Interprofessional Teamwork in Hospital Units

A human factors approach to patient safety

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All journeys have a secret destination of which the traveler is not aware.

— Martin Buber

Dedicated

to my mother Solveig Kylland

and my daughter Christine Aaberg Munksgaard

Summary

Introduction Human factors, such as teamwork and communication, have an important impact on patient safety in hospitals. Hospitals have a patient safety problem, with more than every 10th patient experiencing errors and adverse events during their hospital stay. Root cause analysis have showed that ineffective teamwork and communication failures are the most common causes of errors and adverse events. To improve patient safety in hospital units, healthcare professionals needs competency in teamwork, such as communication, decision making, leadership, situational monitoring and mutual support. Interprofessional team training is a key strategy for improving teamwork and patient safety in hospital units. Previous research on interprofessional team training in specialty units has showed promising results; however, the impact on surgical wards is uncertain. The Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) program had not been implemented in Norway. Team decision-making has not yet been studied previously among multiple healthcare professionals across diverse hospital units.

Aim The overall aim of the thesis is to gain knowledge about teamwork in hospital units and to evaluate and explore the impact of an interprofessional team training intervention regarding teamwork and patient safety culture in a surgical ward. The specific aims of the sub-studies are as follows: 1) To translate the CSACD-T questionnaire into Norwegian and test it for psychometry properties. The further aim is to describe and compare healthcare personnel's perceptions of collaboration and satisfaction about team decision-making across hospital units (Study I, paper 1). 2) To evaluate the professional and organizational outcomes of an interprofessional teamwork intervention among healthcare professionals in a surgical ward after 6 and 12 months (Study II, paper 2). 3) To explore if an interprofessional teamwork intervention in a surgical ward changes the healthcare personnel's perceptions of patient safety culture, perceptions of teamwork, and attitudes toward teamwork over 12 months (Study II, paper 3).

Methods Study I (paper 1) had a cross-sectional design. The Collaboration and Satisfaction About Care Decisions in teams (CSACD-T) questionnaire was used for the survey conducted among healthcare professionals across multiple hospital units (hospital A and B). Study II (paper 2) used a pre-post design with re-measurement (hospital C), with surveys (CSACD-T, TeamSTEPPS Teamwork Perceptions Questionnaire (T-TPQ), and Hospital Survey of Patient Safety Culture (HSOPS)) distributed to healthcare professionals in the intervention ward at baseline and after 6 and 12 months. Study II (paper 3) used a controlled quasi-experimental design, with surveys (CSACD-T, T-TPQ, HSOPS, and TeamSTEPPS Teamwork Attitude Questionnaire (T-TAQ)) distributed to all healthcare professionals in the intervention ward and control ward (hospitals C and D) at baseline and after 12 months. The intervention was a 6-hour TeamSTEPPS interprofessional team training included simulation training, followed by implementation of teamwork tools and strategies in the ward over 12 months (hospital C). The implementation followed Kotter's eight steps for leading change. The human factors systems engineering initiative for patient safety (SEIPS) model was used as a theoretical perspective.

Results The CSACD-T questionnaire showed promising psychometric properties in terms of construct validity and internal consistency. The scores of collaboration and satisfaction with care decisions in teams varied among unit types and were highest among the healthcare professionals in the wards, with a significant difference between the maternity ward and emergency room (paper I). The outcomes from the intervention study showed significant changes in organizational outcomes after six months, and were in the following areas of patient safety culture: "Organizational Learning and Continuous Improvement" and "Communication Openness" (paper 2). After 12 months, significant changes were found in professional outcomes within the intervention ward, which were in three perceptions of teamwork dimensions: "Situation Monitoring," "Mutual Support," and "Communication", in addition to organizational outcomes, which were in three patient safety culture dimensions: "Communication Openness," "Teamwork Within Unit," and "Manager's Expectations & Actions Promoting Patient Safety" (papers 2 and 3). The improved teamwork dimension "Mutual

Support" was found to be a predictor of "Patient Safety Grade" (paper 2). The controlled results revealed significant differences favoring the intervention ward in three patient safety culture measures: "Teamwork Within Unit," "Overall Perceptions of Patient Safety" and "Patient Safety Grade" (paper 3).

Conclusion This thesis presents new insights into team decision-making in diverse hospital units, as reported by healthcare professionals from multiple healthcare professions. The thesis also presents new insights into the impact of an interprofessional TeamSTEPPS intervention in a surgical ward in Norway. The outcomes are promising, indicating that TeamSTEPPS intervention improves teamwork and patient safety culture in a surgical ward. The causal relationships among inputs, processes, and outcomes are, however, not certain, and further studies are required to confirm the outcomes of this comprehensive and well-described interprofessional team-training intervention. Nevertheless, the knowledge from this thesis adds to the vast field of teamwork and patient safety research internationally.

Abbreviations

- CSACD-T Collaboration and Satisfaction About Care Decisions in Teams
- CTT Classroom Team Training
- GLMM General Linear Mixed Model
- HFE Human Factors Engineering
- HSOPS Hospital Survey of Patient Safety Culture
- I-PASS Illness Severity, Patient Summary, Action List, Situation Awareness and Contingency Planning, Synthesis by Receiver
- ISBAR Identification, Situation, Background, Assessment, Request/Recommendation
- KSA Knowledge Skills Attitudes
- PCA Principal Component Analysis
- SBT Simulation Based Team Training
- SD Standard Deviation
- SEIPS Systems Engineering Initiative for Patient Safety
- STEP Status of the Patient, Team members, Environment, and Progress towards the goal
- TeamSTEPPS Team Strategies and Tools to Enhance Performance and Patient Safety
- T-TAQ TeamSTEPPS Teamwork Attitude Questionnaire
- T-TPQ TeamSTEPPS Teamwork Perceptions Questionnaire

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Part 1

Chapter 1. Introduction

This thesis studies interprofessional teamwork in hospital units and patient safety culture. The human factors approach to patient safety in this thesis involves healthcare professionals` team competencies, teamwork training and implementation of a teamwork program in a clinical work system.

In Study I, team decision-making was studied across multiple hospital units, and a psychometric testing of the Collaboration and Satisfaction About Care Decisions in Teams (CSACD-T) questionnaire was conducted. In Study II, the impact of a team training intervention in a surgical ward was explored. The Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) program was used for the team training intervention. The intervention included classroom -and simulation training, in addition to implementation of the TeamSTEPPS program in a surgical ward over 12 months. A human factors theoretical model, the Systems Engineering Initiative for Patient Safety (SEIPS 2.0) was used as a theoretical perspective.

Chapter 2. Background

After the brief introduction above, this chapter presents the central concepts used in the thesis and the background of the conducted studies in the thesis (Studies I-II), followed by the rationale and aim of the thesis and the studies.

A human factors approach to patient safety

Patient safety is defined as the foremost attribute of quality of care and is defined as "the absence of preventable harm to a patient during the process of health care and reduction of risk of unnecessary harm associated with health care to an acceptable minimum [1]. It is both a goal and a practice in which structures and processes aim to make health care safer [2]. The patient safety terms, such as harm, adverse event, and error are often used interchangeably. Health care-associated harm arises from, or is associated with, plans or actions taken during the provision of health care [3]. Adverse events might result in harm to a patient [4]. An error is "a failure to carry out a planned action as intended or application of an incorrect plan. Errors may manifest by doing the wrong thing (commission) or by failing to do the right thing [5] at either the planning or execution phase" [3].

Globally, more than every 10th patient experiences preventable harm or error during their hospital stay [1]. In US health care, errors are the third leading cause of death, and numbers may exceed 250.000 per year [6]. Statistics from Europe show that 23% of hospitalized patients are directly affected by errors, and 18% of patients experienced a serious error while in hospital [7]. A large proportion of these errors are related to surgical care, most of which occur outside the operating room before or after surgery. Up to one-third of errors in the surgical area occurs in the postoperative period [8].

When this study was planned, one patient error occurred during 12% -14% of patient stays in Norway [9], with a slight decline in 2019 [10]. The most common types of patient errors are drug-related injuries,

postoperative infections, postoperative bleeding, and other surgical complications. This shows that hospital units have a patient safety problem that must be addressed.

Root cause analysis have showed that ineffective teamwork and communication failures are the most common causes of errors and adverse events [11]. Evidence has shown that 50%–70% of the errors can be prevented through systemic approaches to patient safety [7]. Although there has been much focus on patient safety protocols in the last two decades since the report "To Err is Human" [12], patient safety in hospitals is still a concern, as reported by healthcare professionals and patients [13].

Patient safety theory might help to understand this huge problem in healthcare. Safety theory distinguish between a system approach and a person approach [14]. The person approach focuses on the unsafe acts of errors and procedural violations made by healthcare professionals at the sharp end, and which often result in disciplinary actions, naming, blaming, and shaming. The system approach assumes that humans are fallible and errors are to be expected, and human errors are seen as consequences rather than causes, having their origins more in systemic factors. In the system approach adverse events do not occur because bad people intentionally hurt patients but rather because the health care system is so complex that the successful treatment and outcome for each patient depend on a range of factors, not just the individual healthcare provider [15].

One of the most used models in patient safety theory [16] is the Swiss cheese model developed by Reason [14] and which is a model of a multilayered system and a metaphor to visualize how patient harm happens, based on a systems approach (Figure 1).

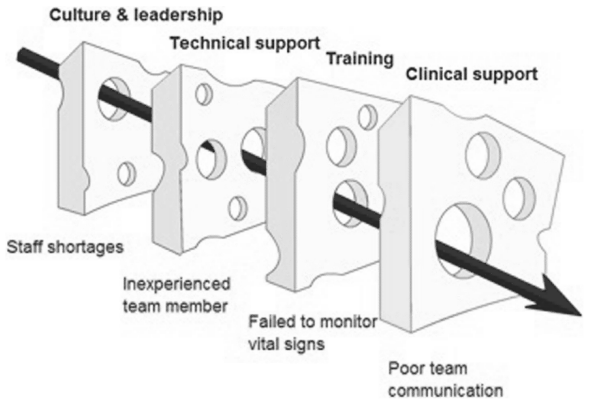

Figure 1. The Swiss cheese model [14]. Adapted from Bajracharya et al. [17].

The system components include the organization, the teams and the individual healthcare professionals, and the procedures and technology in use. Failures in the system components are characterized as latent failures, and might be due to poorly designed work schedules and procedures, lack of teamwork, and equipment failures. Defenses, barriers, and safeguards serve as key factors to protect potential victims (such as patients) from errors, as illustrated by the cheese layers positioned so that their wholes do not align, and which protect against errors most of the time. However, when all the holes in the Swiss cheese layers are aligned, it causes a hole in the defense and a risk of error. In most cases, an error, describes as an active failure, occurs because of a combination of circumstances in the organization (latent failure) and the action taken by an individual healthcare professional in the organization (active failure). The consequences may be hidden for a long time, only resulting in errors when combined with a local trigger at the sharp end [14]. Latent failures are often a result of decisions taken by the leadership at a higher level of the organization. When poorly designed work schedules, lack of teamwork, and equipment failures, are occurring simultaneously and in a particular configuration, it might result in patient errors.

The importance of system configurations is also a central part of the patient safety model, SEIPS 2.0, has also a system perspective based on human factors theory [18] (See Chapter 3). In the human factors, patient safety is viewed from an input–process–output (IPO) systems perspective [18-21], which includes a system perspective on errors, highlighting that errors are not considered a single human error, but a system fault [22]. The science of human factors accounts for and develop the understanding of the effects of tasks, equipment, workspaces, cultures, and organizations on human behavior, to improve performance and prevent errors to occur [23]. The focus in human factors is on enabling and supporting healthcare professionals to promote high-quality and safe care which yields patient, professional, and organizational outcomes in the healthcare systems [19, 23]. To enable and support healthcare professionals in promoting effective and safe care, can be done by establishing systems, routines and procedures, and by team training initiatives. Organizational outcomes in a hospital unit can be e.g. the patient safety culture.

Patient safety culture is an important aspect of patient safety and can be defined as "the product of individual and group values, beliefs, attitudes, perceptions, competencies, and patterns of behavior that determine the organization's commitment to quality and patient safety" [24]. It requires strong leadership, learning from errors, and a culture characterized by psychological safety [25]. Patient safety culture can be improved by changing individuals attitudes, behaviors, and cognitions [26]. Sammer et al. [27] identified a broad range of safety culture properties described as seven subcultures; teamwork, communication, leadership, learning, just culture, evidence-based practice, and patient-centered care. In a learning culture, the organization seeks to learn from its mistakes and improve its performance [27].

Patient safety culture is crucial to patient safety, as demonstrated by the fact that hospitals with a more positive patient safety culture have fewer adverse events [28, 29]. Patient safety culture and teamwork are strongly related. Many of the contributing factors to

errors originate from teamwork failures rather than from clinical skill failures [30]. When patient safety culture scores are inversely related to adverse events, the strongest relationship has been found to be within teamwork, both related to teamwork across and within units [28]. An innovative road to the goal of improving patient safety, is to use a human factors approach [31]. This can be done by strengthening the interprofessional teamwork in hospital units. Teamwork is regarded as an important component of human factors.

Teams and teamwork

A team can be defined as "a distinguishable set of two or more individuals who interact dynamically, adaptively, and inter-dependently; who share common goals or purposes; and who have specific roles or functions to perform" [32]. Teams can have constant membership, but teams with changing memberships are the most common in hospitals [33]. The nature of teams is varied and complex and includes teams that work closely together in one place, or those that are geographically distributed, as often occurs in a surgical ward. An effective team is one in which the team members communicate with each another and combine their observations, expertise and decision-making responsibilities to optimize care in effective teamwork [34].

Teamwork can be defined as "a dynamic process involving two or more healthcare professionals with complementary backgrounds and skills, sharing common health goals and exercising concerted physical and mental effort in assessing, planning, or evaluating patient care." [35 p. 232]. Teamwork is accomplished through interdependent collaboration, open communication, and shared decision-making [35]. Performance specifically refers to *what* healthcare professionals do, and team performance consists of both taskwork and teamwork [36]. Team members must execute both taskwork and teamwork to accomplish their shared goals [37].

Although some teams in hospitals are monoprofessional, most types of teamwork involves more than one profession [38].

Interprofessional teamwork comprises "different health care professions that share a team identity and work closely together in an integrated and interdependent manner to solve problems and deliver health care services" [39]. The effectiveness of interprofessional teamwork is important as it relates to patient care results. Hospitals with better interprofessional teamwork have significantly lower odds of 30-day mortality [40].

Team competencies

The theoretical foundations of teamwork originate from organizational psychologists. Tannenbaum et al. [41] developed an integrative teamwork model that included team competencies, such as communication, conflict resolution, problem-solving, decision-making, and interaction with other team and non-team members. Team competencies are defined as "the requisite *knowledge*, principles, and concepts underlying the team's effective task performance; the repertoire of required *skills* and behaviors necessary to perform the team task effectively; and the appropriate *attitudes* of team members that foster effective team performance" [37]. Salas et al. [42] synthesized team research into five core components of effective teamwork: team leadership, mutual performance monitoring, backup behavior, adaptability, and team orientation. They described team competencies in terms of knowledge, skills, and attitudes, abbreviated as the KSAs of teamwork. The TeamSTEPPS program, which is used for the intervention in this thesis, is built on the basis of this research.

A later update on teamwork and team training from Salas et al. [43] describes team competencies as the ABCs of teamwork (Attitude, Behavior, and Cognition). In traditional crew resource management (CRM), the basic non-technical skills (team competencies) are situation awareness, decision-making, teamwork, leadership, coping with stress, and managing fatigue [44]. The four team competencies in the TeamSTEPPS program are communication, team leadership, mutual support, and situation monitoring [45]. A recent review found

that the most often cited team competencies also includes team decision-making [46].

Communication is regarded as the lifeline in teamwork and effective team communication is described as a "structured process by which information is clearly and accurately exchanged among team members" [45]. Root cause analysis have showed that communication failures are the most common causes of errors and adverse events in hospitals [47]. Communication tools, such as the ISBAR (Identification, Situation, Background, Assessment, Request/Recommendation), closed-loop and the I-PASS handover tool (Identification, Illness Severity, Patient Summary, Action List, Situation Awareness and Contingency Planning, Synthesis by Receiver) have been introduced in healthcare to achieve a shared mental model in communication. The use of closed-loop has showed improved medication administration [48], and the use of structured handover tools have shown improved response for clinically deteriorating patients [49], as well as a reduction in patient safety risks [50]. ISBAR can improve teamwork and strengthen the patient safety [51] and was originally developed by the United States military for communication on nuclear submarines. In healthcare, it is recommended for communication of critical information as e.g. deterioration of a patient`s condition [52]. Recognition, communication and management of patient deterioration are critical factors in preventing avoidable harm in surgical care [53].

Team leadership, which is a cornerstone in effective teamwork and important to patient safety, refers to "the ability to maximize the activities of team members by ensuring that team actions are understood, changes in information are shared, and team members have the necessary resources" [45]. The team leader holds the teamwork together, and ensures that the plan are followed and updated. To be an effective team leader, the leader is dependent on the other team members being good followers. Systematic briefing and debriefing are essential leadership tools for effective teamwork [54]. The leadership team competency is facilitated through

communication, situation monitoring, and fostered by an environment of mutual support [45].

Another team competency, is **Situation Monitoring,** which is crucial to patient safety**.** It is described as "a process of actively scanning and assessing situational elements to gain information or understanding, comprehension of its meaning and anticipation of potential future states" [45]. In other words, it is a way for healthcare professionals to know what is going on around them, and which requires situational awareness (Reader et al., 2011). The concept of situational awareness was first described in aviation to explain the perceptual skills required for fighter pilots to succeed. Situation awareness can enable individuals to adapt to changes in the situation and to support other team members [55]. Situational awareness aims to have a shared mental model for the team members, and thereby a team situation awareness. To be "on the same page" when the stakes are high, is crucial in patient care, but is not always present in healthcare teams [56]. Lack of situational awareness in teams might originate from a latent failure, as for example understaffing and other organizational issues, which can result in an active failure. Contextual factors that might contribute to shaping team situational awareness, are ward layout, systematic handovers, team composition and inter-professional collaboration in e.g. team decision-making [57].

Team decision-making is a team competency that is an important component in effective team performance. It refers to "a team process that involves gathering, processing, integrating, and communicating information in support of arriving at a task-relevant decision" [58 p. 271]. Healthcare professionals in hospital units have to make many decisions in dynamic, and often unpredictable circumstances where decision-making can be compromised and thereby impact patient safety and the quality of care [59]. The team leader has a specific responsibility of fostering team decision-making in health care teams. The leader's role is to integrate the received information from team members, patients, and family, and make a final decision [58]. Most of the previous studies of decision-making

included the medical profession only, as in Hausmann et al. [60], nurses only, as in Nibbelink et al. [61], or nurses and physicians only [62-64]. Team decision-making must involve all members of the healthcare team as they can all have valuable information to support the team leader and each other as team members.

Mutual support is a team competency that refers to the ability to anticipate and support team members` needs through accurate knowledge about their responsibilities and workloads in the teams [45]. In addition to assisting each other, mutual support involves team members in providing and receiving feedback from each other, and to exert assertive and advocacy behaviors when patient safety is threatened. Mutual support in teams, which include open communication among all team members, so that all feel comfortable speaking up regardless of the position in the hierarchical system, is important in fostering a safety culture, and which requires psychological safety [65].

In surgical ward teams, team competencies are important for addressing the system vulnerabilities that can lead to errors [66]. However, efforts made to improve teamwork and patient safety culture can be hindered by hierarchy and silo thinking in an organization [26]. A silo mentality, which can cause division and obstruct communication and joint work processes among healthcare professionals undermines effective teamwork [67-70]. A hierarchy, both within the medical profession and between nurses and physicians, can negatively influence the quality of care and is a safety risk in hospital units [69, 71].

Interprofessional team training is a key strategy for improving teamwork and patient safety [72-74]. From a human factors perspective, team training and patient safety interventions that can reduce the negative impact of latent work system failures on team performance, are highly recommended in surgical care [75].

Team training

Salas and colleges have described team training as a set of tools and methods that form an instructional strategy to promote the acquisition of team competencies [33, 76]. Team training was initiated in the 1970s when the National Aeronautics and Space Administration (NASA) investigated failed teamwork and non-technical competences to understand airline crashes. They designed and developed the concept of Crew Resource Management (CRM) [77]. CRM training was later adopted for health care, starting with anesthesia teams, and surgical teams in the operating room (OR) in addition to trauma teams [78]. Team training has now spread beyond anesthetics, first to Intensive Care Units (ICU), emergency medicine (ER) and operating rooms (OR), and more recently to less acute settings as hospital wards and other areas of healthcare [79].

Team training can include classroom instruction with lectures, simulation-based team training (SBT), or a combination of both training methods [72]. Simulation training has been defined as an "instruction that makes use of facsimiles of clinical contexts wherein learners interact to acquire knowledge, skills, and affective elements that will ultimately transfer to the real clinical context" [80 p. 449]. It is the learning objectives that is the foundation of simulation training and which allow the assessment of change in the desired competencies that should occur due to training [81]. Simulation and classroom training should be followed by a rigorous evaluation and the creation of an environment that facilitates the transfer of learned competencies on the job, in addition to the evaluation of system-level outcomes [80, 82]. When an organization decides to train their healthcare professionals in teamwork and patient safety, by implementing a comprehensive teamwork program, it is a systemic intervention that can remove latent failures and contribute to prevent active failures at the sharp end.

Various team training programs have been developed in the last decades [83], and previous research of team training in hospitals has used different types of team training, as e.g. the Veteran Health

Administration Medical Team Training program, the TeamSTEPPS program and other types of CRM training. A large amount of the research has demonstrated that team training in hospitals can improve the effectiveness of interprofessional teams [74, 79]. More specifically, team training has shown an effect on teamwork and teamwork performance, and less effect on attitudes [84-86]. Team training has showed to improve healthcare professionals` team competencies, such as situational awareness [87, 88] and decision making [88], and improved interprofessional collaboration in team [89, 90]. Team training has also revealed positive effects on care processes, the patient safety culture [74, 91], a reduction of adverse events [92, 93], as well as improved patient outcomes [94-96].

Few of the team training studies included in the reviews are from the context of surgical wards [74, 85, 97-99]. Much of the previous research on team training from the surgical area originated from the OR, and the results revealed a reduction of post-operative adverse events [94], improved safety culture [100], reduced length of stay, improved drug administration, fewer surgical complications [101], and a reduction in mortality rates [101-103].

By the time this thesis was planned, not many of the studies had investigated team training interventions over longer time frames [98], and few studies had evaluated the impact of the intervention at more than one time point [97, 98]. Much of the previous teamwork research focused mainly on the training and its effects [98], without describing an implementation phase [104]. An implementation phase focuses on the transfer of the newly learned team competencies into clinical practice, by changing and sustaining new ways of working [92].

