups in teams (SGDP).	Slide show Flip over **Course folder:** Handouts incl. schedule Participant list Evaluation material Pocket size handbook Cases Nametags Pen & notepad
Module 2: The human factor 45 minutes	Knowledge of human error. Comprehension of how the team can help prevent patient safety incidents.	Human factor notions and theories (L, DVD) Examples from clinical life (PD) Warning signs (PD) Situation awareness (L) Assertion and mutual support (SGDP)	Slide show Flip over
Module 3: Communication 90 minutes	Application of tools and methods for verbal communication.	Clear speech, structured communication, confirmation of information and agreeing on a plan for the patient (L). • ISBAR (~ SBAR) communicative framework during handover • Read-back and call-outs as support of verbal orders or detailed information. • ISBAR med SALSA as communicative framework regarding patient transfer (DVD, PD, SGPF, PD)	Slide show DVD ISBAR-cases Handbook Cases
Module 4: Team-coordination 120 minutes	Comprehension of tools to build and strengthen verbal communication in larger teams.	Team leader and team member tasks (L, PD) Briefing, huddle and debriefing as support of mutual agreement and use of resources. Critical language (L, SGPF).	Slide show 'Low fidelity simulation'-equipment (paper, scissors etc.) Prices for winners
Module 5: Implementation and evaluation 15 minutes	Transfer Evaluation of participants return from the course. Analysis of course improvement potential.	Repetition of min points (PD). Reflection over own returns and course improvement potential (PD) Follow-up (PD). Completion of written evaluation. Verbal feedback to trainer (PD).	Slide show End-of-course critique Knowledge test Flip over Course certificate