Previous team training studies using the TeamSTEPPS program have shown the effect on communication among healthcare professionals, improvement in patient satisfaction, and a decrease in clinical error rates [105-107]. A review of TeamSTEPPS studies among healthcare professionals and students found changes in knowledge, perceptions,

and attitude toward teamwork [107]. [105] found positive outcomes from most of the studies that utilized TeamSTEPPS. Reduction in perinatal morbidity [108] and a decrease in harm following TeamSTEPPS training [109] have been found, in addition to improved areas of the patient safety culture [89, 110-114]. The TeamSTEPPS studies conducted previous to the study in this thesis, were mainly from the US, and studies from Europe were not found by the time this thesis was planned. Most of the studies were from specialty units, as in [112, 115-118] and there were few studies from the context of surgical wards. There were few controlled studies [85, 98], and they had ambiguous results [108, 111, 113, 119].

Rationale and aim

Hospitals have a patient safety problem with unacceptable error rates, and with the highest frequencies of errors related to surgical care. Teamwork is strongly related to patient safety, as failure in teamwork and communication has been identified as the most common cause of errors and adverse events in hospitals, referred to as human factors. To improve patient safety, healthcare professionals need competency in teamwork. Important competencies for improving patient safety in hospitals are communication, leadership, situational monitoring, mutual support and decision-making. team Team training is a key strategy for improving teamwork competencies and, thereby, the patient safety. Interprofessional team training has shown promising results regarding teamwork and patient safety culture from hospital specialty units, such as OR, ICU, and ER. However, the impact on surgical wards was uncertain. Most previous studies had uncontrolled designs, and scarce research studied team training interventions over longer time frames. The TeamSTEPPS program is one of the few standardized training programs that address the impact of human factors on healthcare teams, and was the program chosen for the team training intervention in this thesis. This is the first study to investigate the implementation of the TeamSTEPPS program in Norway, and to the best of our knowledge, the first in Europe. No previous studies were found on team decision-making in larger hospital teams across diverse hospital units. A questionnaire to measure team decision-making was not available in the Norwegian language.

Aims

The overall aim of the thesis is to gain knowledge about teamwork in hospital units and to evaluate and explore the impact of an interprofessional team training intervention regarding teamwork and patient safety culture in a surgical ward. This thesis comprises two studies, Study I and Study II, published in three papers.

The specific aims of the studies are as follows:

Paper 1 To translate the CSACD-T questionnaire into Norwegian and test it for psychometry properties. The further aim is to describe and compare healthcare personnel's perceptions of collaboration and satisfaction about team decision-making across hospital units (Study I, paper 1).

Paper 2 To evaluate the professional and organizational outcomes of an interprofessional teamwork intervention among healthcare professionals in a surgical ward after 6 and 12 months (Study II, paper 2).

The research questions are as follows:

1) Do professional outcomes, measured by healthcare professionals' perceptions of teamwork, and organizational outcomes, measured by patient safety culture, improve from baseline to 6 and 12 months of intervention?
2) Does the patient safety culture related to the intervention vary by profession group or time, demonstrating an effect of the intervention.
3) Are perceptions of teamwork dimensions associated with patient safety culture in the unit after 12 months?

Paper 3 To explore if an interprofessional teamwork intervention in a surgical ward changes the healthcare personnel's perceptions of patient safety culture, perceptions of teamwork, and attitudes toward teamwork over 12 months (Study II, paper 3).

Part of a larger research project

The studies in this thesis are a part of a larger project, "Teamwork in Hospitals," described in [120]. This larger project aims to translate and validate teamwork questionnaires, to investigate health care workers' perceptions of teamwork in hospitals, and explore the impact of an interprofessional teamwork intervention on the structure, process, and outcome. In addition to the studies in this thesis, the larger project includes qualitative interview studies, studies of patient perceptions of care quality, anonymous patient registry data from local registers, and data from patients' medical records.

Outline of the thesis

After the Introduction and Chapter 2, which presented central concepts used in the thesis, background for the studies, rationale, and aims, Chapter 3 describes the TeamSTEPPS program, the Kotter eight-step model for leading change, and the human factors SEIPS model. Chapter 4 presents the methodology used, and Chapter 5 presents the results of the studies. Chapter 6 presents a discussion of the study results, followed by methodological reflections. These five chapters comprise Part One of the thesis. Part Two comprises the three published papers, which are the scientific contributions of the thesis.

Chapter 3. Theoretical framework

The thesis has a human factors perspective, and which includes a team training program and a human factor systems theoretical model. This chapter describes the TeamSTEPPS program, that was used for the team training intervention in the thesis, and the Kotter model for leading change, which was used to implement TeamSTEPPS in a surgical ward. Finally, the human factors theoretical model, SEIPS 2.0, which is used to interpret the study`s intervention and outcomes, is depicted and explained.

The Team Strategies To Enhance Performance and Patient Safety (TeamSTEPPS) program

TeamSTEPPS, which is a framework and an evidence-based team training program [45], was chosen for the intervention in this thesis, because it addresses the impact of human factors on healthcare teams by focusing on teamwork competencies and patient safety [97]. The program is built on the research conducted by Salas et al. [42] and others [121]. It is regarded as the second generation of team training (after CRM) [122], and has been developed for all types of health care contexts. TeamSTEPPS aims to improve patient safety by enhancing the teamwork competencies of team members for effective performance [45, 123].

As a response to the release of “To Err Is Human” [12], the Agency for Health Care Research and Quality (AHRQ) and the Patient Safety Program in the U.S. Department of Defense developed the TeamSTEPPS program specifically for health care organizations [45, 123]. The program was released in 2006 as the national standard for team training in the United States [124]. “TeamSTEPPS 2.0” was released in 2014, but it is referred to as TeamSTEPPS in this thesis.

TeamSTEPPS is based on a framework of five key team principles; team structure and four teachable and learnable team competences (non-technical skills). In the TeamSTEPPS model (Figure 2), the four team competencies are surrounded by the patient care team. The TeamSTEPPS framework assumes that its four team competences are critical for patient safety [45]. The four team competencies are communication, leadership, situation monitoring, and mutual support, and which is described in Chapter 2. There is a two-way dynamic interplay between the team competencies (skills) and the team outcomes: knowledge, attitudes, and performance.

Figure 2. The TeamSTEPPS model of the AHRQ [45].

Each competency has a set of tools and strategies that team members are supposed to utilize in their daily work to ensure effective teamwork in healthcare teams [45] (The tools and strategies are presented in Figure 3 and further explained in Appendix 1).

COMMUNICATION
ISBAR
Call-out
Closed-loop
Handoff;
I-PASS, I PASS the BATON
LEADERSHIP
Brief
Huddle
Debrief
SITUATION MONITORING
STEP
I'M SAFE
Cross-monitoring
MUTUAL SUPPORT
Task Assistance
Feedback
Assertive statement
The Two-Challenge Rule
CUS
DESC-script

Figure 3. The four team competencies in TeamSTEPPS and their related tools and strategies [45].

The fifth key principle in TeamSTEPPS is team structure, which in TeamSTEPPS claims that the patient is a members of the core team, and with a focus on a multi-team systems (MTS) (Figure 4). According to TeamSTEPPS is a multi-team system "composed of several different teams. The multi-team system includes the Core Team, the Contingency Team, the Coordinating Team, Ancillary and Support Services, and Administration" [45]. In addition, the TeamSTEPPS framework highlight the importance of acknowledging the patient as a member of the multi-team system".

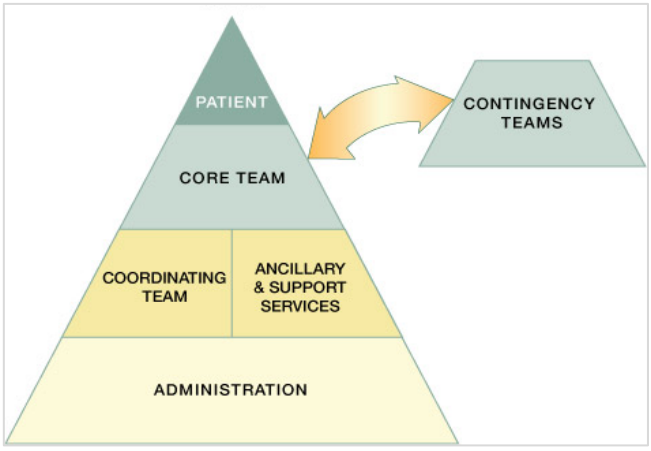

Figure 4. The multi team system [45].

The TeamSTEPPS program provides a comprehensive strategy for training, implementation, and change management, and offers a change model described in three phases (Figure 5). The TeamSTEPPS change model is based on Kotter model for leading change [125]. In Study II in this thesis, the TeamSTEPPS change model guided the overall project planning, and the Kotter model served as a guidance for the training and implementation in the surgical ward.

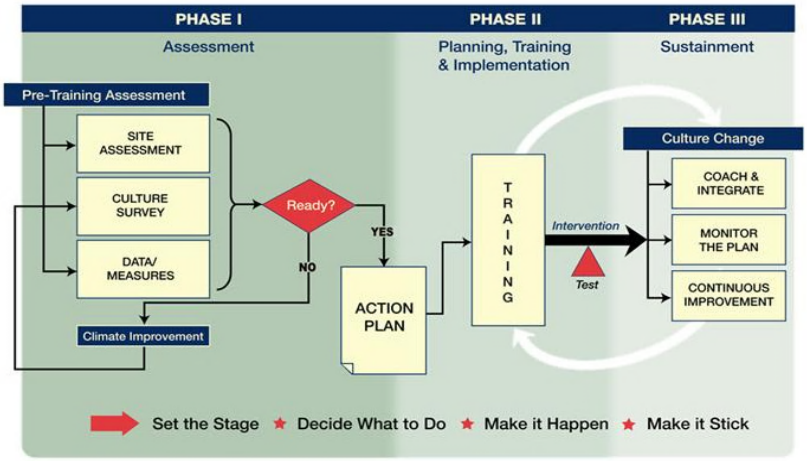

Figure 5. The TeamSTEPPS change model [45].

The Kotter model for leading change

In this section the Kotter eight-step model for leading change is described. How the steps were used in the studies of this thesis, is described in the intervention section, as well as in Aaberg et al. [126].

Implementation models can be a useful guide for implementing changes [127-129]. The theory on implementing change in organizations has its roots in the early work of Lewin [130] who described change as a progress through three successive phases called unfreezing, moving, and freezing. Building on this early work, several other researchers have described models for implementing changes [131-134] with Kotter being the most used change model in business, and recommended for use in the healthcare industry. Kotter recommended eight steps for change to be followed in implementing changes, and highlighted the importance of following all the steps and in the recommended order Kotter [125] (Figure 6). Below is a description of the eight steps.

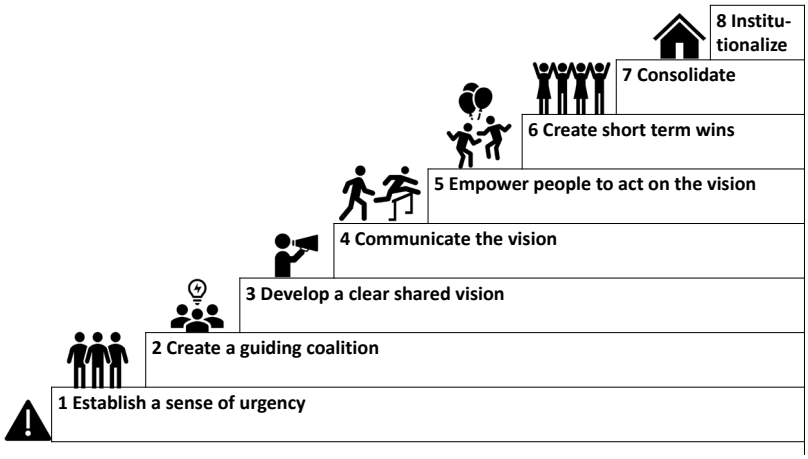

Figure 6. The Kotter model for leading change [125].

Step 1. Establish a sense of urgency.

Without urgency, people will not make the required extra effort that is often essential; they might cling to the status quo and resist change.

Step 2. Create a guiding coalition.

The coalition should be powerful in terms of title, expertise, reputation, and relationship and have leadership capabilities. A guiding coalition without strong line leadership cannot achieve enough power to overcome obstacles.

Step 3. Develop an action plan with a clear vision and goals to accomplish the desired results.

The goals for the intervention stated in the implementation plan should be aligned with organizational and departmental goals. Vision plays a key role in producing change by directing, aligning, and inspiring the actions of the people in the organization.

Step 4. Communicate the vision and plan through numerous communication channels.

Be creative and use many forms of communication to repeat the message, including leading by example. Behaviors exhibited by important persons in the organization who are consistent with their words (role models) are the most powerful. Use two-way discussions, and listen to feedback.

Step 5. Empower people to act on their vision.

This can be achieved by removing obstacles and barriers, as well as changing structures, systems, routines, and processes in ways that will facilitate implementation.

Step 6. Plan for and create short-term wins by celebrating successes.

Creating short-term wins builds momentum for continued change. Transformation takes time, and people often lose interest if they do not see the results after 6 to 18 months. Accordingly, feedback on results related to short-term goals is important so that people do not let up.

Step 7. Consolidate improvements and continue to change.

Consolidate improvements and continue to change structures, systems, routines, and processes that are not consistent with the vision. Avoid declaring victory too soon; continue the change efforts, as it might take 3 to 10 years for new approaches to sink deeply down into the culture.

Step 8. Institutionalize the change - sustain it.
Institutionalize and anchor new approaches in the culture. Until new ways of working are rooted in social norms and shared values, there will always be a risk of degradation of the change effort. To sustain the changes, show people how specific behaviors and attitudes have helped to improve performance [125].

The Systems Engineering Initiative for Patient Safety (SEIPS) model

SEIPS is a Human Factors Engineering framework and a theoretical model for studying and improving patient safety in complex organizational systems [18]. The SEIPS 2.0 model is a further development of the work system model [135] and SEIPS 1.0 [20]. The model combines Human Factors work systems with a systems perspective, by focusing on the relationships and causations among work systems (structures), processes, and outcomes. The SEIPS model illustrates how the work system is linked to patient safety [136] through care processes [137]. SEIPS 2.0 is hereafter referred to as SEIPS in this thesis.

This model was found appropriate as a theoretical perspective in the. thesis and is used to interpret the intervention and outcomes of the intervention study. The SEIPS configural diagram is shown below (Figure 7). The works system with its components and elements, the process with its agents, and the outcomes, are explained in the next paragraphs.

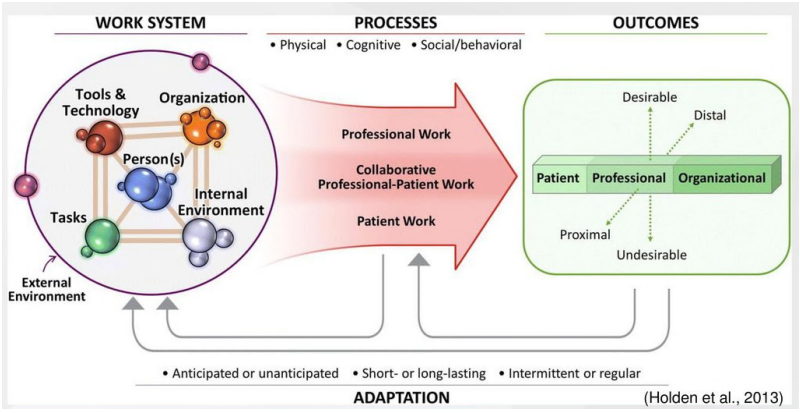

Figure 7. The SEIPS 2.0 model [18].

The work system (structure, input) is depicted on the left in the SEIPS model and comprises six components that interact with—and influence—each other (configuration) [18]. The configurations can be described as all the component elements networked in a complex work system. Any number of components can interact simultaneously at different time points, thereby shaping the performance **processes**, in which healthcare professionals perform their clinical work, which in turn, produces the **outcomes**.

The six components in the work system that interact with and influence each other are 1) person(s), 2) organization, 3) tasks, 4) tools and technologies, 5) the internal environment, and 6) the external environment [18]. Each component is described in detail below.

The **person** component refers to patients, family, healthcare professionals, caregivers and teams. The placement of the person at the center of SEIPS illustrates that human beings are the most important component in the work system [20, 21]. The studied agents in this thesis were the healthcare professionals. The TeamSTEPPS intervention in the organization component targeted the person component by training the healthcare professionals aiming to improve their teamwork competencies. Training of the teamwork competencies - communication, decision-making, team leadership,

situational monitoring and mutual support – was conducted to improve patient safety in the surgical ward [45].

Organization has elements such as financial recourses, training provided, teamwork, organizational structure, leadership, administration, and staffing levels [18]. The patient safety culture studied in this thesis, is regarded as an organizational element in the work system of SEIPS.

Tasks are specific actions within larger work processes and can include all types of direct and indirect patient jobs [18]. The healthcare professionals` work tasks were not studied in this thesis.

Tools and technology in the work system are objects required by the healthcare professionals or others need to complete tasks. These objects can be what healthcare professionals need for completing the work or tools to assist with the work they do. Holden et al. [18] distinguished between physical and psychological elements. Psychological elements can be teamwork tools and strategies, as in TeamSTEPPS, such as ISBAR, I-PASS, and closed-loop [45].

The **internal environment** is a physical environmental element and can be the layout of patient rooms, nurse station, or physician's office in a hospital ward [18]. The **external environment** component that surrounds the internal work system in the model incorporates macro-level societal, economic, ecological, and policy elements *outside* the organization [18].

The process part in the model illustrates the clinical work processes, for example, in a hospital ward [18]. There are different agents in the process, as healthcare professionals, patients and family members. In this thesis it was the healthcare professionals as agents that were studied.

Changes to any of the above components and elements, as well as their configurations, will negatively or positively affect the healthcare professionals' work in the clinical processes and, in turn, affect the

outcomes. Outcomes are important indicators of performance and process indicators [18].

Outcomes are defined as states or conditions resulting from the work process, and are produced through the interactions between the various components in the work system and the process. The outcomes are described in three outcome types in the SEIPS model, 1) organizational, 2) professional, and 3) patient outcome [18]. *Professional* outcomes can be team competencies (non-technical skills), perceived teamwork in the unit, and job satisfaction. Organizational outcomes can include sick leave, adverse events, and patient safety culture. Patient outcomes are typically mortality, length of stay, and quality of life. The outcomes that are being measured in this study are perceptions of teamwork and attitudes toward teamwork regarded as professional outcomes, and patient safety culture, regarded as the organizational outcome in the SEIPS model.

Proximal and distal outcomes can be distinguished from each other, as some outcomes might be an immediate result of work processes, as the use of closed-loop in daily work. Other outcomes might be further down the causal chain and emerge over time, such as a patient safety culture [138]. Improved situational monitoring and mutual support can lead to the prevention of errors in the daily clinical work. These desired changes due to a TeamSTEPPS implementation can improve teamwork and patient safety culture, and which can be measured as outcomes.

SEIPS includes **feedback loops,** which means that the work system is adjustable over time [18]. The feedback loops represent adaptations, both intended and unintended. A planned adaptation can be an adaptation based on the introduction of a training program. Adaptations can also be spontaneous, such as the day-to-day problem-solving of healthcare professionals when encountering operational problems.

The SEIPS systems perspective aligns with teamwork theory [139]. The team competencies that healthcare professionals are aimed to learn in a TeamSTEPPS intervention can be described as an **outcome** of teamwork within the input–process–output (IPO) framework which assumes that certain **inputs** (e.g. team member knowledge) affect team outputs (e.g. observed performance or perceptions of teamwork) via the interactions in the care **process** (e.g. team communication) [58]. Also other elements of **input** (as staffing, equipment etc.) into the work system are parts of the precondition for successful teamwork and team performance. According to teamwork theory, the learning and transfer of the team training determine the effect of the training on teamwork in the clinical work processes in the ward, that in turn impact the outcomes [139].

Chapter 4. Methodology

The methodology, which is the contribution of a research paradigm and the research strategies and methods used [140], is outlined in this chapter, with a description of design of the studies, the intervention, data collection, and statistical analysis used in the thesis. At the end of the chapter, ethical considerations and the research approvals are described.

Research approach

In this section, the philosophical research paradigm and the design of the studies published in the three papers are described. This section also provides methodological considerations of how to evaluate the intervention in Study II.

Philosophical underpinning

The overall research approach of this thesis is quantitative, which originates from a post-positivistic research paradigm. [141]. A research paradigm, also referred to as a worldview, can be roughly categorized into two main views: positivism with quantitative research methods and constructivism (or interpretivism) with naturalistic research methods [142]. In positivism, knowledge can only be verified through scientific methods, such as experiments, observations, and logical and mathematical proof. In constructivism, knowledge is seen as a human construct and is therefore subjective [143]. The post positivistic paradigm lies at the intersection of positivism and constructivism [141]. The post-positivist tradition has challenged the original positivistic research paradigm with the traditional notion of the absolute truth of knowledge, recognizing that humans cannot be positive about their claims of knowledge when studying others' behaviors and actions [140]. Post-positivism adheres to a deterministic philosophy in which causes determine outcomes or effects but where knowledge is conjectural and the belief is that the absolute truth can never be found [140].

To achieve the aims of the studies in this thesis, a quantitative research approach is adopted, using quantitative data collection methods and statistical analysis methods regarded as a post-positivistic research paradigm [141].

Study design

In this section the design of the studies is presented, first the study in paper 1 (Study I) and then the design of the studies in paper 2 and 3 (Study II). Table 1 presents an overview of the studies.

Paper	Participants (n)	Design and data collection	Outcome variables	Statistical analysis
1	247 healthcare professionals from hospital A and hospital B from multiple unit types	Cross-sectional design Survey One questionnaire Background characteristics	2 variables Perceptions of teamwork CSACD-T	Frequencies, percentages, mean, SD Correlation Principal Component Analysis (PCA) Cronbach's alpha Kruskal–Wallis test ANOVA w/Tukey test
2	35, 32, and 31 = 98 healthcare professionals from a surgical intervention ward in hospital C 28 responded both at baseline	Pre post design with a re-measurement Surveys Three questionnaires	17 variables Perceptions of teamwork CSACD-T (one dimension) T-TPQ (five dimensions)	Frequencies, percentages, mean, SD Wilcoxon Signed Rank Test Paired t-test

	and after 6 months 25 responded both at baseline and after 12 months	Background characteristics	Patient safety culture HSOPS (nine unit level dimensions, two single items)	Standard multiple linear regression General linear mixed model (GLMM)
3	35 and 31 healthcare professionals from an intervention ward in hospital C 25 responded both at baseline and after 12 months. 40 and 26 healthcare professionals from a control ward in hospital D 19 responded at baseline and after 12 months	Controlled quasi-experimental design Surveys Four questionnaires Background characteristics	25 variables Perceptions of teamwork dimensions: CSACD-T (one dimension) T-TPQ (five dimensions) Patient safety culture HSOPS (12 dimensions, 2 single items) Attitude towards teamwork T-TAQ (five dimensions)	Frequencies, percentages, mean, SD Pearson chi-square test Mann–Whitney U test Wilcoxon Signed Rank Test Paired t-test Effect size analysis General Linear Mixed Model (GLMM)

Table 1. Overview of the studies

Study I

For Study I, a cross-sectional design was found to be appropriate for investigating healthcare professionals' perceptions of collaboration and satisfaction with team decision-making in hospital units [144]. In addition to investigating team decision-making, the cross-sectional study was part of a validation study of the CSACD-T questionnaire (paper 1). The nine-item CSACD-T questionnaire was translated into Norwegian according to a translation-backtranslation procedure

(Brislin, 1970), with further details given in the Data collection section below.

Study II

To achieve the aims in Study II, a quasi-experimental design was chosen [142, 145-147]. A quasi-experimental study is also categorized as an evaluative study [147]. Evaluation of team training interventions can be performed on different levels, as outlined in the Kirkpatrick model, where level 1 is reaction (satisfaction), level 2 is learning, level 3 is behavior and performance, and level 4 is outcome [148]. Although the initial 6-hour team training was evaluated by a same-day survey administered to all participants, which measured satisfaction (level 1) and self-reported learning outcomes (level 2), these data were not a part of the aims of the studies in this thesis. To measure the impact of the intervention on performance, qualitative observation would have been preferable. However, observation of teamwork might be challenging in a surgical ward, as teamwork does not occur in a defined room around a specific patient, where the observer can be positioned in a corner to take notes, or record on video. Teamwork in a surgical ward takes place all over the ward, and the communication lines are often beyond the physical ward [149]. For practical reasons, this evaluation method was excluded from the planning phase of the study.

A study design that can contribute to maximizing the strengths and minimizing the weaknesses of a qualitative or quantitative study design, is the mixed methods design [150, 151]. This was, however, outside the scope of the study in this thesis. Nevertheless, a qualitative interview study from this TeamSTEPPS intervention was conducted by other members of the research group [120].

As stated in the guidelines for complex intervention studies [145], a range of measures are required in such a study, and which differs from intervention research in medicine, where one main endpoint is most commonly used. Although a single primary outcome and a few secondary outcomes are the most straightforward regarding the

statistical analysis, this is not recommended in complex intervention studies, as it might not facilitate optimal utilization of the data [145].

According to the patient safety research framework of Brown et al. [152], the patient safety culture is an outcome variable that determines the extent to which a hospital unit demonstrates patient safety. Attitudes are also appropriate as a pre- and post-test measure, because they can be determinants of behavior, and may have influence on performance and the quality of patient care [153]. Attitudes toward patient safety, are not only individual, but also a part of the culture in the unit. Teamwork perception is regarded as an indirect measure of team performance [154]. Outcome measures occurring prior to patient outcome are also known as surrogate outcomes in patient safety research [152].

In this thesis, the evaluation of whether the intervention had an impact in the surgical ward, were decided to be measured on professional and organizational outcomes in the SEIPS model. More specifically, by measuring the attitudes toward teamwork, perceptions of teamwork (regarded as professional outcomes in the SEIPS model), and patient safety culture (regarded as organizational outcomes in SEIPS). These evaluation methods were found appropriate from a human factors systems perspective and the SEIPS model, and because TeamSTEPPS is a program aiming to enhance teamwork and patient safety [45]. Although other endpoints (as e.g. adverse events and patient outcome data) could have been chosen in accordance to the SEIPS model, these self-report endpoints were chosen due to practical considerations.

If the study size was larger and more hospital units were included, yielding a larger sample size and stronger design, such as a randomized control design, which is the golden standard in hypothesis testing, would have been preferable. That would have given more power to the study, and a power analysis in advance of the study would then have been conducted [155].

Regardless of exactly which quantitative study design is chosen, what is missing in quantitative data obtained from complex intervention studies, are data of how the participants experienced the intervention. Such data, from a so-called process evaluation, form an important part of an intervention study evaluation to assess both the fidelity and quality of implementation, as well as for clarifying causal mechanisms and identify contextual factors [156]. A process evaluation would have provided valuable insights into why parts of the intervention worked and others did not, and how the intervention could have been optimized [155]. However, a process evaluation was outside the scope of the study in this thesis.

Paper 2

In paper 2, a pre–post design with a re-measurement was found to be the appropriate design to evaluate the professional and organizational outcomes of the team training intervention among the healthcare professionals within the ward at two time points [146]. Because much of the previous research has measured the impact of team training interventions over shorter periods, the aim was to measure changes over a longer period of time, first after 6 months of intervention, and followed with a re-measurement after 12 months; the results obtained at each stage were compared with those obtained at the baseline.

Paper 3

To minimize confirmation bias, which is common within intervention studies [155], a control group was included in the study published in paper 3. A surgical ward that was not exposed to the team training intervention was included to use as a benchmark for comparing the outcome in the intervention group. To achieve the aim of the study, which was to explore if the teamwork intervention changed the healthcare professionals` perceptions of patient safety culture, perceptions of teamwork, and attitudes toward teamwork, a controlled quasi-experimental design was chosen [146].

Setting and sample

The thesis studies were conducted in four hospitals (hospitals A, B, C, and D) in the south and east of Norway. All four hospitals are affiliated with the same regional health trust, which is a strategic unit that owns the state hospitals in the region.

Setting and sample - Study I

Paper 1

Study I was conducted in multiple units in Hospital A (with approximately 100 beds) and Hospital B (approximately 200 beds). All the units at the two hospitals were invited to participate in the study. The units that agreed to participate, were nine units from hospital A and three units from hospital B, grouped in the following unit groups in this study: maternity ward, medical /surgical wards, operation room/ anesthesia unit, intensive care unit, and emergency room (ER) (paper 1).

The sample was recruited by convenience sampling. Participants were healthcare professionals (registered nurses, post-educated registered nurses, nursing assistants, physicians, occupational therapists, and physical therapists). All healthcare professionals in the units were invited to participate in the study. Table 2 shows the characteristics of the participants.

		Hospitals A and B	Hospital C Intervention ward			Hospital D Control ward	
			Baseline	6 months	12 months	Baseline	12 months
Sample size		624	43	42	40	55	46
		n (%)	**n (%)**	**n (%)**	**n (%)**	**n %)**	**n (%)**
Response		247 (40)	35 (81)	32 (76)	31 (78)	40 (73)	26 (57)
Gender	Female	225 (91)	28 (80)	22 (79)	25 (83)	33 (94)	19 (79)
Age group	≤ 30	49 (20)	7 (21)	7 (26)	5 (17)	12 (35)	6 (25)
	31–50	119 (49)	16 (47)	11 (41)	15 (50)	20 (59)	13 (54)
	≥ 51	76 (31)	11 (32)	9 (33)	10(33)	2 (6)	5 (21)
Profession	RN	102 (41)	20 (57)	20 (59)	21 (68)	31 (77)	18 (69)
	NA	27 (11)	6 (17)	4 (12)	3 (10)	3 (8)	2 (8)
	Doc	12 (5)	9 (26)	8 (24)	7 (22)	6 (15)	6 (23)
	Post RN	84 (34)	-	-	-	-	-
	P&O	22 (9)	-	-	-	-	-
Employment time	0–5 years	87 (35)	10 (29)	8 (29)	4 (14)	23 (67)	10 (42)
	6–15 years	84 (34)	14 (39)	12 (44)	14 (48)	9 (27)	13 (54)
	≥16 years	75 (31)	11 (32)	7 (26)	11 (38)	2 (6)	1 (4)
	Miss	3	0	5	2	6	2

Table 2. Characteristics of the participants in the studies. [1]RN = Registered nurses, [2]NA = Nursing assistants, [3]Doc = Physicians, [4]PRN = Post-educated registered nurses, [5]P&O = Physio -and occupational therapists

Setting and sample - Study II

Paper 2

Regarding recruitment, the project group had to find a hospital ward that was willing to participate as the intervention ward in the study. The hospital was selected by convenience. The Chief Executive Officer (CEO) from a hospital agreed to the request, and a research consultant in the hospital administration selected and requested the leadership at a specific surgical ward. As recommended in the TeamSTEPPS change model, a readiness assessment was conducted to assess whether the ward was suitable for the intervention [45]. The leaders of the surgical ward assessed that the ward was ready, and they agreed to participate in the study.

The hospital of the intervention ward had approximately 200 beds and was in East Norway (hospital C). The ward had 20 beds, which 14 beds that were reserved for gastrointestinal surgery patients and 6 were reserved for urology patients. The bed occupancy was 87% and average length of stay (LOS) was 3.5 days in the study period. At baseline, there were 12 gastrointestinal surgeons and 1 urologist affiliated with the intervention ward, as well as 6 nursing assistants and 20 registered nurses. The nurse-to-bed ratio was 1:1 in the study period.

The sick leave percentage and registered adverse events were included in the collection of site assessment data from the intervention ward. The number of registered adverse events was 38 in the year before the intervention (2015), 42 in the first intervention year (2016), and 52 in 2017. The percentage of sick leave among nurse staff was 13.22% on average in the six months prior to the intervention, and 5.05% the first six month of intervention, and 7.58 % in the last six months. For the physician group, the number of sick leaves was 3.55% in average the six months prior, 1.47% in the first six months, and 2.58% on average in the last six months of the study period. No team training had been conducted previously in the ward,

and there were no impending change initiatives expected in the next 12 months.

Regarding the sample, all healthcare professionals from the intervention ward (hospital C), except for those with leadership positions, were invited to participate in the study. They were recruited by ward affiliation and therefore the number of healthcare professionals in the ward determined the sample size. The participants were registered nurses, nursing assistants, and physicians (Table 2).

Paper 3

For a description of the intervention ward, please refer to the previous section. A control group that matched with the intervention ward was found. The Chair of the surgical department at hospital D (with approximately 300 beds) agreed to participate in the study as a control group. The control ward was selected based on the matching with the intervention ward, as well as the distant location. It was a combined ward for gastrointestinal surgery patients and ear, nose, and throat (ENT) patients. The control ward had 26 beds (20 beds reserved for the gastrointestinal surgery patients and 6 for the ENT patients). At the baseline, there were 3 nursing assistants, 31 registered nurses, and 12 gastrointestinal physicians affiliated with the ward. Bed occupancy was 91% during the study period. The nurse-to-bed ratio was 1:1, the two wards were also similar in terms of LOS, and both wards had patients from two surgical disciplines. As for the intervention ward, no team training had been conducted previously, and there were no impending change initiatives expected in the next 12 months. A table displaying the baseline profiles of the two surgical wards can be found in the published paper 3.

As for the intervention ward, all healthcare professionals, except for those with leadership positions, were invited to respond to the survey. The sample consisted of registered nurses, nursing assistants, and the gastrointestinal surgery physicians, and they were recruited by ward affiliation. The ENT physicians did not agree to participate in

the study. Besides that, the sample groups of healthcare professionals from the two wards were quite similar. However, a significant difference were detected in employment time in the ward (p-value .03), as the control ward had a higher share of short-term (0–5 years) employment time, and the intervention ward had a higher share of long-term employment of over 16 years (Table 2).

The TeamSTEPPS intervention

In this section, the intervention in Study II is described in three phases, as shown in Figure 8. Phase 1 is the planning phase, and phase 2 is the team training and implementation phase, while phase 3 is the implementation and sustainment phase. Phases 2 and 3 overlap and although these two phases are similar in terms of the implementation of teamwork tools and strategies, phase 2 is described more in detail, with examples of how the teamwork tools and strategies were implemented in the surgical ward. At the end of the section, Figure 12 presents an overview of the timeline for the TeamSTEPPS project, with main meetings and training sessions.

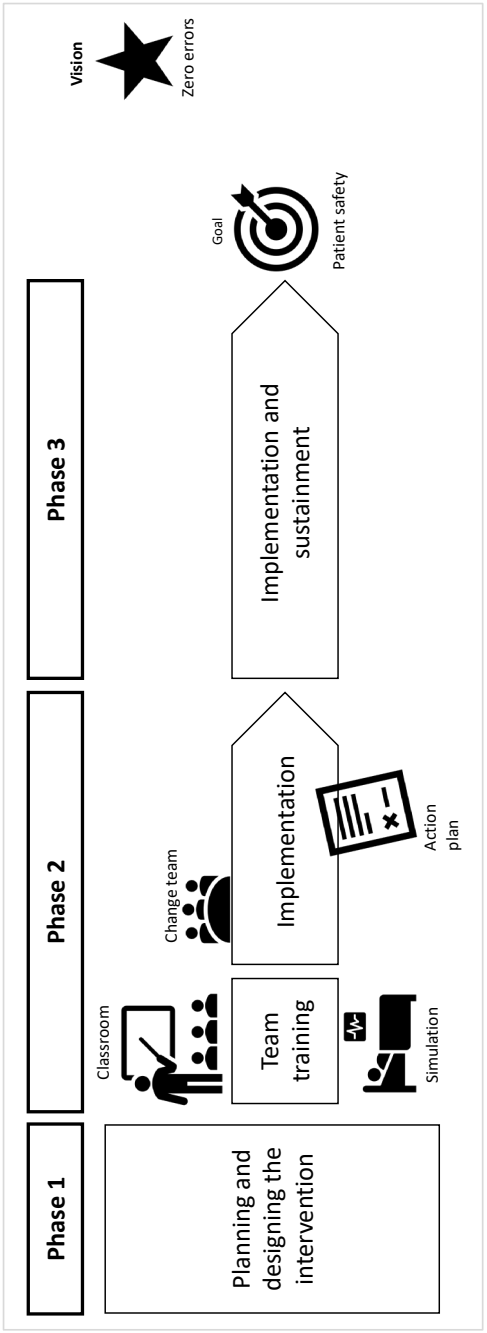

Figure 8. The three phases of the intervention.

The TeamSTEPPS program was translated into Norwegian by a translation agency and reviewed by the research group and experts in the field. The intervention was guided by the Kotter model for leading change [125] (Figure 4), and the TeamSTEPPS model of change (Figure 5).

Phase I of the intervention included site assessments and six months of planning and designing of the intervention by a project group. The members of the project group were three researchers from the university, five leaders from the hospital ward (physician and nurse leaders), and one research consultant from the hospital's administrati The fundamental team training of TeamSTEPPS for all employees was carefully planned. The scripts for the simulation scenarios were drafted by one of the researchers in collaboration with the leaders at the surgical ward, based on the ward's training needs. Course materials such as Power Points, simulation scenarios, the TeamSTEPPS pocket guide, and large posters were prepared and produced.

Team training was approved by the Norwegian Medical Association with six hours of an optional course for doctors specializing in general surgery and specialists' continuing education (April 26, 2016), and by the Norwegian Nurse Association with six hours of a clinical specialist and advanced training program in nursing (May 9, 2016).

Two head surgeons, the nurse unit manager, and the clinical nurse specialist attended a two-day TeamSTEPPS master's course in New York. They were certified as TeamSTEPPS instructors (April 2016). Two of the researchers (the author of the thesis and one of the co-supervisors (R.B.) had attended master's training in June 2015. Before the intervention's start, two researchers held information meetings with nursing staff, and one of the researchers held information meetings with the physicians (separately). In advance of the training, TeamSTEPPS pocket guides and booklets were distributed to all participants, with an information sheet and encouragement to read the materials to prepare for the training.

In **phase II** of the intervention, a 6-hour team training was conducted, and the implementation was initiated. The initial team training was completed over three days during a three-week period. The number of healthcare professionals attending the training was 41 (April 24: 12 persons, May 2: 14 persons, and May 9: 13 persons). In addition, the nurse unit manager, the clinical nurse specialist, the two head surgeons, and the chair of the surgical department attended a total of 46 persons from the intervention hospital. The training was conducted in the Patient Safety and Simulation Center at the university.

The TeamSTEPPS training was delivered by the master-trained nurse and physician leaders in the intervention ward in collaboration with the researchers and a simulation expert (operator), and comprised of classroom training (lectures, video, and role-play) and two scenarios of high-fidelity simulation training. The scenarios reflected potential postoperative complications, one with a gastrointestinal surgery patient and one with a urology patient which deteriorated during the training sessions (Appendix 2).

To establish a sense of urgency, as recommended by **Kotter step 1**, the TeamSTEPPS course was initiated by making the participants watch the Sue Sheridan video* [45], followed by a presentation of previous registered adverse events in the ward, presented by the Chair or a head surgeon. Lectures in TeamSTEPPS were provided in combination with role play, discussions, and the simulation sessions. Four of the attending healthcare professionals (1 physicians, 2 nurses, and 1 nursing assistant) were active participants in each scenario, while the rest of the group was viewed through video transference. In the debriefing sessions, the facilitator engaged the participants in a dialogue about teamwork to promote discussions regarding teamwork and patient safety.

The Sue Sheridan video is a story of a person with two relatives that experienced two serious errors. One experienced a fatal outcome, and the other, serious brain damage.

At the end of the course day, all the attending healthcare professionals were asked to identify patient safety issues in the ward and suggest TeamSTEPPS tools that could help solve the problem. After the training was completed, the TeamSTEPPS Course Evaluation Form was distributed to all participants [157], [45]and the participants were given time to complete the survey before leaving the simulation center. The results of the course evaluation showed good results, both on self-reported learning and on satisfaction, with the highest learning scores on Mutual support and The two-challenge rule. The results are presented in Appendix 3. Course certificates documenting the credits were distributed to all participants.

Shortly after the training, 12 champions were identified and assigned as members of a change team, as recommended by **Kotter step 2**. The members of the change team members were from all levels in the organization: the Chair of the surgical department, the nurse unit manager, the clinical nurse specialist, four physicians, three registered nurses, one nurse assistant, a former patient, and a researcher (the author of the thesis). The change team met five times during the first six months of the study period. Due to shift schedules and clinical work demands, on average, five members met each time. For the first five months, the researcher attended the change team meetings, and worked with the leaders by giving and gathering input through site visits and e-mail communications throughout the study period.

As recommended by **Kotter step 3**, a vision for the intervention was set and an action planned was developed and communicated (**Kotter step 4**). The vision was “Zero Errors.” An assigned group of the change team developed the action plan based on the identified patient safety issues that were identified during the course days. Goals were set for each selected patient safety issue. These goals were aligned with those of the surgical department. The action plan was approved by the Chair of the surgical department, and communicated by e-mail to the healthcare professionals in the ward and to the leaders at all levels. Posters with safety information for patients and family

members were placed in the ward hallways. The poster text declared that the ward was focused on teamwork and patient safety, and encouraged the patients and family to raise their voice if they saw something that could threaten the patients' safety (Appendix 4).

The implementation of the TeamSTEPPS tools and strategies among the healthcare professionals was led by the nurse unit manager and the clinical nurse specialist in collaboration with the head surgeons, who were all members of the change team. They implemented the TeamSTEPPS tool in a stepwise manner, approximately one per month, for a total of five tools during the first six months (Figure 10). The leaders used Kotter's steps to implement the changes, and used the steps in the recommended order. The "tool of the month" was communicated by e-mail in weekly newsletters to the healthcare professionals and to the leaders at all levels. The "tool of the month" was also a topic of discussion in the weekly morning meetings for the nursing staff, led by the nurse unit manager or the clinical nurse specialist. Posters displaying TeamSTEPPS tools were placed in the nurse work stations and in the physicians' meeting rooms.

The introduction of each tool was linked to specific tasks or situations (Table 3). After completing the training days in April/May, they started with two communication tools that were not quite unfamiliar to them. In May 2016 they introduced closed-loop. Closed-loop was used in various communication situations, from phone orders of medication from a physician to a nurse, to ordering of meals for the patient from the service staff. However, when the nurses used closed-loop to physicians from other departments who had not participated in the training, the physician could say, "Are you questioning my prescription?" Then, they had to explain that it was a "check-back".

In June, they introduced the ISBAR as the tool of the month, while continuing with the closed-loop. When introducing ISBAR, the ward leaders arranged an ice cream kiosk at the nurse station (ISBAR means ice cream kiosk in Norwegian). To get a free ice cream, the individual healthcare professional had to tell what the meaning of the letters in

the mnemonic ISBAR, and if they managed to do it without any help, they got extra drizzles on the ice cream (Figure 9).

Figure 9. The ISBAR ice cream bar.

They continued using these two teamwork tools throughout the summer. In August, they introduced the Briefing strategy for leading teams. The team leaders held a briefing at the start of each shift, sharing important information and if there were specific challenges in the ward, they were highlighted with a special focus on patient safety (**Kotter step 5**). In September they introduced the leading strategy, Huddle, by introducing daily interprofessional team huddles in front of the patient safety board after rounding, in which the nursing assistants also participated (Kotter step 5). The huddles were led by a nurse, and some of the nurses felt uncomfortable leading a team with a physician as a team member. The cross-monitoring tool, which was introduced as the tool of the month in October, was used to highlight the importance of double control of all intravenous medication administration by two registered nurses. By focusing on patient safety, they managed to re-establish this important routine. After the first six months, they started using closed-loop, ISBAR and cross-monitoring depending on the situation, and they briefed and huddled daily.

Tool Strategy	Introduction to use of the tools and strategies related to tasks or situations	Healthcare professionals
Closed-loop	All types of information—especially regarding a physician`s medication orders by phone	Registered nurses nursing assistants and physicians
ISBAR	For example, when a nurse contacted a physician because of a patients` deteriorating situation	Registered nurses and physicians
Briefing	Start of shift	Registered nurses nursing assistants, and physicians
Huddles	Daily after rounding by the patient white-board; the rounding physician and nursing staff—lead by a registered nurse. And	Registered nurses nursing assistants, and physicians
Cross monitoring	Mandatory control by two registered nurses with intravenous medication administration	Registered nurses, nursing assistants and physicians
Debriefing	Systematic scheduled routine debriefings - once a week led by the nurse unit manager	Registered nurses ansd nursing assistants
Task assistance	Distribution of workload at the shift-start briefing, and throughout the shift – offering help, - justified by patient safety	Registered nurses and nursing assistants
STEP	Update care plan	Nursing staff
Two challenge rule	Speak-up until heard when seeing a situation that might threaten patient safety	Registered nurses, nursing assistants and physicians
I-PASS	Handoffs with focus on patient safety risks	Registered nurses

Table 3. Examples of how the TeamSTEPPS tools and strategies were introduced.

As recommended by **Kotter step 6**, milestones were celebrated along the way. For example, when interprofessional patient safety board huddles were achieved every day in a row for one month, they celebrated with a homemade ice cream cake that was designed just as that shown on their patient safety board.

After five months, separate TeamSTEPPS refresher courses were held in the hospital separately for the nursing staff and physicians. The content of the refresher course was the following four team competencies, communication, team leadership, situational monitoring, and mutual support.

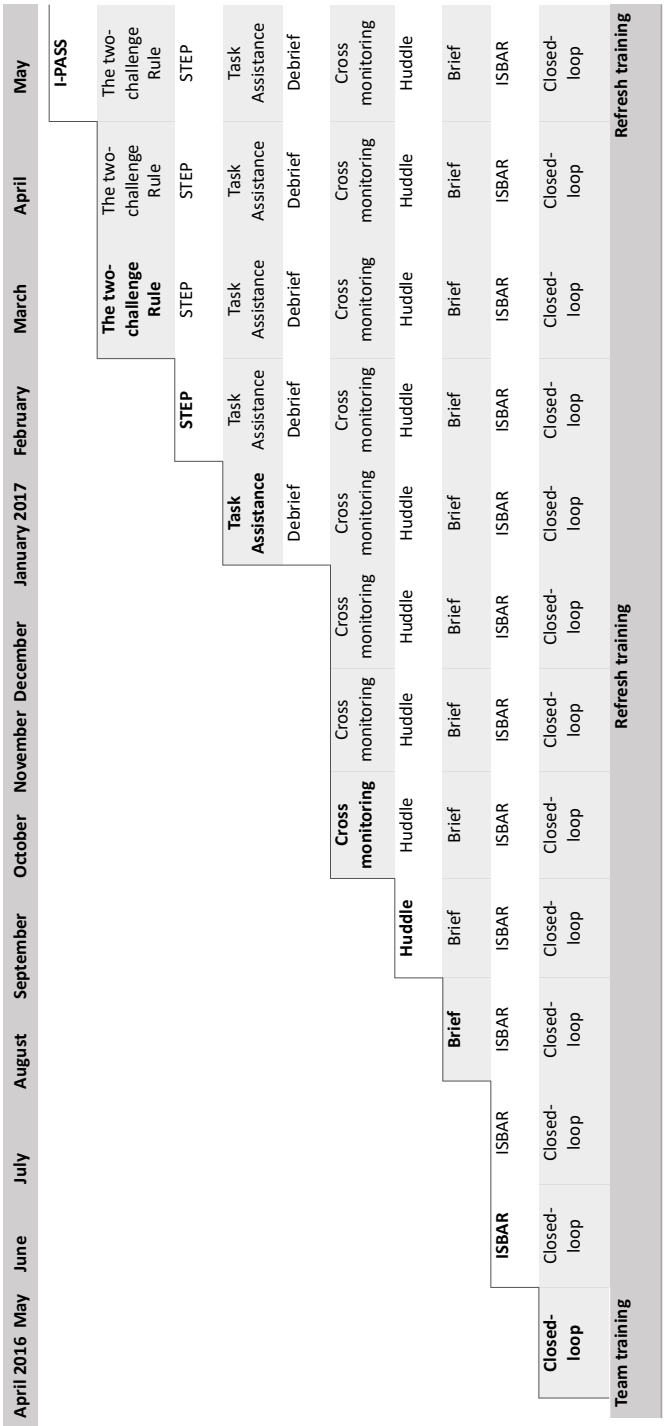

Figure 10. Timeline of the step-wise implementation of the selected teamwork tools and strategies.

After five months, separate TeamSTEPPS refresher courses were held in the hospital separately for the nursing staff and physicians. The content of the refresher course was the following four team competencies, communication, team leadership, situational monitoring, and mutual support. All the 27 nurse staff members participated in the 75-min TeamSTEPPS session delivered by the master-trained nurse unit manager or the clinical nurse specialist over three days. A refresher course for physicians was delivered by a master-trained head surgeon at a morning meeting for physicians.

In **phase III** of the TeamSTEPPS intervention, the implementation of tools and strategies continued. Five more tools were implemented (**Kotter step 7**). The action plan that led the way for the implementation, was monitored and adjusted. Change team meetings continued, with two meetings held during the last six months. The master-trained leaders coached the healthcare professionals, and together with the other members of the change team, they contributed to the integration of TeamSTEPPS into the ward.

After 11 months, another 75-minute TeamSTEPPS refresher course was held. The content of the refresher course included the four team competencies of TeamSTEPPS and the selected tools for the ward. All 27 nursing employees attended. The physicians did not conduct the second refresher course.

At the end of the study period, the leaders` in the surgical department initiated the distribution of a monthly "Learning note" for adverse events to all healthcare professionals in the ward. The learning note which was designed in the form of a newspaper with headlines and cartoons etc., described the adverse event/s, what interventions had been conducted, the outcomes, and a description of the learning points. The note included a reminder of using the appropriate TeamSTEPPS tool or strategy when necessary, such as the "two-challenge rule" (Figure 11).

Figure 11. The two-challenge rule from the surgical ward`s Learning note

Figure 12 (next page) presents an overview of the timeline for the TeamSTEPPS project, main meetings, and training sessions.

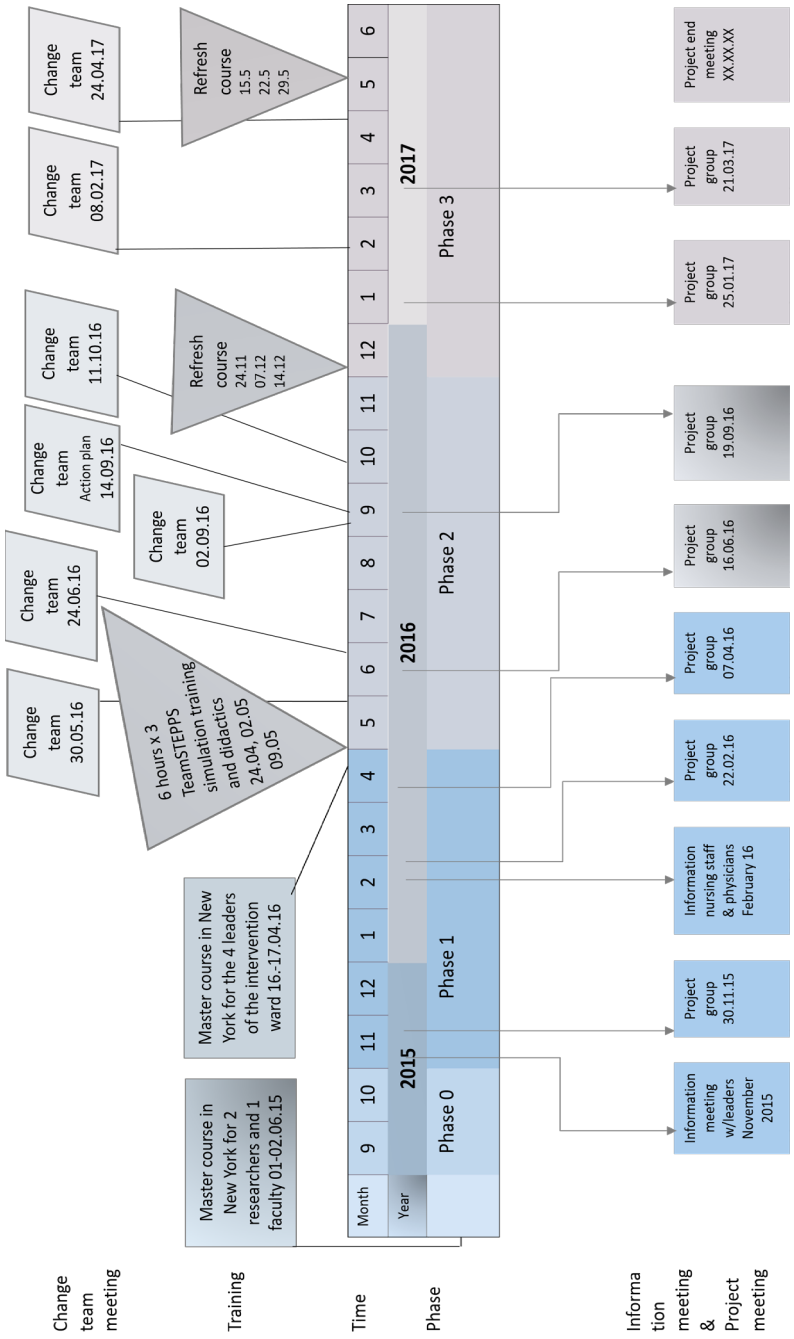

Figure 12. Timeline of the TeamSTEPPS project.

Data collection

Questionnaires

Norwegian versions of the four questionnaires were used in the studies in the thesis (Appendices 5 and 6). Table 4 provides an overview of these questionnaires.

Questionnaires	Study	Paper
The Collaboration and Satisfaction About Care Decisions in Teams questionnaire (CSACD-T)	I, II	1, 2, 3
The TeamSTEPPS Teamwork Perceptions Questionnaire (T-TPQ)	II	2, 3
The Hospital Survey on Patient Safety Culture (HSOPS)	II	2, 3
The TeamSTEPPS Teamwork Attitude Questionnaire (T-TAQ)	II	3

Table 4. Overview of the questionnaires used in the studies.

Questionnaire used in papers I, 2, 3

The Collaboration and Satisfaction About Care Decisions in Teams questionnaire was used in Study I and Study II (papers 1, 2, and 3). It is a team version of the nurse–physician Collaboration and Satisfaction About Care Decisions (CSACD) questionnaire developed by Judith Baggs [158]. Because the original CSACD focuses on nurse–physician teams only, we chose the team version of the questionnaire, the Collaboration and Satisfaction About Care Decisions in Teams (i.e. CSACD-T) (e-mail from Professor Baggs, June 5, 2015). The CSACD-T is a nine-item questionnaire with response options on a Likert scale ranging from 1 to 7. The first six items measure attributes of collaboration in teams, with response options ranging from strongly disagree (1) to strongly agree (7). The seventh item measures global collaboration, with the response options ranging from no collaboration (1) to complete collaboration (7). The last two items in the questionnaire measured satisfaction with team decisions, and the response options ranged from not satisfied (1) to very satisfied (7).

The team version had not been validated previously; therefore, we did so in Study I. The translation and validation part of the study followed a rigorous procedure for translation [159], followed by a psychometric testing of the questionnaire. The translation procedure included the following steps:

Forward translation—Forward translation into the target language (Norwegian) was conducted by three blinded translators: an American-Norwegian bilingual physician, a bilingual professional translator, and a Norwegian academic nurse.
Review—The research group reviewed the three versions and compared them with the original version for linguistic congruence and contextual relevance, and agreed on a translated version, whichwas reviewed by three academic nurses with expert competencies in collaborative care and teamwork in hospitals.
Back-translation—A professional translator, who was blinded to the original version, back-translated the Norwegian version.
Compare—The research group compared the back-translated version with the original and found no differences in the meanings of the items.
Pilot testing—To check for face validity and the understanding of the questionnaire items, a pilot test was conducted among multi-professional healthcare personnel (N = 40) from four hospital units (19 registered nurses, 12 postgraduate nurses, 5 physical/ occupational therapists and 5 physicians). They found the items understandable, well-worded, precise, and relevant to their profession, and gave some inputs as suggestions for clarifications. A consensus on the final Norwegian CSACD-T version was eventually reached by the research group.

Due to the importance of patient participation in care decisions, an extra item was developed and added by the research group: “Do patients participate in decision-making related to their own care?” with response options ranging from 1 (no participation) to 7 (complete participation). The extra item was used in Study I only.

Questionnaires used in papers 2 and 3

In addition to the CSCAD-T, three questionnaires developed by the American Institutes for Research and AHRQ, were used to measure the impact of the intervention in Study II.

The TeamSTEPPS Teamwork Perceptions Questionnaire (T-TPQ), is a self-report questionnaire measuring individuals' perceptions of group-level teamwork in the workplace [160]. It has 35 items composed of responses on a 5-point Likert response scale ranging from 1 = "Strongly agree" to 5 = "Strongly disagree." The items are negatively scored and must be converted before being computed into each of the five dimensions that are related to the five key components of teamwork, as in the TeamSTEPPS program: Team Structure, Leadership, Mutual Support, Situational Monitoring, and Communication [160]. The T-TPQ was developed by American Institutes for Research [160] and with Cronbach's alpha ranging from 0.88 to 0.95 in the validation study. It was later tested on a larger sample, and Cronbach's alpha was 0.98 for the total questionnaire [161]. It was translated into Norwegian in 2015 and psychometrically tested by Ballangrud et al. [162]. The Norwegian version had a Cronbach's alpha ranging from 0.79 to 0.84 on the five dimensions.

The Hospital Survey on Patient Safety Culture Questionnaire (HSOPS), is a questionnaire for assessing healthcare professionals' perceptions of patient safety culture within their workplace, developed by Sorra et al. [163]. The questionnaire comprises 44 items, of which 42 are meant to have 12 dimensions. Nine dimensions aim to measure the patient safety culture at the unit level, and three dimensions ("Hospital Management Support for Patient Safety," "Teamwork across Units," and "Handoffs and Transitions") measure the patient safety culture at the hospital level. In addition to these dimensions, there are two single items: the "Patient Safety Grade," which asks healthcare professionals to provide an overall grade on patient safety for their work unit (A = Excellent, B = Very Good, C = Acceptable, D = Poor, E = Failing), and the "Number of Events Reported," which indicates the number of adverse events the

healthcare professionals have reported over the past 12 months (no events, 1 to 2 events, 3 to 5 events, 6 to 10 events, 11 to 20 events, or 21 events or more). The questionnaire uses a 5-point Likert response scale of agreement with five choices from "Strongly Disagree" to "Strongly Agree" with "Neither" in the middle, or a 5-point Likert response scale of "How often," from "Never" to "Always" (Never, Rarely, Sometimes, Most of the Time, and Always). Of the 44 items, 18 are negatively worded and must be converted before computing the items into dimensions [164]. Four measures in the questionnaire are defined as outcome measures: "Overall Perceptions of Patient Safety," "Patient Safety Grade," "Number of Events Reported," and "Frequency of Events Reported" [165]. In a validation study conducted using a US sample, the the HSOPS questionnaire had a Cronbach's alpha ranging from .62 to .85 [163]. It was translated into Norwegian by [166] and psychometrically tested among diverse hospital employees, with the Cronbach's alpha values ranging from 0.38 to 0.78.

Questionnaire used in paper 3

The TeamSTEPPS Teamwork Attitude Questionnaire (T-TAQ), developed by Baker et al. [154] measures individuals' general attitudes toward teamwork in healthcare. It has 30 items composed of responses on a 5-point Likert response scale, ranging from 1 = "Strongly disagree" to 5 = "Strongly agree." The T-TAQ items are supposed to be computed into each of the five dimensions that are related to the five key components of teamwork, as in the TeamSTEPPS program: team structure, leadership, mutual support, situational monitoring, and communication. Four items are negatively worded and must be converted before computing the dimensions [167]. The Cronbach's alpha ranged from 0.70 to 0.83 in a validation study conducted using a US sample [154]. It was translated into Norwegian in 2015 and psychometrically tested by Ballangrud et al. [168]. The Cronbach's alpha ranged from 0.53 to 0.76 for the five dimensions in the Norwegian version.

Background variables

Information about respondents was collected along with the questionnaires (gender, age group, profession, and time employed in the ward).

Procedure for data collection

In the study published in paper 1, paper surveys were distributed to all healthcare professionals in the included hospital units (hospitals A and B) in November 2015. Two reminders were sent by email to the leaders of the hospital units (paper 1).

In the study published in paper 2, electronic surveys (SurveyXact by Ramboll) were distributed to all healthcare professionals in the intervention ward through work email at baseline (February – March 2016), after 6 months (November–December 2016) and after 12 months of intervention (June 2017).

In the study published in paper 3, electronic surveys were distributed to all healthcare professionals in the control ward, in addition to the intervention ward, at baseline (February – March 2016) and after 12 months of intervention (June 2017). Three reminders were sent.

Figure 13 provides an overview of the data collections and samples adopted in Study II.

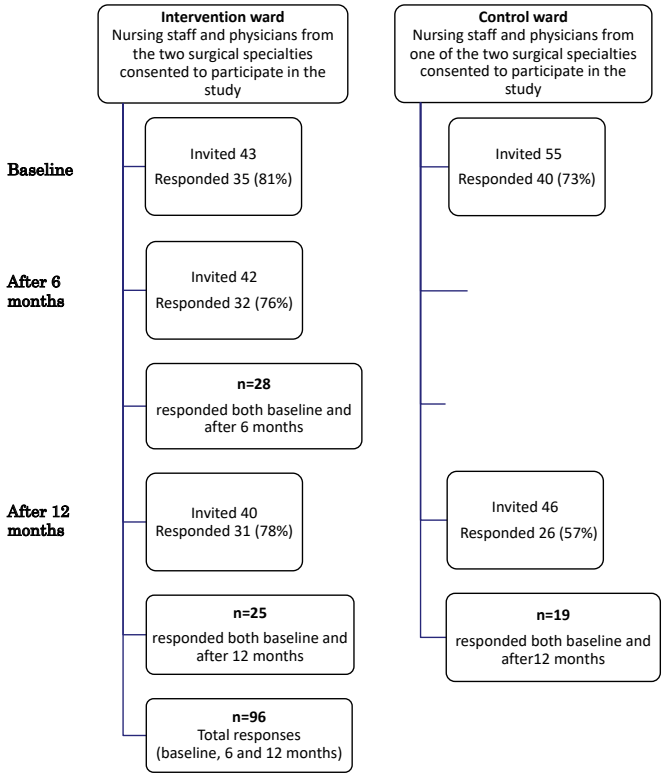

Figure 13. Overview of the samples and data collection times.

Statistical analyses

All the data were analyzed using SPSS Version 24 [169] and R [170]. To analyze the data obtained from the two studies, different statistical analysis methods were used, which is described in the following paragraphs. A two-tailed significance level of p-value <0.05 was used for all tests, except for the correlation test conducted in Study I (<.001) [142]. Table 1 presents an overview of the statistical analysis methods used in the studies of the three published papers.

Statistical analyses – Study I

Descriptive statistics, such as frequencies and percentages were used for categorical data, such as sample characteristics. Mean and

standard deviation (SD) were calculated for the continuous data, such as the CSACD-T scores [142].

Since this team version of the questionnaire had not been validated previously, an exploratory factor analysis (EFA) was planned to test the factor structure of the questionnaire [144]. A principal component analysis (PCA), which is often used interchangeable with EFA, and which is a variable reduction technique that is recommended when variables are highly correlated, was used. It reduces the number of the observed variables to a smaller number of components (factors) which account for most of the variance of the observed variables [171]. The nine items of the CSACD-T were subjected to PCA [158], and prior to this, the suitability of the data for PCA was assessed and found not to be violated. A correlation was performed to determine the relationships between the items. The correlation coefficients had values between 0.30 and 0.70, which were considered appropriate [172] (paper 1). To check for the internal consistency among the items, Cronbach's alpha was applied [142].

To compare the differences in the score of healthcare professionals' between the unit groups, a one-way ANOVA with a post-hoc Tukey test was performed on the total mean score of the questionnaire [142]. A Kruskal-Wallis test, which is a non-parametric alternative to ANOVA, was used on the extra single item.

Statistical analyses - Study II

An overview of the parametric and non-parametric tests chosen to address the aims and answer the research questions in papers 2 and 3 is presented below (see also Table 1).

Characteristics of the respondents were analyzed by descriptive statistics and presented as numbers and percentages (papers 2,3). To determine the differences in the characteristics between the sample in the intervention ward and the control ward, a **Pearson chi square test** was conducted on these categorical data [142].

Negatively worded items of T-TAQ were reversed and the 30 items were computed into 5 dimensions as recommended in the TeamSTEPPS® Teamwork Attitudes Questionnaire (T-TAQ) Manual [160]. All items of The 35 items of T-TPQ were reversed and computed into 5 dimensions as recommended in the TeamSTEPPS® Teamwork Perceptions Questionnaire (T-TPQ) Manual [160]. Negatively worded items of HSOPS were reversed and the 42 of the 44 items were computed into 12 dimensions as recommended in the Hospital Survey on Patient Safety Culture User's Guide [164]. The total mean score of the nine CSACD-T items was computed. Mean and SD were calculated for the continuous data, such as these questionnaire score data, both for the dimension data and for the two single items [142] (paper 2 and 3).

To determine the differences in healthcare professionals' mean scores between the intervention ward and control ward at baseline, a **Mann–Whitney U-test** was conducted [173] (paper 3).

To validate the changes in healthcare professionals' scores between baseline and 6 months (paper 2) and between baseline and 12 months (paper 2, 3), a **paired t-test** was conducted [142]. The choice of a t-test was based on that the samples being taken from the same subjects, i.e. those who had responded at both times. The results on the 12-month data are presented with ES and 95% confident interval (CI) in addition to the p-values. ES was calculated and standardized by taking the score obtained after 12 months, subtracted by the score obtained at the baseline, and divided by the baseline SD. Cohen's standards for ES were applied as follows: small effect 0.2, medium effect 0.5, and large effect 0.8 [174]. A **Wilcoxon signed rank test,** which is the non-parametric alternative to the paired t-test, was performed on the two single items of HSOPS [175] (paper 2,3).

To investigate the impact of the intervention on the unit-based patient safety culture dimensions of HSOPS, whether there were differences among physicians and nurse staff, and after 6 and 12

months, a **General Linear Mixed Model (GLMM)** was applied. GLMM It can tests the overall fixed effects and can model the effects of time and intervention, as well as the interaction between time and intervention [176]. The nine unit-based HSOPS dimensions were used as the dependent variables, and profession group (nursing staff and physicians) and time (baseline, 6 months, and 12 months), as the independent variables in the model. The GLMM was applied on the total sample of 98. The model were run in R and SPSS and the outputs were displayed as estimates with 95% confidence intervals (paper 2).

To assess the ability of teamwork being predictor to the patient safety after 12 months, a **standard multiple linear regression analysis** was performed on the 12-month data. The T-TPQ dimensions "Communication," "Situation Monitoring," and "Mutual Support" that were significantly improved from baseline, served as independent variables, and the two outcome variables of HSOPS, the "Overall Perceptions of Patient Safety" and the "Patient Safety Grade," served as dependent variables in two separate models [142] (paper 2).

To determine the differences in change of the healthcare professionals` score on teamwork and patient safety culture between the intervention ward and control ward after 12 months, the application of ANOVA was first considered on the continuous dimension score data. However, because of violated assumptions for ANOVA, the **GLMM** was found to be the preferred analysis method [173, 177]. GLMM is more flexible than traditional ANOVA, as it can handle unbalanced data and is recommended for non-randomized controlled studies, as it accounts for the subject confounding effect [176]. To determine the differences between groups, GLMM was fitted with individuals as a random effect, adjusting for the baseline differences in the model. The models had separate terms for group and time, the interaction between group*time, and a person random effect. Three models were run on the data from the intervention ward and control ward: one model with six dependent variables (CSACD-T and the five T-TPQ variables), one model for the five T-TAQ variables,

and one model for the fourteen HSOPS variables. The results are presented with p-values and values <.05 were considered statistically significant (Tables 7 and 8).

Research ethics

Before beginning the study, approval to conduct the study was taken from the Norwegian Center for Research Data (Ref. No. 46323) (Appendix 7). The application for the collection of the reported adverse events was sent to the Regional Committees for Medical Research Ethics (REC) in South East Norway, with the reply that approval was "not required" if the data were anonymized, which they were. Approvals from the leaders of the units and departments in the study's hospitals were obtained verbally. In addition, for Study II, letters of agreement that included the universities` and the hospitals' responsibilities in the study were signed by the parties for both hospitals. The studies were conducted according to ethical principles for medical research involving human subjects developed by the World Medical Association (WMA) [178]. The design of the studies was described and justified in a research protocol [178], which was approved by the doctoral committee of the University of Stavanger (2015/12/15). A study protocol of the overall project was retrospectively registered (registration date 2017/05/30) with a trial registration number of ISRCTN13997367 [120]. The invited study participants were informed about the study in a written form (Appendices 8 and 9). The information included the aim and design of the study, the data were used under this aim, it was voluntary to participate in the study, and the participants had the right to refuse to participate or to withdraw from the study at any time without reason and without reprisal [178]. Before conducting Study II, verbal and written information was provided to the healthcare professionals.

Although team training in the intervention ward was compulsory during the work hours, participation in the surveys occurred voluntarily. The completion of the surveys was considered informed

consent [178]. The privacy of the research subjects and the confidentiality of their personal information were protected in line with the ethical guidelines. The university`s ethical guidelines for the collection and storage of data for research projects were followed [179], which are under the ethical guidelines from [178]. The invited participants were informed that all information was processed without a name and directly recognizable information. It was impossible to identify the respondents in the published papers or in the thesis, as all results were presented at the group level. A code that linked the respondent's information was used, and the lists with codes and names were kept in a locked office at the university. The codes and e-mail addresses for Study II were filed in the SurveyXact computer program, and only the researchers had access to the files. There were no identified risks related to participation in the studies. The only possible disadvantage that the participants may have experienced in Study I, was the time used to respond to the surveys.

In Study II, the healthcare professionals' participation in the team training sessions, can be regarded as benefits for the ward, and although some individual healthcare professionals might have experienced the intervention as stressful, it could be perceived as beneficial by these professionals as a continuing education opportunity.

Chapter 5. Results

The results of the studies are presented below, and with references to the three papers. See also Tables 5-8.

Results—Study I

A total of 247 participants responded to the survey (155 from hospital A and 90 from hospital B) and the overall response rate was 40% (Table 2). The results of the PCA showed one component for the total score of the CSACD-T questionnaire with an eigenvalue of 6.154 on one component, which explained 68% of the variance in the questionnaire, and with an eigenvalue of about 1.0 on the other components. The inter-item correlations ranged from 0.45 to 0.81 and all correlations were significant (<0.001). The KMO values were 0.93 for the total questionnaire. The Cronbach's alpha value of the questionnaire was 0.94 (range: 0.93–0.94) and was not improved when each item was removed (paper 1).

The results of healthcare professionals' collaboration and satisfaction with team decision-making across hospital units showed a total mean score of 5.14 (0.95) (range 1–7). The scores varied by unit type, with the highest score obtained for the maternity ward group, 5.66 (0.88), followed by the medical–surgical wards, 5.20 (0.91). Single-item mean scores for the total sample ranged from 4.17 ("Coordination of decision-making among team members") to 5.40 ("Shared responsibilities for decision-making"). There were significant differences in the total mean scores between the maternity ward and Emergency Room, with the latter having the lowest total mean score: 4.69 (1.06). The added item "patient participation in decision-making" had a mean score of 4.63 in the total sample, and there was a statistically significant difference between the unit groups ($\chi 2$ (4) = 11.77, p = 0.001), with the highest score obtained for maternity ward (5.18) and the lowest score obtained for Emergency Room (3.57). Table 5 presents an overview of the CSACD-T mean scores (paper 1).

Short version of the items of CSACD-T[1]	Total sample	Med./Surg.[3]	Maternity[4]	OR[5]/AN[6]	ICU[7]	ER[8]
	n = 245	n = 160	n = 24	n =16	n = 21	n = 24
	Mean (SD[2])	Mean (SD[2])	Mean (SD[2])	Mean (SD[2])	Mean (SD[2])	Mean (SD[2])
	5.14 (0.95)	5.20 (0.91)	5.66 (0.88)	4.84 (0.94)	4.89 (0.94)	4.69 1.06
1 Plan together in decision-making	5.35 (1.13)	5.41 (1.09)	5.82 (1.01)	4.75 (1.18)	5.14 (1.11)	5.04 (1.33)
2 Open communication in decision-making	5.32 (1.14)	5.38 (1.14)	6.00 (0.98)	4.94 (0.10)	4.81 (1.12)	5.00 (1.14)
3 Shared responsibilities for decision-making	5.40 (1.30)	5.51 (1.12)	5.55 (1.37)	5.31 (1.45)	5.24 (1.58)	4.75 (1.42)
4 Team members cooperate in decision-making	5.29 (1.11)	5.34 (1.07)	5.82 (0.91)	5.13 (1.15)	5.19 (1.03)	4.63 (1.28)
5 All team members' concerns in decision-making	4.87 (1.26)	4.96 (1.21)	5.36 (1.09)	4.38 (1.15)	4.62 (1.32)	4.33 (1.55)
6 Coordination in decision-making	4.82 (1.24)	4.85 (1.20)	5.64 (1.14)	4.50 (1.10)	4.76 (1.14)	4.17 (1.34)
7 Level of collaboration in decision-making	5.07 (1.11)	5.13 (1.04)	5.68 (1.09)	4.88 (1.09)	4.81 (0.98)	4.42 (1.38)
8 How satisfied with the decision-making process	4.93 (1.11)	5.00 (1.08)	5.45 (1.01)	4.56 (1.46)	4.43 (1.08)	4.70 (1.02)
9 How satisfied with the decisions	5.26 (0.96)	5.27 (0.94)	5.64 (1.09)	5.13 (0.96)	5.00 (1.10)	5.22 (0.99)
Patient participation in decision-making[9]	4.63 (1.25)	4.81 (1.19)	5.18 (0.96)	3.94 (1.24)	4.33 (1.20)	3.57 (1.20)

Table 5. Results of healthcare professionals score on decision-making in teams across diverse hospital units. [1]The Collaboration and Satisfaction About Care Decisions in Teams. [2]Standard deviation [3]Medical/Surgical wards, [4]Maternity Ward, [5]Operation Room, [6]Anesthesia Unit, [7]Intensive Care Unit, [8]Emergency Room, [9]The added item for this study.

Results - Study II

The impact of the intervention was evaluated among healthcare professionals within the intervention ward (hospital C) after 6 and 12 months, in addition to a comparison with a control ward (hospital D) after 12 months. The numbers of healthcare professionals who responded to the surveys within the intervention ward (hospital C) were 35 (81%) at baseline, 32 (76%) after 6 months, and 31 (78%) after 12 months. From the control ward (hospital D), 40 (73%) responded at baseline and 26 (57%) responded after 12 months (Table 2). The results of the healthcare professionals` mean scores that answered at two time points are displayed in Tables 6–8 and reported in the following paragraphs. The answers on research questions 2 and 3 in paper 2 are also reported in this section (not displayed in tables).

Results obtained after 6 months of intervention

When the TeamSTEPPS intervention was evaluated after six months of the study period, the results among the health professionals within the intervention ward showed no changes in any of the teamwork dimensions measured by T-TPQ or CSACD-T (professional outcomes). Regarding patient safety culture (organizational outcomes), significant improvements were observed in two dimensions of HSOPS: “Organizational Learning & Continuous Improvement” and “Communication Openness” (paper 2).

Results obtained after 12 months of intervention

After 12 months of intervention, the results among the health professionals within the intervention ward showed significant changes from baseline, such as significant improvements in three perceptions of teamwork dimensions: “Situation Monitoring,” “Mutual Support,” and “Communication” (professional outcomes) (papers 2 and 3). One significant improved score was found in perceptions of the “Leadership” dimension within the control ward (paper 3). Significant changes from baseline were also observed in the

patient safety culture, such as significant improvements in the three patient safety culture dimensions (organizational outcomes): "Communication Openness," "Teamwork Within Unit," and "Manager's Expectations & Actions Promoting Patient Safety" (papers 2 and 3). No changes were observed in patient safety culture or attitude towards teamwork within the control ward (professional outcome) (paper 3).

To answer the research question whether the impact of the intervention on patient safety culture varied by profession group, the results from the GLMM suggested that physicians had an overall significant positive effect on the intervention compared to nursing staff on "Frequency of Events Reported" and "Patient Safety Grade". The model estimates also indicated that the intervention had a significant effect on "Communication Openness" and "Organizational Learning & Continuous Improvement" after 6 months (paper 2). To answer whether teamwork dimensions were associated with any of the nine unit-based patient safety culture dimensions, the results from the regression analysis showed that the improved perception of "Mutual Support" was a predictor of "Patient Safety Grade" after 12 months of intervention (paper 2).

Results compared to the control ward

Compared to the control ward, no significant differences were found between the two wards in perceptions of teamwork measured by CSACD-T and T-TPQ, except for the "Leadership" dimension of T-TPQ, which differed significantly in favor of the control group. No significant differences were found in any of the attitude towards teamwork dimensions, measured by the T-TAQ. Regarding patient safety culture, the results showed significant differences between the two groups in three measures of HSOPS—"Teamwork Within Unit," "Overall Perceptions of Patient Safety," and "Patient Safety Grade" after the 12-month study period — all in favor of the intervention ward (paper 3).

	Paper 2			Paper 3									
	Intervention ward								Control ward				Difference Between wards after 12 months
	0-6 months. n = 28			0-12 months. n = 25					0-12 months. n = 19				
T-TPQ[5] dimensions	**Baseline Mean (SD[1])**	**6 months Mean (SD[1])**	**p[2]**	**Baseline Mean (SD[1])**	**12 months Mean (SD[1])**	**Mean change (95% CI[2])**	**p[2]**	**ES[3]**	**Baseline Mean (SD[1])**	**12 months Mean (SD[1])**	**p[2]**	**ES[3]**	**p[4]**
Team Structure	3.93 (.40)	3.96 (.44)	.638	3.95 (.43)	4.08 (.44)	.13 (-.03, .30)	.100	.30	4.03 (.56)	4.03 (.34)	.98	.00	.334
Leadership	4.24 (.40)	4.21 (.49)	.700	4.16 (.39)	4.15 (.63)	-.01 (-.20, .18)	.926	-.03	3.64 (.73)	4.01 (.60)	**.04**	.51	**.039**
Situation Monitoring	3.79 (.47)	3.98 (.56)	.094	3.70 (.43)	4.06 (.54)	.40 (.22, .58)	**.001**	.84	3.97 (.51)	4.13 (.36)	.13	.31	.077
Mutual Support	3.85 (.44)	3.93 (.51)	.382	3.83 (.44)	4.03 (.50)	.21 (.03, .39)	**.027**	.45	3.86 (.52)	4.03 (.45)	.11	.32	.804
Communication	3.84 (.40)	3.94 (.50)	.345	3.81 (.39)	4.02 (.53)	.26 (.06, .47)	**.015**	.54	3.94 (.42)	3.99 (.26)	.58	.12	.119
CSACD-T[6]													
Team decision making	4.73 (.89)	5.02 (1.09)	.207	4.69 (.92)	4.95 (1.03)	.26 (-.15, .66)	*.200*	.28	4.80 (.89)	5.10 (1.16)	.28	.34	.903
T-TAQ[7] dimensions													
Team Structure				3.84 (.32)	3.96 (.46)	.12 (-.05, .29)	.156	.38	3.88 (.41)	3.87 (.55)	.65	-.02	.205
Leadership				4.34 (.36)	4.41 (.55)	.07 (-.15, .29)	.510	.19	4.26 (.49)	4.35 (.64)	.69	.18	.986
Situation Monitoring				4.05 (.44)	4.26 (.51)	.21 (-.04, .46)	.094	.48	4.06 (.33)	4.10 (.43)	.75	.12	.249
Mutual Support				3.94 (.45)	4.05 (.47)	.11 (-.05, .27)	.174	.28	4.04 (.35)	4.08 (.89)	.61	.11	.533
Communication				4.04 (.39)	3.99 (.60)	-.06 (-.30, .19)	.648	-.13	3.91 (.30)	3.99 (.49)	.38	.27	.394

Table 6. Changes to perceptions of teamwork and attitude towards teamwork within the wards, and differences between the wards.[1]Standard Deviation, [2]Paired t-test, [3]Effect Size, [4]General Linear Mixed Model, [5]TeamSTEPPS Teamwork Perception Questionnaire, [6]Collaboration and Satisfaction About Care Decisions in Teams Questionnaire, [7]TeamSTEPPS Teamwork Attitude Questionnaire.

	Paper 2			Paper 3									
	Intervention ward								Control ward				Difference Between wards
	0 - 6 months. n = 28			0 - 12 months. n = 25					0 - 12 months. n = 19				
HSOPS[5] dimensions	Baseline Mean(SD[1])	6 months Mean (SD[1])	p[2]	Baseline Mean (SD[1])	12 months Mean (SD[1])	Mean change (95% CI[2])	p[2]	ES[3]	Baseline Mean(SD[1])	12 months Mean (SD[1])	p[2]	ES[3]	p[4]
Teamwork in Unit	3.87 (.54)	4.08 (.52)	.084	3.78 (.52)	4.06 (.48)	.27 (.04, .51)	**.025**	.54	4.07 (.63)	3.93 (.51)	.24	-.22	**.016**
Communication Open	3.83 (.49)	4.07 (.60)	**.025**	3.81 (.49)	4.02 (.53)	.26 (.05, .47)	**.017**	.43	3.89 (.51)	3.92 (.61)	1.0	.06	.125
Manager Expectations	4.18 (.60)	4.29 (.50)	.370	4.11 (.56)	4.33 (.51)	.28 (.07, .49)	**.012**	.39	3.81 (.62)	3.92 (.59)	.47	.18	.325
Staffing	3.52 (.46)	3.39 (.52)	.292	3.52 (.46)	3.52 (.62)	.01 (−.23, .25)	.955	.00	3.26 (.69)	3.38 (.60)	.44	.14	.554
Organizional Learning	3.82 (.51)	4.05 (.61)	**.001**	3.76 (.51)	3.93 (.61)	.21 (−.03,.45)	.087	.33	3.88 (.57)	3.79 (.58)	.42	-.16	.077
Feedback About Error	3.71 (.62)	3.85 (.70)	.965	3.77 (.59)	3.97 (.46)	.20 (−.02, .42)	.078	.34	3.72 (.62)	3.81 (.62)	.57	.15	.460
Nonpunitive to Errors	2.90 (.69)	3.14 (.83)	.178	4.13 (.49)	4.29 (.60)	.13 (−.15, .42)	.342	.33	4.05 (.71)	4.00 (.35)	.63	-.07	.755
Frequencies of Events Reported[10]	2.88 (.70)	3.13 (.84)	.059	2.86 (.66)	2.96 (.82)	.12 (−.11, .36)	.287	.15	3.13 (.79)	3.37 (.48)	.41	.30	.811
Overall Perception of Patient Safety[10]	3.71 (.62)	3.85 (.70)	.363	3.65 (.58)	3.92 (.57)	.25 (−.02, .52)	.065	.47	3.90 (.51)	3.67 (.66)	.21	-.45	**.030**
Hosp. Man. Support				3.28 (.60)	3.20 (.77)	−.03 (−.29, .24)	.838	-.13	3.14 (.61)	2.78 (.87)	.11	-.59	.195
Handoffs & Transition				3.49 (.45)	3.34 (.57)	−.22 (−.45, .01)	.082	-.33	3.55 (.27)	3.50 (.34)	.23	-.19	.805
Teamwork Acr. Units				3.40 (.53)	3.31 (.54)	−.08 (−.28,.12)	.415	-.17	3.35 (.47)	3.14 (.55)	.11	-.45	.400

Table 7. Changes to the patient safety culture dimensions within the wards and differences between the wards.[1]Standard Deviation, [2]Paired t-test, [3]Effect Size, [4]General Linear Mixed Model, [5]Hospital Survey of Patient Safety Culture Questionnaire, [6]Wilcoxon Signed Rank Test, [10]HSOPS outcome dimension.

	Paper 2			Paper 3						
	Intervention ward						Control ward			
	0 - 6 months. n = 28				0 - 12 months. n = 25		0 - 12 months. n = 19			0-12 months
HSOPS[5] single items	Baseline Mean(SD[2])	6 months Mean (SD[2])	p[3]	Baseline Mean (SD[1])	12 months Mean (SD[1])	p[3]	Baseline Mean (SD[1])	12 months Mean (SD[1])	p[3]	Difference between wards p[4]
Number of Events Reported over the past 12 months[5]	2.11 (.83)	2.00 (.80)	.527	2.24 (.78)	2.15 (.72)	.439	2.42 (1.07)	2.78 (1.22)	.31	.147
Patient Safety Grade[5]	3.67 (.56)	3.79 (.59)	.414	3.67 (.57)	3.92 (.56)	.059	4.00 (.47)	3.71 (.85)	.10	**.012**

Table 8. Changes to the patient safety culture on the two single items of HSOPS within the wards and differences between the wards.[1]Hospital Survey of Patient Safety Culture, [2]Standard Deviation, [3]Wilcoxon Signed Rank Test, [4]General Linear Mixed Model, [5]HSOPS outcome items. Number of Events Reported Scale: 1= No events, 2=one to two events, 3=three to five events, 4=six to 10 events, 5=11 to 20 events, 6=21 events or more. Patient Safety Grade scale: 1=E (Failing), 2= D (Poor), 3=C (Acceptable), 4=B (Very Good), and 5=A (Excellent)

Chapter 6. Discussion

In this section, the main results of the studies will be discussed, reflected on, and compared to those of previous studies. The main result in Study I was that CSACD-T was found to be a psychometrically sound questionnaire in terms of construct validity and reliability. The levels of team decision-making varied among the hospital unit types and were the lowest among healthcare professionals in ER and highest in hospital wards. When exploring the impact of interprofessional teamwork intervention in the surgical ward, in Study II, significant positive changes were found within the intervention ward in three perceptions of teamwork dimensions within the ward, regarded as professional outcomes, in addition to four areas of patient safety culture, regarded as organizational outcomes. Compared to the control ward, three areas of patient safety culture differed significantly in favor of the intervention ward. The results indicate that the intervention impacted the teamwork and patient safety culture in the surgical ward.

Team decision-making across hospital units – Study I

The results of the principle component analysis of the survey data showed that the nine items of the questionnaire formed one component or one dimension. However, as also mentioned in paper 1, although the results of the principal component analysis showed that all nine items formed one dimension, this result needs to be discussed. The concepts of the questionnaire could also be considered as two dimensions, as satisfaction with collaboration in decision-making is an extra dimension of collaboration in decision-making in teams. If the questionnaire had more than two items on the satisfaction part, the analysis might have revealed a two-dimensional questionnaire. In the validation study of the original nurse–physician version of the CSACD questionnaire, the results of the principal component analysis yielded only one dimension for items 1–6 [158].

The Cronbach's alpha that was performed to determine the internal consistency of the questionnaire was above the desirable value of 0.80, both for items 1–6 and items 1–9, which indicates a good reliability of the questionnaire [180]. The alpha value of items 1–9 is in line with a previous study of the original CSACD (nurse–physician version) of the total questionnaire [181]. The alpha value of items 1–6 was higher than that in the validation study of the original nurse–physician version of CSACD [158].

As concluded in paper 1, the results obtained from the psychometric testing demonstrate that the Norwegian version of the CSACD-T questionnaire exhibits promising psychometric properties in terms of construct validity and internal consistency, but the structure validity needs further investigation. Moreover, due to a biased sample composition including few responding phycisians, the results need careful attention, and the conclusions might be interpreted with caution [142].

The further aim of Study I, which was to describe and compare healthcare personnel's perceptions of collaboration and satisfaction with team decision-making across hospital units, showed varying results. The different unit types represented different work systems and had different cultures and ways of working in teams. The highest score was obtained for the healthcare professionals working in the wards, while the lowest score was obtained for those working in specialty units. The absolute lowest score was obtained for healthcare professionals in ER. This might be because teamwork in emergency care is characterized by high complexity and greater uncertainty compared to the care in wards. The decision-making process might be extra challenging in this context [59]. Decision-making in ER has previously been found to be affected by high workload, time constraints, complexity of cases, human factors, and organizational systems [59]. Instead of interprofessional teamwork with mutual interdependence, multiprofessional collaboration, which places greater emphasis on specialized roles and individual tasks than on interdependency, has been found to be the most common working model in ER [182]. This might explain the low score obtained in ER in this study. In addition to the high scores obtained in the maternity ward, the relatively high

scores among healthcare professionals in the medical-surgical wards might be due to a more structured nurse–physician collaboration in the wards [183].

The mean scores obtained in this study for all units were higher than those in most of the previous studies of collaboration and satisfaction about care decisions in nurse–physician teams, measured with the original CSACD, both studies conducted in ICU [184], NICU [185], and in a community healthcare center [186]. Since team decision-making in larger hospital teams that involve multiple healthcare professionals has been less studied, there are few studies to compare these results with. However, a qualitative study of interprofessional team decision-making in a hospital unit showed that considerable observations conducted in the interprofessional team meetings, as well as the jargon being used, were biomedical and mainly fronted by the physicians. The other healthcare professions in the teams fronted their perspectives by asking questions to get their voices heard [187]. In a qualitative study of interprofessional collaboration in surgical ward teams, the findings from the interviewed nurses and physicians were that "organization and culture," "communication," and "trust and respect" influenced the interprofessional collaboration [71]. They reported a blurred distribution of roles and responsibilities with little room for professional discussions and no use of communication tools. Further studies are required to investigate whether healthcare professionals are satisfied with their roles in hospital teams regarding decision-making.

The added item "patient participation in decision-making," which had the lowest score in all groups, is a highly valued component of patient safety [188]. Patients and families often have preferences regarding their own treatment choices [188]. Involving the patients in the decision-making process can contribute to informed preferences, which in turn contribute to better decisions from a patient's viewpoint [189], as well as from a patient safety perspective [58]. Patient participation in decision-making is a comprehensive and important topic that requires a more comprehensive investigation. Therefore, it was not studied further in this thesis.

Organizational and professional outcomes from the TeamSTEPPS intervention - Study II

In this section, the significant changes following 12 months of implementation of TeamSTEPPS are discussed and reflected on, and compared to the results obtained in previous studies. Finally, some of the variables that were not improved, are commented on, and with some reflections on the impact of the intervention seen in light of the work systems perspective and patient safety.

The patient safety culture results are regarded as organizational outcomes in this thesis, and the perceptions of teamwork and attitude towards teamwork results are regarded as professional outcomes. The main results obtained in Study II are the significant changes within the intervention ward on the healthcare professionals' scores in teamwork and patient safety culture, as well as differences between the two study wards, and which are summarized in the following paragraph.

After 6 months of the TeamSTEPPS intervention, the following two patient safety culture dimensions of HSOPSC improved significantly within the intervention ward, which were the "Organizational Learning—Continuous Improvement", and "Communication Openness." After 12 months, significant improvement was observed in three patient safety culture dimensions of HSOPS, the "Managers' Expectations & Actions Promoting Patient Safety", "Communication Openness", and "Teamwork Within Unit". Furthermore, differences in favor of the intervention ward were found in three patient safety culture (HSOPS) measures (organizational outcome): the **"**Teamwork within Unit," "Overall Perception of Patient Safety," and "Patient Safety Grade", the two latter regarded as outcome measures in HSOPS. After 12 months of intervention, three perceptions of teamwork dimensions (T-TPQ) improved, "Communication," "Situation Monitoring," and "Mutual Support" (professional outcomes).

Impact on the patient safety culture in the surgical ward

In the control ward, during the study period, it was "business as usual," and there was no improvement in the patient safety culture. The significant differences in favor of the intervention ward on three patient safety culture measures, "Teamwork Within Unit," "Overall Perception of Patient Safety," and "Patient Safety Grade," indicate that the 12-months TeamSTEPPS intervention impacted the patient safety culture in this surgical ward, as interpreted by the SEIPS model with the causation of work system, process and outcome.

These outcomes from the controlled part of the study are in line with, or slightly better than, previous controlled TeamSTEPPS studies with an interprofessional approach. In the study of Spiva et al. [113] conducted in orthopedic and neurological wards, none of the HSOPS measures differed between groups after nine months. In a more recent study, conducted in a maternity ward, positive difference in favor of the intervention ward was found on one HSOPS dimension after one year: the "Supervisor/Manager Expectations and Actions Promoting Safety» Staines et al. [190]. A TeamSTEPPS study from multiple healthcare facilities, found significantly higher positive scores in three dimensions of HSOPS in the intervention units compared to the controls after one year: "Organizational Learning & Continuous Improvement," "Teamwork Within Unit," and "Teamwork Across Units" Jones et al. [111]. However, significant differences in favor of the intervention ward on the two outcome variables of HSOPS as in this thesis, have not been found in any of the previous controlled studies.

An interesting finding within the intervention ward, was that the physician group had a higher impact on the intervention on **"Patient Safety Grade,"** Some claims that physicians are the professionals with the highest influence on sustainment effects [110]. It is often challenging to get physicians involved in interprofessional interventions with nurses and other healthcare professionals [191]. In this intervention, the head surgeon was a member of the change team, together with other physicians, nurses and nursing

assistants. However, although this was a significant association in the model, there were with few physicians in the sample, so more studies are needed to confirm this result. The model also indicated that the physician group had a higher impact on the intervention on "**Frequency of Events Reported,**" compared to the nursing staff. The number of registered adverse events in the intervention ward increased from 38 in the year before the intervention (2015), to 52 in 2017, which can be explained by an improved error reporting culture. However, this registered adverse events data was not from the physicians only, but from all healthcare professionals in the ward.

Regarding the within unit (pre post) results, the improvements after 6 months in two patient safety culture dimensions, **"Organizational Learning & Continuous Improvement" and "Communication Openness,"** are few, but promising results. However, one can reflect on whether there were not more improvements after 6 months. It takes time to change culture, and therefore, the impact of the intervention was also measured after 12 months.

Regarding the patient safety culture outcomes after 12 months, improvement in **"Teamwork Within Unit",** was the one patient safety variable that both changed within the intervention ward, and the change also differed positively when compared to the control ward. Improvement in "Teamwork Within Unit" indicates that the intervention positively impacted the teamwork in the ward, which might be significant for patient care. Positive outcomes in this dimension has shown associations with positive patient outcome data, such as lower patient fall rates, lower adverse event rates, and lower surgical site infection rates [192]. Wong et al. [114], who conducted interprofessional TeamSTEPPS training in ER, found improvement on this dimension in addition to improved "Handoffs and Transitions" and "Frequency of Event Reporting" after one year. Thomas et al. [110], who implemented TeamSTEPPS in a large hospital system, found significant changes in "Teamwork Within Unit" after two years, but not after one year.

"Communication Openness," which was improved after both 6 and 12 months, is a teamwork dimension that is crucial to patient safety and also

measure of psychological safety [164). Psychological safety concerns speaking up freely and questioning team members higher in the hierarchy when seeing something that might negatively affect patient safety {Edmondson, 1999 #2678]. "Communication Openness" was the only dimension that was improved over time within the intervention ward in the study , and indicates a change that was captured early, and with a sustainment effect. The initial team training, which focused on patient safety and errors, aimed to create a sense of urgency and an understanding of the importance of speaking up. The joint training for both nurse and physician professions might have contributed to building down the hierarchy within and between profession groups and thereby contributing to this improvement. In a qualitative study from the same intervention, "Communication Openness" and learning from errors were the areas of patient safety culture that were reported as an experienced impact of the TeamSTEPPS program [193]. Improvement in this dimension, can have clinical significance for the patient safety, as for example speaking up when seeing something that can threaten the patient safety. "Communication Openness" also refers to feeling safe to report errors and adverse events, which is important for developing a patient safety culture [194]. The study of [113] from orthopedic and neurology wards found improvement in the "Communication Openness" dimension after nine months, in addition to improved "Feedback and Communication About Error," "Teamwork Within Hospital Units," and "Teamwork Across Hospital Units."

In addition to improvement in "Teamwork Within Unit" within the intervention ward and the continued improvement in "Communication Openness," the **"Manager Expectations & Actions Promoting Patient Safety"** that was also improved after 12 months, was the HSOPS measure with the highest score during the study period. The fact that the nurse unit manager and the chief surgeon led the implementation and were members of the change team together with multiple physicians, nurses and nursing assistants, might have contributed to that outcome [195, 196]. Improvement in this dimension has also been found in previous studies: one study found the improvement after one year [190] and another study after two years [110]. In addition to improvement in "Manager Expectations & Actions Promoting

Patient Safety," Staines et al. [190] found improved scores on "Teamwork Within Units" and "Nonpunitive Response to Errors" after one year.

Although the causal effect is not certain, these positive changes in two areas of patient safety culture after 6 months and in three areas of patient safety culture after 12 months, and difference in one more measure between the wards, indicate that the teamwork intervention in the work system has had an impact on the healthcare professionals' team performance in the clinical work processes and has influenced the organizational outcomes - when interpreted by the SEIPS model [197]. The 12-month improvements in three areas of patient safety culture *within* the intervention ward in this study are in line with what others have found after implementing TeamSTEPPS in hospital units. In a study conducted in the context of Emergency Room [114], and a TeamSTEPPS implementation in a large hospital system [110] found improvement in three HSOPS dimensions. Two studies, one conducted in orthopedic and neurology wards [113] and one conducted in a maternity ward, found improvement in four HSOPS dimensions after TeamSTEPPS implementation [190]. A recent review of team training studies (not just TeamSTEPPS) conducted in hospital units, found improved patient safety culture in only 3 out of the 20 included studies [92]. In this study, six out of the nine unit-based HSOPS measures changed or differed significantly (at different time points) during the 12-month study period, which is promising for the patient safety culture in this ward, and which, in time, can positively impact the patients by contributing to that the patients experiencing fewer errors in the future.

Impact on the teamwork in the surgical ward

There were no differences between the intervention ward and control ward in perceptions of teamwork (T-TPQ) or attitude towards teamwork (T-TAQ), except for the difference in the "Leadership" dimension which improved in the control ward, after 12 months of study period. The difference in "Leadership" score, might be attributable to a shift leadership positions during the study period, or other secular factors [198].

The three significant improved teamwork dimensions of T-TPQ within the intervention ward represent three of the four teamwork competencies in the TeamSTEPPS program, which are valuable outcomes. In other studies, perceptions of teamwork have been found to be predictors of both patient outcomes and organizational outcomes [74].

The T-TPQ dimension which changed the most during the study period, was the "**Situation Monitoring,**" and which might be attributable to the intervention ward's focus on situation monitoring and situational awareness during the study period. A qualitative interview study from the same intervention, reported that the nurses experienced improved competency in situational awareness and had become more vigilant about medication administration, following the TeamSTEPPS intervention [199]. Only one of the previous quantitative interprofessional TeamSTEPPS studies found improvement in "Situational Monitoring" which was in a study from a perinatal context, when measuring among nurses only, three months after team training [191]. In this study, the "Situational Monitoring" tools, "cross monitoring" and "STEP", were implemented in the work system during the study period. As interpreted by the SEIPS model, the team training and the teamwork tool implementation in clinical practice, might have interacted with other elements and components in the work system, such as leadership support and other unknown factors, and influenced the performance, and thereby resulting in this outcome. The "Situational Monitoring" was the one improved teamwork dimension with a large ES, and which strengthens the practical significance of this outcome [145].

The improved perceptions of "**Communication**" in the intervention ward after 12 months and with a medium ES, might be attributable to the implementation of the two communication tools "closed loop" and "ISBAR," which were considerably focused on in the training and the simulation scenarios. These two tools were the first ones implemented in the surgical ward post training. The ISBAR tool for structured communication of critical information, has been recommended in the healthcare systems in the last decade; however, it is still not in common use in many hospital units [200].

Previous studies of interprofessional TeamSTEPPS training have showed ambiguous results on the "Communication" dimension of teamwork. Some found improvements three months after training [191, 201], while Kim [119] found no improvement, the latter was a study where they implemented only parts of the TeamSTEPPS program. Scotten et al. [202] found improved "Communication" after 12 months, as in this study.

The positive change in the "**Mutual Support,**" with a medium ES, can also be seen as an impact of the intervention in this study, due to the implementation of "task assistance" and the "two-challenge rule". The "two-challenge rule" is crucial to patient safety when the situation requires its use [45], and together with "Task assistance" these two strategies forms the two most significant patient safety strategies in TeamSTEPPS. None of the previous detected studies that measured teamwork outcome by T-TPQ, found improvement in "Mutual Support". In the traditional CRM training concept (e. g. in anesthetists' non-technical skills system) [44], "Mutual support" is not included as a team competency or a non-technical skill. Because of the theoretical foundation of the TeamSTEPPS program, "Mutual Support" is one of the four team competencies, and which is the team competency with most teamwork tools and strategies - all focusing on patient safety [45].

Many of the above mentioned previous studies are studies with a pre post design, and quality improvement studies. Although these studies have an implementation phase included, few studies have a broad description of the implementation phase. Most of the studies did not report which teamwork tool and strategies that were implemented in clinical practice, except [191, 202, 203]. The study having maximum similarity with the present study is that conducted in a medical-surgical ward context by [113]. These authors reported a decrease in teamwork perceptions after two and nine months. However, this might be due to an unfortunate oversight of not having reversed the items in T-TPQ, as their mean scores were very low (2.35 at baseline and 1.66 post) (the T-TPQ scale is opposite to the T-TAQ scale) [160]. However, they found improved attitudes toward teamwork and improvements in patient fall rates, following TeamSTEPPS.

Only one of the previous interprofessional TeamSTEPPS studies found improvements in three perceptions of T-TPQ teamwork dimensions, as in this study. That was from an interprofessional TeamSTEPPS study conducted in a perinatal context, which found improvements in "Team Structure," "Communication," and "Situational Awareness" after three months, however, they measured the impact among nurses only [191]. A study conducted in a pediatric context found improvement in two dimensions of T-TPQ: "Team Structure" and "Communication," in addition to improved ratings in shared decision-making after 12 months [202].

"Team structure," which is defined as organizational structures, roles, and resources and described as a multiteam model in TeamSTEPPS [45], was not improved in this study. This might be because of the lack of significant structural changes caused by the intervention. Changing structures, systems, and routines, are, according to step 5 in the Kotter model, important steps to be followed to facilitate the desired changes. Step 5 is also about to empower people to act on the set vision and aims and to remove obstacles and barriers, and is a step in which the ward's leaders play the most important roles [131]. In this study, this step was less followed. Except for changes in some teamwork routines (such as interprofessional daily huddles), the organizing of the nurse staff and physicians remained the same in this ward—in silos. The two professional groups had separate leaders, separate grand rounds, separate morning meetings and shift reports. Hierarchical structures and professional cultures can act as barriers to change, rooted in the work system elements [204]. Team training programs are not always enough; well-trained frontline staff do not necessarily achieve long-term patient safety results without systemic organizational changes [205]. Hierarchy and silos can be seen as latent failures in the work system. The organization's top management and leadership are responsible to initiate changes that can mitigate latent failures to prevent errors and improve the patient safety culture. A desire for closer interprofessional teamwork in surgical wards has been reported by both nurses and physicians, claiming that interprofessional teamwork is being obstructed by organizational structures [71]. The only detected study that found improvement in the perception of "Team Structure" was that

conducted by Scotten et al. [202]. They combined TeamSTEPPS with the implementation of an interprofessional care model and whose intervention design implied structural changes in the unit. To improve "Team structure", the optimal team training intervention might be a combination of interventions and with adaptation to fit local clinical settings [183], such as implementation of selected TeamSTEPPS tools and strategies focusing on specific patient safety issues, as e.g. medication administration, patient falls, or interprofessional team decision making related to discharge.

The lack of improvement in perceptions of **team decision-making** in this study, might be attributable to the lack of focus on team decision-making in the TeamSTEPPS program. Maxson et al. [206] found improved decision-making in nurse–physician teams when measured two weeks and two months after the TeamSTEPPS simulation training. In a study conducted in a pediatric unit, they found improved ratings of shared decision-making after 12 months [202]. This result might be due to the interprofessional care model they implemented in the period, in combination with the implementation of the three TeamSTEPPS tools they implemented in the study period. Implementation of 10 teamwork tools over 12 months, as in the study in this thesis, might be considered as too many. Maybe it would be more effective to have a 2-year plan when implementing TeamSTEPPS in clinical practice. This is a reflection that can be followed up and tested in a future study.

Although attitude is one of the three components in team competencies: Knowledge, Skills and Attitudes (KSA) or ABC of teamwork (Attitudes, Behaviors, and Cognitions), no significant changes were found in any of the **attitude towards teamwork** dimensions in this study. The attitude towards "Situational Awareness" measured by T-TAQ, showed, however, a medium ES, and might be of clinical importance. New knowledge about the multi-team system, might have contributed to this non-significant change but with the medium ES. However, the lack of significant changes in attitude towards teamwork in this study, aligns with the findings obtained from studies conducted on other types of team training [84]. Regarding previous TeamSTEPPS studies, improved attitude toward teamwork has been found

mainly in studies that performed the measurement immediately after the training, as in a maternity ward (improvement in three dimensions of T-TAQ) [114] and in a neonatal resuscitation simulation training (improvement in all five dimensions of T-TAQ) [207]. Improved scores immediately after training might be attributable to a training reaction effect, such as excitement and satisfaction. However, some studies found improved attitudes after longer periods, which were in studies that combined TeamSTEPPS with clinical care issues. Spiva et al. [113] found improved attitudes toward teamwork in three dimensions of T-TAQ after nine months in a TeamSTEPPS intervention with a special focus on attitudes and communication on patient falls. In a study conducted in a pediatric unit, where TeamSTEPPS was combined with a special focus on transitional care, improvement were found in three dimensions of T-TAQ after 6 and 12 months [202].

Some further reflections on the intervention study

Although the teamwork tools were implemented in a stepwise manner over time in the surgical ward, it is not certain whether the healthcare professionals actually utilized the knowledge and tools that they learned during team training, since the teamwork performance was not directly observed in this study. However, qualitative studies conducted from the same intervention, the healthcare professionals reported that they used the implemented teamwork tools in the daily practice, and that they experienced improved teamwork and patient safety [199]. Although these data were obtained only from a few persons and cannot be generalized to all healthcare professionals in the ward, qualitative data are important and can complement the quantitative results from the study in this thesis [142].

An improvement in teamwork in the ward`s work process might have contributed to the improvement in outcomes, as demonstrated by improvement in both professional and organizational outcomes. The outcome from the controlled part of the study, supports the conclusion that the outcomes were due to the intervention. In the mixed model in paper 2, the perception of “Situation Monitoring” was shown to be a predictor of the

"Patient Safety Grade" after 12 months of TeamSTEPPS implementation in the surgical ward, which supports that the improvement in teamwork might have contributed to improved patient safety culture.

The outcomes of Study II are in line with, or slightly better than, the results from previous TeamSTEPPS studies conducted in other or similar contexts. The changes demonstrated by the professional and organizational outcomes in this study can, in the long run, be of clinical significance for patients and for patient outcomes. The changes can be seen as the beginning of a positive trend that can continue to be further developed in this surgical ward. According to Vincent et al. [208], it takes up to 5 or 10 years to change a safety culture, which agrees with Kotter [125], who stated that it might take 3 to 10 years for organizational changes to be deeply integrated into a culture. This requires that the leadership continues with the change work focusing on patient safety—without letting up.

The human factors theoretical perspective in this thesis and the use of the SEIPS model to understand and reflect on the intervention and outcomes, was found useful. It strengthened the understanding of the intervention and mechanisms in the work system that influenced the process and the outcomes. Systems models are widely used frameworks for patient safety research in health care [209], and SEIPS has been used in studies from different areas of health care with success, but not many studies have targeted more than one component or element in the SEIPS work system [137]. In this study, the Organizational component (teamwork, team training, patient safety culture), the Person component (healthcare professionals, teams, healthcare professionals' team competencies), and the Tools and Technology component (teamwork tools) were included in the study, in addition to the professional and organizational outcomes. Although it was only the outcomes that were measured, the use of the SEIPS model gave a valuable systems perspective to the study in the thesis.

Although SEIPS has been used in studies from different areas of health care with success, the model has also been criticized under the following claim: the

configural diagram is only one-dimensional, while the real-world work system is three-dimensional; therefore, the complexity of today's healthcare systems cannot be depicted in a configurational two-dimensional model [16]. In 2021, SEIPS 10.0 was released, which is a simplified version of the sociotechnical system in SEIPS 2.0, and is just a practical sketch of the most essential components in SEIPS [210]. However, the model is just a model, with the intention of simplifying reality to better understand basic human factors and system mechanisms in research and in change work.

In a work system with latent failures, organizational inputs, such as systematic team training, might close holes in the cheese layers in the surgical ward [14]. Healthcare professionals` team competencies, and the use of communication tools can act as barriers to errors, and prevent the holes in the cheese layers from aligning. When teams are trained in TeamSTEPPS, it might impact direct patient care and patient safety in the work process. For example, if one team member is about to commit an error at the sharp end, another team member who has competency in situation monitoring, can use the "cross-monitoring" strategy. When the alert team member feels psychologically safe, he or she will speak up and, thereby, prevent an error from happening. If not heard at first, the team member can use the "two-challenge rule," which is an effective safety strategy when needed [211]. That is how the TeamSTEPPS program can have a significant impact on hospital units and health care professionals, and most of all, on patients.

Improved teamwork and patient safety culture following team training and implementation in clinical practice - is a human factors approach to patient safety.

Methodological reflections

In this section, methodological reflections on the studies' validity and reliability, as well as strengths and limitations, are discussed.

Study I

Validity

In the translation and cross-cultural validation of a research questionnaire, conceptual and semantic equivalence validity is important [144]. To ensure the semantic equivalence of the Norwegian CSACD-T, a rigorous forward–backward translation process was conducted with the help of a professional translator agency and an expert group [144, 212]. However, the expert group comprised nurses only and no physicians, which can be seen as a limitation.

An upfront assessment of whether the construct had meaning and relevance for healthcare professionals in Norway was performed by the expert group. In addition, a pilot test of the questionnaire was conducted, where the questionnaire was assessed at the item level. The respondents were asked if the statements in the questionnaire were precise, well-articulated, and understandable, and if they were formulated as relevant for their own profession in direct patient care as part of interprofessional teams. Overall, the results obtained from the pilot study showed that the questionnaire measured what it was intended to measure, in a Norwegian sample as well, and the construct and conceptual equivalence was good. The CSACD-T questionnaire was psychometrically tested for the first time; therefore, a principal component analysis (PSA) was applied to test the factor structure of the questionnaire [142, 171]. Although the PCA results were interpreted as promising in terms of the structural validity of the questionnaire, this needs further studies to confirm.

A re-test of the questionnaire in the same situation and population to test for stability over time is recommended as part of the psychometric testing of the

questionnaire [213]. However, a re-test was not conducted in this study, which can be considered a limitation [142].

Another limitation of Study I is related to the distribution of responses. The overall response rate was low (39%), especially among physicians (11%). This is a common problem in research on healthcare professionals [214]. The group of healthcare professionals from the different hospital units varied in size. The four units that were merged into one medical/surgical ward group comprised 164 persons, and the other unit groups comprised 16 to 24 persons. Only healthcare professionals from medical wards participated in hospital B, and the differences between the two hospitals were not analyzed to validate the confounding differences between the hospitals.

Reliability

The value of Cronbach's alpha, which tests the internal consistency of the questionnaire, indicated a high reliability of the questionnaire, both for items 1–6 and items 1–9 [180], and was higher than that in the previous studies of the original nurse–physician version of the questionnaire [158, 181]. In contrast, as also discussed in paper 1, the alpha value might have been too high in this study. An alpha value that is ≥0.90 is attributable to the fact that some items might be redundant, meaning that some of the items ask the same thing, just in other ways [213]. Further studies are required to explore this.

Study II

The design and conduction of Study II (papers 2 and 3) have strengths, but also limitations that are important to be aware of when interpretating the outcomes and concluding on the validity and reliability of the study. Study II was published in two papers, with differences in design, sampling, questionnaires, and variables used, as discussed and reflected on in the following paragraphs.

Validity

The pre-post design might not be optimal in terms of internal and external validity; a pre-post design for a complex intervention study in clinical practice can nevertheless provide valuable results [145] (paper 2). The controlled design in paper 3 is a stronger design, and the improvements found in the intervention ward were not found in the control group. Although not a randomized design, this strengthens the conclusions of the impact of the intervention (paper 3). A quasi-experimental design can yield valuable results, especially for a TeamSTEPPS team-training study conducted in a context with few previous studies, with few of them being controlled studies. The strengths of the study in paper 3 are the 12-month study period and the control group, and the strengths of the study in paper 2 are the 12-month study period and the two post-measuring time points. However, possible biases that can be a threat to the validity of the study need to be discussed and reflected on.

The method of convenience sampling of the two study wards in papers 2 and 3 might be a selection bias and a limitation in this study. First, a power analysis was not performed due to the selection of a single intervention ward. In hindsight, a power analysis for, for example, a paired t-test analysis, given the total sample size of a minimum number of participants that would allow the detection of a large ES at an alpha of 0.05 and power of 0.80, would have been preferable [215]. One possible option would have been to include more than one intervention ward in the study, but limitations due to time and practical considerations made that option difficult (papers 2 and 3).

The controlled part of Study II (paper 3) had bias risks due to the sampling methods. The study wards were not selected randomly, which is a limitation. One way to randomize the study units is having two wards, flipping a coin, and deciding which ward has the intervention, but this was not feasible in this study. However, in the selection of the control ward, matching criteria were used to strengthen the comparability of the control group. The control ward was selected from another area of the country to avoid the contamination effect, which can be seen as a strength [142]. However, including a control ward from another part of the country might also be disputed. In controlled

studies, there is always a bias risk for what is happening in the control group that can impact the outcomes. Although it was "no dosing" in the control ward, other activities and interventions might have occurred during the same period. However, the site assessment data, which were collected from both groups at the baseline and after 6 and 12 months, showed that there were no other teamwork and patient safety activities in any of the wards during the study period, except for the National Patient Safety program "In Safe Hands" conducted in Norway [216], which could have influenced the patient safety culture outcomes. However, the same program was used at both hospitals (both wards) and, therefore, not considered a significant bias risk. Although a thorough site assessment was conducted at both sites, not all local attributes of a ward can be measured. The possible differences in the culture, organization, and leadership style might have indirectly biased the comparability between the wards. However, the GLMM analysis, which adjusted the differences in baseline data and the subject effect, might have contributed to limiting this bias risk (paper 3).

Regarding the organizational outcome measure in the study (HSOPS), it has been argued that the use of self-reported outcomes alone in patient safety research, should be interpreted with caution, because they are based on the hypothesis that they positively impact patient safety—which is not evidenced without hard patient safety data, as error rates and other patient outcomes [217]. However, the use of such data requires a longer study period and a larger study scale and, and was therefore, not included in the study in this thesis. Nevertheless, self-reported outcomes, as attitudes and perceptions, are well-recognized measurements, and although prone to bias, it is recommended to facilitate the development of cumulative knowledge about teamwork to discriminate different levels of teamwork and, thus, recognize improvement [218, 219] (papers 2 and 3).

Regarding the validity of statistical conclusion in Study II, appropriate statistical tests and models were used in the study. However, due to the design of the study and the sample sizes, the statistical conclusions have some limitations.

Since the assumptions for a parametric test were violated, a non-parametric test (Mann Whitney U test) was conducted to assess the differences in mean scores between the two groups at baseline (paper 3). Although this was an appropriate test for use in this situation, a non-parametric test has less power than a parametric test; therefore, a parametric test is recommended for dimension data if the assumptions are fulfilled [173].

Due to samples from the same subjects, a t-test was performed on the within-group analysis of the dimension data, which can be seen as a strength. Although the data representing the scores from the healthcare professionals were analyzed and presented at the group level, the data were linked at the individual level, facilitating a comparison of the baseline data of each person with follow-up measures to assess the impact of the training, and which is a strength (papers 2 and 3). In addition, ES was reported on the changes, where the three improved teamwork dimensions had medium to large ES, and which strengthens the practical significance of the outcomes [145] (paper 3).

A threat to the validity of the study results, was that, in addition to the small samples, the number of outcome variables was high (17 variables in paper 2 and 25 variables in paper 3). Although multiple variables are recommended in complex intervention studies [145], too many variables on such small samples can, however, stretch the limits for the statistical analysis used, resulting in a threat to the validity of the study results. When multiple tests (many dependent variables) are run on the same sample, there is a known risk of Type 1 error, which is the rejection of a true 0-hypothesis and, thereby, a risk of obtaining "false-positive" conclusions [142]. Therefore, the significant improvements in teamwork and patient safety culture in this study might be interpreted with caution. Reducing the risk of rejecting a true 0-hypothesis could have been achieved by adjusting the significance level [142] (papers 2 and 3). However, if the significance level is adjusted, the risk for Type II error increases, which indicates a higher risk of accepting a false 0-hypothesis. Nonetheless, all variables used in the study are dimensions (composites), except the two single variables of HSOPSC, which can be considered a strength.

The multiple variables on small samples is also a problem when using GLMM. Although there is no exact rule for a maximum number of independent variables to be included in a GLMM based on the sample size of a study, a maximum of three dependent variables for a sample size of 100 is often recommended [176]. In this study, 14 variables in a model for a sample size of 44 were run, which might have stretched the data excessively, and the significant differences between wards should potentially be interpreted with caution (paper 3).

Another validity threat related to the use of the GLMM, is that if there are too many variations in the samples, there might be a risk of overfitting the model; that is, the model is too complicated for the specific dataset. In an overfitted model, the regression model fit the quirks and special variations in that specific sample and there might not be a real relationship between the predictor and the response variable [176]. The fit of the model was not validated in this study, which can be considered a limitation (paper 3).

In summary, because of the bias risks described above, especially the risk of Type I error due to multiple tests on the same samples, might the conclusions on the internal validity be drawn with caution [155]. However, most of the results obtained from previous studies, although in different contexts, are in accordance with those obtained in the study in this thesis [220]. Moreover, there are few interprofessional team-training studies with implementation phase in the surgical ward context, and few controlled studies; thus, the results obtained from this 12-month theory-based complex intervention study in clinical practice might have yielded valuable results.

Reliability

To avoid the measurement bias caused by the choice of data collection tools, all questionnaires used were tested for psychometric properties and found to be valid and reliable, which can be seen as a strength [154, 158, 161, 163]. The HSOPS questionnaire, which was used to measure the impact of the intervention on the patient safety culture outcome, is a well-recognized instrument for measuring patient safety culture in hospitals [192, 221, 222].

This instrument has a multidimensional approach that provides specificity and is recommended as a useful tool to guide patient safety improvement interventions [26]. It has been widely used in previous studies [192, 221, 222], including studies in Norway [223], and is the most commonly used measure of patient safety culture worldwide [192]. Two of the teamwork questionnaires used to measure the impact of the intervention on teamwork (T-TPQ and T-TAQ) [154, 161] reflect teamwork competencies in the TeamSTEPPS program, which is also considered a strength (papers 2 and 3).

Concluding remarks

Conclusion

This thesis contributes to increasing the knowledge base of teamwork science in healthcare, knowledge about interprofessional teamwork in diverse hospital units, and the impact of a team-training intervention in a surgical ward on teamwork and patient safety.

In Study I, the CSACD-T questionnaire was found to be valid and reliable for measuring team decision-making in hospital teams. The results showed that the healthcare professionals' perceptions of team decision-making varied across the diverse hospital units. Since decision-making is an important aspect of patient safety, this study makes an important contribution to address this problem, which has been scarcely studied previously.

The findings in Study II suggest that the TeamSTEPPS training and the implementation of the TeamSTEPPS program positively impacted teamwork and patient safety culture in the surgical ward. Most of the positive changes were found 12 months after the implementation. The outcome of this study can provide motivation for other hospitals to implement TeamSTEPPS in surgical wards and in other healthcare units.

This acquired knowledge can guide hospital leaders when planning for and initiating change efforts targeting teamwork to improve patient safety in hospital units. Using a human factors engineering system approach and Kotter's change model to engage physicians, nursing staff, and leaders from all levels in the organization can improve interprofessional teamwork and patient safety culture within surgical wards.

Implications for practice

The results of these studies can be used by healthcare professionals and hospital leaders to improve patient safety in clinical practice. The following are recommended:

- To measure interprofessional teamwork in hospital units that aim to improve team decision-making regarding patient safety, the Norwegian version of CSACD-T, is recommended for use in clinical practice improvement interventions.
- To improve interprofessional teamwork and patient safety culture, TeamSTEPPS can be used in surgical wards and other healthcare contexts in Norway. The findings are important to hospital leaders and managers who are planning similar interventions in hospital units or throughout a hospital.
- Using a systems-based human factors engineering approach when conducting teamwork and patient safety interventions in organizational units can be useful for leaders of hospital units when planning and conducting change activities.
- To achieve changes, an implementation method is recommended, and the Kotter eight-step model was found useful in this study, which can be recommended in future teamwork and patient safety improvement projects.

Future studies

Based on the researchers' experiences while conducting these studies, the following are recommended for future studies.

- Additional studies are required to confirm the results of the psychometric testing of the CSACD-T questionnaire.
- Patients and families are members of a team, and their participation in decision-making is an important patient safety dimension that is worth addressing in future studies.

- The observation of interprofessional teamwork and the actual use of teamwork tools and strategies would be interesting in future studies.
- Team-training program interventions in the surgical area that target the entire surgical pathway to improve the quality of care and patient safety at all stages of the patient's journey would be an interesting research problem to be addressed in the future.
- It would be interesting to investigate more outcomes of the SEIPS model, such as job satisfaction, adverse events, patient satisfaction, and other patient outcomes, as well as their interrelatedness in future studies.
- Future studies that examine how organization-level elements affect individual and team elements in a work system regarding patient safety would be of interest.
- To sustain the changes over time, structural changes are recommended, such as replacing silo organization with shared organizational structures and shared leadership across diverse professions in organizational units, and which could be an important research problem to be addressed in the future.

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Part 2

The papers

List of papers

Paper 1

Oddveig Reiersdal Aaberg, Marie Louise Hall-Lord, Sissel Iren Eikeland Husebø, Randi Ballangrud. Collaboration and Satisfaction About Care Decisions in Team questionnaire - Psychometric testing of the Norwegian version, and hospital healthcare personnel perceptions across hospital units. ***Nursing Open***. 2019. 6(2): p. 642-650.

Paper 2

Oddveig Reiersdal Aaberg, Marie Louise Hall-Lord, Sissel Iren Eikeland Husebø, Randi Ballangrud. A Human Factors Intervention in Hospital - Evaluating Outcome of a TeamSTEPPS Program in a Surgical Ward. ***BMC Health Service Research.*** 2021. 21(114): p. 1-13.

Paper 3

Oddveig Reiersdal Aaberg, Randi Ballangrud, Sissel Iren Eikeland Husebø, Marie Louise Hall-Lord. An interprofessional team training intervention with an implementation phase in a surgical ward: A controlled quasi-experimental study**.** ***Journal of Interprofessional Care***. 2019: p. 1-10.

Paper 1

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RESEARCH ARTICLE

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Collaboration and Satisfaction About Care Decisions in Team questionnaire—Psychometric testing of the Norwegian version, and hospital healthcare personnel perceptions across hospital units

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Abstract

Aim: To translate "The Collaboration and Satisfaction About Care Decisions in Team" questionnaire (CSACD-T) into Norwegian and test it for psychometric properties. The further aim was to describe and compare healthcare personnel's collaboration and satisfaction about team decision-making (TDM) across hospital units.

Design: A cross-sectional study.

Methods: The questionnaire was translated into Norwegian. A total of 247 healthcare personnel at two hospitals responded to the questionnaire. An explorative factor analysis was performed to test the factor structure of the questionnaire, while a Cronbach's alpha analysis was used to test for internal consistency. A one-way ANOVA analysis and a Kruskal–Wallis test were applied to test for differences between hospital units.

Results: The results demonstrate that the Norwegian version of the CSACD-T has promising psychometric properties regarding construct validity and internal consistency. The mean score of the CSACD-T was significantly higher in the maternity ward group than in the emergency room group.

1 | INTRODUCTION

The benefits of collaboration and teamwork in health care are well documented (Epstein, 2014; Havyer et al., 2014; Schmutz & Manser, 2013). To achieve a quality of care and patient safety, healthcare personnel need competencies in teamwork (Salas, Cannon-Bowers, & Johnston, 2014). Team decision-making (TDM) is a key competency of effective teamwork and important for the results of patient care (Reader, 2017).

2 | BACKGROUND

Collaboration and teamwork among healthcare personnel include sharing the responsibilities of problem-solving and decision-making in formulating and carrying out plans for patient care (O'Daniel & Rosenstein, 2008). TDM refers to the process of reaching a decision among interdependent individuals to achieve a common goal (Bognor, 1997). Healthcare teams may take many forms and range in size. A team is described as a "distinguishable set of two or more

people who interact dynamically, interdependently and adaptively towards a common and valued goal, who have each been assigned specific roles or functions to perform and who have a limited life span membership" (Salas, Dickinson, Converce, & Tannenbaum, 1992, p. 4).

Decision-making and problem-solving are important parts of everyday practice for hospital healthcare personnel, including physicians, nurses and allied healthcare personnel (Levenson, 2010), with all professions being members of interprofessional teams from time to time (Weinberg, Cooney-Miner, Perloff, Babington, & Avgar, 2011). Although physicians play an essential role in patient treatment decisions (Farnan, Johnson, Meltzer, Humphrey, & Arora, 2008; Levenson, 2010), nurses and allied healthcare personnel hold patient information that is important in planning, managing and making decisions about patient care and should therefore be involved in the decision-making process (Marshall, West, & Aitken, 2011). TDM involves both the group which shares information and the team leader who integrates the information and makes a final decision. TDM is important in hospital units, which are often characterized by rapidly changing environments and time pressures (Lipshitz, Klein, Orasanu, & Salas, 2001; Reader, 2017).

Previous research on decision-making in health care has focused on physicians making decisions about patient treatment (Farnan et al., 2008; Hausmann, Zulian, Battegay, & Zimmerli, 2016), whereas studies on interprofessional collaboration in decision-making having mostly been about nurse–physician collaboration (DeKeyser Ganz, Engelberg, Torres, & Curtis, 2016; Maxson et al., 2011; Nathanson et al., 2011). Physicians report the most positive perceptions of collaborating in a team; in contrast, nurses are often less satisfied. A limited number of studies have investigated decision-making in larger hospital teams, beyond nurse–physician teams (Lancaster, Kolakowsky-Hayner, Kovacich, & Greer-Williams, 2015; Zwarenstein, Rice, Gotlib-Conn, Kenaszchuk, & Reeves, 2013). The results of these studies show that care decisions most often take place in isolation by physicians and that the decisions are rarely made collectively. Previous research of multi-professional TDM across different hospital units has been limited.

Multiple instruments have been developed to measure collaboration in teams (Valentine, Nembhard, & Edmondson, 2015), but not many specific for measuring TDM. The "Collaboration and Satisfaction About Care Decisions in Teams" (CSACD-T) was designed to measure healthcare personnel's perceptions of collaboration and satisfaction with decision-making in healthcare teams and is based on the original "Collaboration and Satisfaction about Care Decisions" (CSACD) questionnaire (Baggs, 1994). The original CSACD was developed to measure collaborations between nurses and physicians (Baggs, 1994) and has been used in multiple studies (Klipfel et al., 2011; Maxson et al., 2011; Nathanson et al., 2011; Papathanassoglou et al., 2012) and has also been linked to patient outcomes (Baggs et al., 1999; Boev & Xia, 2015). When the original CSACD was tested for psychometric properties, an EFA was applied only on the first six items of the questionnaire and found the six items to be one factor (Baggs, 1994). When the team version (CSACD-T) was developed, only minor changes were made in the items with different wordings to capture a broader healthcare team (Fox & Heineman, 2002). The team version of the nine-item questionnaire (CSACD-T) has not previously been psychometrically tested.

The theory base of the original CSACD questionnaire was drawn from the work of Thomas (1976), which described a model of collaboration and coordination in complex organizations. According to that model, collaboration is necessary in situations where two or more persons have common interests and the stakes are high. In complex organizations, regarded as dynamic and unpredictable, collaborative solutions provide maximum satisfaction for all parties concerned (Thomas, 1976). Baggs and Schmitt (1988) broadened that model to cover collaborations in decision-making in health care. Through an extensive literature review, they identified five critical attributes of collaboration: assertiveness, planning, shared decision-making, open communication and coordination (Baggs, 1994).

An important aspect of TDM in health care is patient participation in decision-making. The involvement of the patient as a member of the healthcare team is increasingly recognized as a key component of healthcare processes and is advocated as a means to improve patient results and patient safety (Epstein & Gramling, 2013; Longtin et al., 2010; WHO, 2013). An extra item was therefore added to the survey for this study.

We did not find a Norwegian questionnaire that measures healthcare personnel's perception of collaboration in decision-making in teams. Because CSACD-T is a brief and simple questionnaire and not profession-specific, we chose this questionnaire for our study. To the best of our knowledge, no previous studies have investigated TDM among multi-professional healthcare personnel teams across different hospital units. The aim of the study was to translate "The Collaboration and Satisfaction About Care Decisions in Teams" questionnaire into Norwegian and test it for psychometric properties. The further aim was to describe and compare healthcare personnel's perceptions of collaboration and satisfaction about team decision-making across hospital units.

3 | METHODS

3.1 | Design

This study was designed as a cross-sectional study. The nine-item CSACD-T questionnaire was translated into Norwegian according to a translation-back-translation procedure (Brislin, 1970), with further details given in Section 3.4. It was then distributed as a survey to test its psychometric properties.

3.2 | Setting and sample

In total, 624 healthcare personnel (registered nurses, postgraduate nurses, midwives, occupational therapists, physical therapists, assistant nurses and physicians) were invited to participate in the

study. The respondents were from two hospitals in two different hospital trusts in Eastern Norway: 436 from hospital A (110 beds) and 188 from hospital B (167 beds). The healthcare personnel from hospital A (*N* = 436) were from the emergency room (ER), intensive care unit (ICU), operating room (OR)/anaesthesia unit (AN), maternity ward and the medical/surgical (med./surg.) wards, whereas the healthcare personnel from hospital B (*N* = 188) were from medical wards only. All healthcare personnel from the included units were invited to participate in the study. A total of 247 healthcare personnel from the two hospitals responded to the survey.

3.3 | The CSACD-T questionnaire

The nine-item CSACD-T questionnaire has response options on a Likert scale ranging from 1–7. The first six items measure attributes of collaboration, ranging from 1 (strongly disagree) – 7 (strongly agree). The seventh item measures the level of global collaboration and ranges from 1 (no collaboration) – 7 (complete collaboration). The last two items consider satisfaction with decisions and have response options ranging from 1 (not satisfied) to 7 (very satisfied; Baggs, 1994). The CSACD-T questionnaire was obtained from its creator, Professor Judith Baggs, and permission was obtained to translate the questionnaire into Norwegian.

Due to the importance of patient participation in care decisions, an extra item (item 10) was developed and added by the research group: "Do patients participate in decision-making relating to their own care?" The response options ranged from 1 (no participation at all) – 7 (complete participation). This item was not included in the psychometric testing of the questionnaire. The study included the following background data: sex, age, profession, unit type and time employed in the unit.

3.4 | The translation process

The Brislin Model (Brislin, 1970) was used to translate the English version of the CSACD-T questionnaire into Norwegian with the following steps:

1. *Forward translation*—Forward translation into the target language (Norwegian) was conducted by three blinded translators: a bilingual professional translator, an American bilingual physician and a Norwegian bilingual academic nurse.
2. *Review*—The research group reviewed the three forward translation versions and compared them with the original version for linguistic congruence and contextual relevance. There were only minor differences among the translators, mostly related to wording. The research group assessed the three versions and agreed on a preliminary translated version. The reconciled Norwegian version was then reviewed by three academic nurses with expert competencies in collaborative care and teamwork in hospitals. Based on their feedback, minor linguistic changes were made.
3. *Back-translation*—A bilingual professional translator, who was blinded to the original English version, back-translated the Norwegian version into English.
4. *Compare*—The research group compared the back-translated version with the original version and found no differences in meaning. Thus, the Norwegian questionnaire was approved for pilot testing.
5. *Pilot testing*—To check for face validity and the understanding of the items in the questionnaire, a pilot test was conducted among multi-professional healthcare personnel (*N* = 40) from four hospital units in a 180-bed hospital in another part of the country. The pilot cohort consisted of 19 (47%) registered nurses, 12 (30%) postgraduate nurses, five (13%) physical or occupational therapists and four (10%) physicians. Most of the respondents found the items understandable, well worded, precise and relevant to their profession. Most also indicated that the CSACD-T was useful for measuring collaboration and satisfaction with decision-making. Taken together, the results of the pilot study were considered satisfactory and no further changes were made. Lastly, a consensus on the wording of the final Norwegian CSACD-T version was reached.

3.5 | Data collection

The survey was distributed as a paper version in November 2015. Two e-mail-based reminders were administered, with the assistance of managers, during a data collection period of 3 weeks. Completed surveys were sealed in return envelopes and placed in boxes in the units.

3.6 | Data analysis

Data analyses were performed with SPSS version 24 (IBM). An explorative factor analysis (EFA) was conducted to test the factor structure of the questionnaire. The aim of the EFA was to test the factor structure of the group of items. In addition to testing the factor structure of the total questionnaire (items 1–9), an EFA was used to analyse items 1–6, due to the intension of comparing our results to those of the original CSACD (Baggs, 1994). Prior to the EFA, we assessed the suitability of our data for factor analysis. This included a correlation matrix for displaying the relationships between the items, as well as correlation coefficients between 0.30–0.70 considered significant (Polit & Beck, 2017; Tabachnick & Fidell, 2013). A Kaiser–Meyer–Olkin (KMO) test was performed to measure sample adequacy. Within the KMO range of 0–1, a value of 0.60 and above was considered suitable for EFA (Pett, Lackey, & Sullivan, 2003; Tabachnick & Fidell, 2013). A principal component analysis (PCA) was chosen for factor extraction. We applied the "eigenvalue rule," which only allows items of 1.0 or more to be retained for further investigation (Polit & Yang, 2016). A Cronbach's alpha was performed for items 1–9 to check for internal consistency and for items 1–6 to also compare with the original CSACD. A Cronbach's alpha for each item removed was calculated for items 1–9 (Pett et al., 2003).

Descriptive statistics were used to describe the characteristics of the sample and to analyse the results of the CSACD-T scores. A between-group one-way ANOVA, with a Tukey post hoc test, was conducted to compare for differences between unit groups on the total mean score of the healthcare personnel's perceptions of TDM (Polit & Beck, 2017). A Kruskal–Wallis test was conducted to test for differences between groups regarding item 10 (patient participation in decision-making; Polit & Beck, 2017). A two-tailed significance level of *p*-value <0.05 was used for all tests (Polit & Beck, 2017).

3.7 | Ethical considerations and approvals

"The Norwegian Center for Research Data" approved this study (ref. no. 43295). In addition, the hospital administrations provided approvals. The study was conducted according to the Declaration of Helsinki and ethical guidelines for research (World Medical Association, 2018). The survey included information about the aim of the study, confidentiality and voluntary participation. Completion of the survey was regarded as informed consent.

4 | RESULTS

4.1 | Translation and psychometric testing of the CSACD-T questionnaire

The total of 247 healthcare personnel that responded to the survey represented an overall response rate of 40%. Table 1 shows the distribution of response per healthcare profession.

Among these individuals, 156 (response rate 36%) were at hospital A and 91 (response rate 48%) at hospital B. Characteristics of the sample are shown in Table 2. Registered nurses constituted most respondents, followed by postgraduate nurses and then midwives. Most of the respondents were female, with 75% of the sample from hospital wards (maternity ward and med./surg. wards). Leaving more than 50% of items blank, two respondents were excluded from further analysis.

Inter-item correlations ranged from 0.45–0.81 for the total questionnaire (items 1–9) and from 0.51–0.81 for items 1–6. All correlations were significant (<0.001). The KMO values were 0.93 for the total questionnaire (items 1–9) and 0.89 for items 1–6. The PCA identified one factor for the total questionnaire (item 1–9), with an eigenvalue of 6.154 on one factor, explaining 68% of the variance and eigenvalues <1.0 on the remaining factor solutions. The PCA on item 1–6 also identified one factor for these items, with an eigenvalue of 4.294 on one factor, explaining 72% of the variance and with eigenvalues <1.0 on the remaining factor solutions (Table 3). PCA factor loadings for the total questionnaire (item 1–9) ranged from 0.72–0.87 and factor loadings for items 1–6 ranged from 0.77–0.89 (Table 4). The Cronbach's alpha was 0.94 for items 1–9 and was not improved when each item was removed (ranged from 0.93–0.94). The Cronbach's alpha value for items 1–6 was 0.92.

TABLE 1 Distribution of response per healthcare profession

	Invited	Responded	
	N = 624	*N* = 247	%
Registered nurse	270	102	38
Postgraduate nurse/Midwife	135	84	62
Assistant nurse	59	27	46
Physiotherapist/Occupational therapist	26	22	85
Physician	110	12	11

4.2 | Collaboration in team decision-making across different hospital units

The entire sample of healthcare personnel's perceptions of TDM showed a total mean score of 5.14 (*SD* = 0.95), as measured by

TABLE 2 Characteristics of the sample (*N* = 247)

Variable	*N*	%
Sex		
Female	225	91
Male	21	9
Missing	1	
Age		
≤30 years	49	20
31–50 years	119	49
≥51 years	76	31
Missing	3	
Profession		
Registered nurse	102	41
Postgraduate nurse/midwife	84	34
Assistant nurse	27	11
Occupational & physical therapist	22	9
Physician	12	5
Unit type		
Medical & surgical wards	162	65
Maternity ward	24	10
Operation room & Anaesthesia unit	16	6
Intensive care unit	21	9
Emergency room	24	10
Time employed in the unit		
0–5 years	87	35
6–15 years	84	34
≥16 years	75	31
Missing	3	

TABLE 3 Initial eigenvalues and variance explained—The Collaboration and Satisfaction About Care Decisions in Team questionnaire

Factor component	Eigenvalue item 1–9	% variance explained item 1–9	Eigenvalue item 1–6	% variance explained item 1–6
1	6.154	68. 382	4.294	71. 569
2	0.738	8.205	0.527	8.784
3	0.460	5.116	0.462	7.694
4	0.421	4.678	0.290	4.827
5	0.307	3.412	0.252	4.202
6	0.276	3.070	0.175	2.923
7	0.246	2.731		
8	0.229	2.544		
9	0.167	1.860		

Note. Principal component analysis.

the CSACD-T (Table 5). Single-item mean scores for the total sample ranged from 4.82 (*SD* 1.24) ("Coordination of decision-making among team members") to 5.35 (*SD* 1.13) ("Shared responsibilities for decision-making") (see Table 5). The added item (item 10), which was healthcare personnel's perceptions of "patient participation in decision-making," had a mean score of 4.63 (*SD* 1.25) in the total sample (Table 5).

The results of the one-way ANOVA revealed statistically significant differences in the total mean score of the CSACD-T across unit groups ($F(4, 240) = 4.1$, $p = 0.003$). The effect size, calculated using eta squared, was 0.06 (medium effect). Post hoc comparisons, using the Tukey post hoc test, showed a significantly higher score in the maternity group than in the ER group ($p = 0.001$). A Kruskal–Wallis test of item 10 revealed a statistically significant difference between the unit groups ($\chi^2(4) = 11.77$, $p = 0.001$) with the highest score in the maternity ward group and the lowest score in the ER group.

TABLE 4 Factor loadings—The Collaboration and Satisfaction About Care Decisions in Team questionnaire

	Items 1–9	Items 1–6
1. Team members plan together in decision-making	0.843	0.856
2. Open communication among team members in decision-making	0.865	0.891
3. Shared responsibilities for decision-making	0.720	0.774
4. Team members cooperated in decision-making	0.856	0.884
5. All team members concerns were considered in decision-making	0.825	0.807
6. Coordination of decision-making among team members	0.861	0.860
7. Level of collaboration among team members in decision-making	0.854	
8. How satisfied with the decision-making process	0.820	
9. How satisfied with the decisions	0.787	

Note. Extraction method: Principal component analysis.

5 | DISCUSSION

5.1 | Translation and psychometric testing of the CSACD-T questionnaire

The purpose of translating a questionnaire is to obtain an instrument in a new language that is equivalent to the instrument in the original language (Sousa & Rojjanasrirat, 2011). The translation-back-translation method used in this study is recommended as a reliable method for translating research instruments (Brislin, 1986; Jones, Lee, Phillips, Zhang, & Jaceldo, 2001). The translation process was thorough; both medical and nursing professionals participated to assure the content and cross-cultural validity of the questionnaire (Polit & Yang, 2016). No major problems occurred in the translation or back-translations steps. The respondents in the pilot study provided adequate responses to the items, which suggested that the translated questionnaire was well understood.

The results of the EFA showed one factor for all nine items, and all loadings were above 0.40, which was considered good and the structural validity was thereby supported (Polit & Yang, 2016). Only the first six items were tested and found to be a one-factor scale in the validation study of the original CSACD (Baggs, 1994). However, when Sapnas, Ward-Presson, and Monzeglio (2006) conducted a psychometric test to evaluate the original CSACD in diverse hospital unit types, their EFA identified one factor for all nine items of the CSACD questionnaire when tested in diverse hospital unit types, as we found in our study. In any case, since the EFA can only identify clusters of tests that measure the same things, there is no assurance that these "same things" are primary dimensions. Consequently, a factor analysis alone is insufficient to confirm that a factor corresponded directly to the "real" dimension of the construct measured (Polit & Yang, 2016). The interpretation of the results is just as important, a good PCA must make sense (Polit & Yang, 2016). The theory base of the questionnaire

TABLE 5 The healthcare personnel's perceptions of collaboration and satisfaction about care decisions in team

	Total sample *N* = 245		Med/Surg[a] *N* = 160		MW[b] *N* = 24		OR/AN[c] *N* = 16		ICU[d] *N* = 21		ER[e] *N* = 24	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
The total CSACD-T questionnaire (item 1–9)	5.14	0.95	5.20	0.91	5.66	0.88	4.84	0.94	4.89	0.94	4.69	1.06
1. Plan together in decision-making	5.35	1.13	5.41	1.09	5.82	1.01	4.75	1.18	5.14	1.11	5.04	1.33
2. Open communication in decision-making	5.32	1.14	5.38	1.14	6.00	0.98	4.94	0.10	4.81	1.12	5.00	1.14
3. Shared responsibilities for decision-making	5.40	1.30	5.51	1.12	5.55	1.37	5.31	1.45	5.24	1.58	4.75	1.42
4. Team members cooperate in decision-making	5.29	1.11	5.34	1.07	5.82	0.91	5.13	1.15	5.19	1.03	4.63	1.28
5. All team members` concerns in decision-making	4.87	1.26	4.96	1.21	5.36	1.09	4.38	1.15	4.62	1.32	4.33	1.55
6. Coordination in decision-making	4.82	1.24	4.85	1.20	5.64	1.14	4.50	1.10	4.76	1.14	4.17	1.34
7. Level of collaboration in decision-making	5.07	1.11	5.13	1.04	5.68	1.09	4.88	1.09	4.81	0.98	4.42	1.38
8. How satisfied with the decision-making process	4.93	1.11	5.00	1.08	5.45	1.01	4.56	1.46	4.43	1.08	4.70	1.02
9. How satisfied with the decisions	5.26	0.96	5.27	0.94	5.64	1.09	5.13	0.96	5.00	1.10	5.22	0.99
10. Patient participation in decision-making[f]	4.63	1.25	4.81	1.19	5.18	0.96	3.94	1.24	4.33	1.20	3.57	1.20

[a]Medical/Surgical wards. [b]Maternity ward. [c]Operating room/Anaesthesia unit. [d]Intensive care unit. [e]Emergency room. [f]The added item for this study.

included satisfaction with the decisions as an important part of the collaboration in decision-making (Baggs, 1994). Nonetheless, if the satisfaction part of the questionnaire had included more than two items, the EFA might have resulted in a two-factor solution.

The CSACD-T had a Cronbach's alpha value above the desirable 0.80 (Polit & Beck, 2017) and demonstrated a good internal consistency. Result from the previous study of the nine items CSACD showed alpha value over 0.90 (Sapnas et al., 2006). Tavakol and Dennick (2011) argue that the maximum value to be recommended is 0.90, which means that the alpha value of item 1–9 was maybe too high.

Regarding sample size, the recommended sample size for EFA in validation studies is disputed and no consensus exists (Polit & Yang, 2016). Some suggest a minimum of 300, but emphasize that if there is strong correlations and few distinct factors, a smaller sample is adequate (Tabachnick & Fidell, 2013). Others offer guidance on the number of respondents per items, ranging from 5–40 or 50 per item, with the most common recommendation as a minimum of 10 cases per item (Polit & Yang, 2016). The sample size of 247 in the current study was thereby considered satisfactory with 27 number of respondents per item. Multiple types of healthcare personnel from multiple types of hospital units were represented in the sample; hence, a heterogeneous study sample was obtained, as recommended for testing questionnaires (Taber, 2017).

5.2 | Collaboration in team decision-making across different hospital units

After translating and testing the psychometric properties of the Norwegian version of the CSACD-T, we aimed to describe and compare healthcare professional's perceptions of collaboration and satisfaction with TDM across different hospital units. The results showed that the mean CSACD-T scores were at the same level or slightly higher than those reported in previous studies of nurse–physician collaboration in decision-making in ICUs (Nathanson et al., 2011; Papathanassoglou et al., 2012) and in paediatric teams (Jankouskas et al., 2007), as measured by the original CSACD. The explanation for why the healthcare personnel from the maternity ward reported a significantly higher score than the healthcare personnel in the ER may be due to having a more team-based approach to their work (Gregory et al., 2017). Nonetheless, many factors influence TDM such as the amount of work load, time stress and culture (Gregory et al., 2017), as in other types of hospital units.

The lower score in the ER group might be explained by more inefficient teamwork, which may be due to the way clinical work is organized for the sub-acute patients in ERs in Norway. A nurse or a physician triages the patients and then assigns the patient to a dedicated nurse. By the time the patient's physician arrives, the dedicated nurse has often moved on to attend to the next patient (Krogstad,

Lindahl, Saastad, & Hafstad, 2015). The ER is an area of the hospital that is characterized by high complexity, high throughput and high uncertainty and patient care decisions can be affected by the pressures imposed by the high workload and ineffective teamwork (Zavala, Day, Plummer, & Bamford-Wade, 2018). Team-based care and TDM are of great importance to ensure quality patient care, in ERs as in other hospital units (Reader, 2017).

The added item "patient participation in decision-making" had the lowest mean score in the ER group. Although it is well-known that patients should be included in care decisions, they are still not always included in practice (Williams, Fleming, & Doubleday, 2017). They should be included because they might have valuable information about their own health condition (WHO, 2013). Patient participation may contribute to help healthcare personnel make the right decisions and to minimize decision errors (Zavala et al., 2018). Although healthcare personnel are striving for patient participation in decision-making to increase the quality of care and patient-centred outcomes in the ER (Grudzen, Anderson, Carpenter, & Hess, 2016), many patients cannot participate in decisions because of their critical condition (Joseph-Williams, Elwyn, & Edwards, 2014). In addition, decision-making in the ER is complex with rapid assessments and decisions to make and includes transferring patients to the next level of care. But for the healthcare team, TDM is possible, as well as being a contribution to safe care, also in the context of the ER (Reader, 2017).

5.3 | Limitations

Some limitation of the study must be stated. The response rate from physicians was low, which is a common problem in research on healthcare personnel in hospitals (Cunningham et al., 2015). Furthermore, the participants from hospital B were only from medical wards, and except for the med./surg. ward group, unit groups were relatively small. Although this study displayed a relatively low overall response rate, the sample size of 245 respondents was sufficiently large to conduct a factor analysis of the nine-item questionnaire (Polit & Yang, 2016).

6 | CONCLUSION

The results of the study demonstrate that the Norwegian version of the CSACD-T is a questionnaire with promising psychometric properties regarding construct validity and internal consistency. The CSACD-T questionnaire can be used in assessing collaboration and satisfaction with TDM in hospital teams, in quality improvement, in continuing education endeavours for healthcare personnel and in research. Moreover, the results showed that the levels of collaboration in care decisions in healthcare teams varied across hospital units, with significantly higher scores in the maternity ward group than in the ER group. Further studies are needed with representative samples from diverse hospital units. Additional studies are also needed to confirm our results of the psychometric testing of the questionnaire.

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CONFLICT OF INTEREST

All authors declare no conflict of interest.

AUTHOR CONTRIBUTION

All the authors made substantial contributions to the conception and design of the study, the analysis and interpretation of data, and the drafting of the manuscript. All the authors critically revised the manuscript for important intellectual content, and all have given their final approval of the version to be published.

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Paper 2

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RESEARCH ARTICLE Open Access

A human factors intervention in a hospital - evaluating the outcome of a TeamSTEPPS program in a surgical ward

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Abstract

Background: Patient safety in hospitals is being jeopardized, since too many patients experience adverse events. Most of these adverse events arise from human factors, such as inefficient teamwork and communication failures, and the incidence of adverse events is greatest in the surgical area. Previous research has shown the effect of team training on patient safety culture and on different areas of teamwork. Limited research has investigated teamwork in surgical wards. The aim of this study was to evaluate the professional and organizational outcomes of a team training intervention among healthcare professionals in a surgical ward after 6 and 12 months. Systems Engineering Initiative for Patient Safety 2.0 was used as a conceptual framework for the study.

Methods: This study had a pre-post design with measurements at baseline and after 6 and 12 months of intervention. The intervention was conducted in a urology and gastrointestinal surgery ward in Norway, and the study site was selected based on convenience and the leaders' willingness to participate in the project. Survey data from healthcare professionals were used to evaluate the intervention. The organizational outcomes were measured by the unit-based sections of the Hospital Survey of Patient Safety Culture Questionnaire, and professional outcomes were measured by the TeamSTEPPS Teamwork Perceptions Questionnaire and the Collaboration and Satisfaction about Care Decisions in Teams Questionnaire. A paired t-test, a Wilcoxon signed-rank test, a generalized linear mixed model and linear regression analysis were used to analyze the data.

Results: After 6 months, improvements were found in organizational outcomes in two patient safety dimensions. After 12 months, improvements were found in both organizational and professional outcomes, and these improvements occurred in three patient safety culture dimensions and in three teamwork dimensions. Furthermore, the results showed that one of the significant improved teamwork dimensions "Mutual Support" was associated with the Patient Safety Grade, after 12 months of intervention.

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Conclusion: These results demonstrate that the team training program had effect after 12 months of intervention. Future studies with larger sample sizes and stronger study designs are necessary to examine the causal effect of a team training intervention in this context.

Trial registration number: ISRCTN13997367 (retrospectively registered).

Keywords: Human factors, Implementation, Intervention, Interprofessional teamwork, Longitudinal, Patient safety culture, SEIPS 2.0, TeamSTEPPS, Team training

Background

Patient safety in hospitals is being jeopardized, since too many patients experience adverse events [1, 2]. The risk of adverse events in surgical care is higher than in other areas of hospitals [3, 4]. Most adverse events arise not from the solitary actions of individuals but from the systems of which they are a part and with which they interact [5]. Root cause analyses have revealed that human factors, such as poor teamwork and communication failures, are the underlying factors for the majority of adverse events in hospitals [2, 6]. Focusing on patient safety culture is crucial for minimizing adverse events and improving patient safety [7]. An organization's patient safety culture is the product of individual and group values, beliefs, attitudes, perceptions, competencies, and patterns of behavior that determine the organization's commitment to quality and patient safety [8]. Patient safety requires that healthcare professionals have the right competencies and tools to perform their tasks. It is therefore crucial to conduct patient safety interventions that focus on healthcare professionals and work system factors that contribute to safe care [9]. In this study, we conducted a team training intervention in a surgical ward.

The surgical ward is a microsystem within a hospital organization and a unit with a high degree of complexity [10]. The interdependency among healthcare professionals contributes to this complexity [1]. Clinical work requires a broad spectrum of competencies, and healthcare professionals are often working under high time pressure [11]. Surgical ward physicians are often called to the operating room for surgical procedures during a work shift [12], and this makes interprofessional teamwork in the wards extra challenging.

Human factors is a multidisciplinary science at the intersection of psychology and engineering [13] and is commonly described as a discipline devoted to studying and improving the interactions among humans and other elements of a system [14]. Human factors interventions aim to improve system performance and prevent accidental harm, which for healthcare means supporting the cognitive and physical work of healthcare professionals and promoting high-quality, safe care for patients [15]. Human factors interventions, such as team training, are regarded as an innovative approach for improving patient safety [16–18]. Team training is described as applying a set of instructional strategies that rely on well-tested tools (e.g., simulation, lectures, and videos) to achieve specific team competencies [19, 20].

Previous research on team training interventions has shown improvements in different areas of teamwork [21, 22] and safety culture [23, 24], reductions in surgical harm [25], and reductions in surgical mortality [26]. However, most of the team training research has been conducted in specialty units, and limited research has investigated teamwork in surgical wards [27] or investigated teamwork over long time frames [28]. Few studies have examined the associations between perceptions of teamwork and patient safety culture after a 12-month team training intervention. Observational studies have found that interprofessional teamwork was associated with organizational culture [29] and that event reporting, communication, and leadership were predictors of patient safety culture [30].

In this study, we implemented Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS®) in a surgical ward. TeamSTEPPS is a generic program based on research [31, 32] and is built on five key principles: "Team Structure" and the four team competencies "Leadership", "Situation monitoring", "Mutual support" and "Communication" [32]. The four team competencies of TeamSTEPPS have 15 associated tools and strategies that are meant to be implemented in clinical practice to improve performance and patient safety [33]. "Team decision making" is an additional team competency or team process [2, 34, 35] that is not included in the TeamSTEPPS program but was included in this study since it is an important aspect of teamwork and has significance for patient safety and patient care [34, 36]. Research from other areas of hospitals shows that most clinical decisions are still made independently by medical professionals, with only some sharing of information, and that such decisions are rarely made collectively by the interprofessional care team [37].

Since the need to implement team training programs in the surgical ward context is being increasingly

recognized, an interprofessional TeamSTEPPS intervention was initiated in a surgical ward. We anticipated that training and implementation of teamwork tools and strategies in daily practice among healthcare professionals would improve professional outcomes in terms of perceptions of teamwork, and organizational outcomes in terms of patient safety culture, since the TeamSTEPPS program focuses on both teamwork and patient safety [32]. It takes time to achieve culture change and to embed and sustain new ways of working. Changes that occur in a short time, due to training experience and excitement, may disappear [23]. Therefore, we measured the effect of the intervention 6 and 12 months after initiation.

The aim of the study was to evaluate the professional and organizational outcomes of a team training intervention among healthcare professionals in a surgical ward after 6 and 12 months. The research questions were as follows:

1. Did professional outcome measured by healthcare professionals' perceptions of teamwork and organizational outcome measured by patient safety culture improve from baseline to 6 and 12 months of intervention?
2. Did patient safety culture related to the intervention vary by profession group or time, demonstrating an effect of the intervention?
3. Were perceptions of teamwork dimensions associated with patient safety culture in the unit after 12 months?

Conceptual framework

Teamwork and patient safety may be explained on the basis of an input-process-output (IPO) framework that describes the impact of input on process and output, as in classic system theory [20, 34, 38]. The human factors model "The Systems Engineering Initiative for Patient Safety 2.0" (SEIPS 2.0) is an IPO model developed for innovative patient safety research in healthcare [5, 39]. The model emphasizes structural elements in the work system with a person at the center. The person may be represented by patients, healthcare professionals, or healthcare teams - as in this study. The team members perform a range of tasks using various tools and technologies in an internal and external environment and under specific organizational conditions, which all influence the care processes and which in turn influence the outcomes [5, 39]. Unlike most of the IPO models, the SEIPS model differentiates the outcomes in 1) patient outcomes, 2) professional outcomes and 3) organizational outcomes [39]. The interrelatedness of the elements (person, tasks, tools and technology, organization, internal and external environment) within the work system, and among the work system, process and outcome illustrates the complexity of the system [39].

In this study, we used the SEIPS 2.0 model to conceptualize the intervention and the outcomes of the study from a system perspective [40]. Implementation of a team training program was regarded as an input in the organization element to strengthen the work system by attempting to improve healthcare professionals' team competencies and patient safety culture [20, 38]. The SEIPS 2.0 model illustrates how input, in the work system, such as team training, may improve healthcare professionals' team competencies and influence work processes that in turn influence professional and organizational outcomes. See Fig. 1.

Methods

Study design

We conducted a study with a pre-post design with measurements at baseline, after 6 months and after 12 months of intervention.

Setting and sample

The intervention was conducted in a 20-bed urology and gastrointestinal surgery ward in a 180-bed hospital in Norway. The study site was selected by convenience and based on the leaders' willingness to participate in the project, motivated by patient safety incidents in the ward. The profile of the surgical ward is displayed in Table 1. No major changes in the unit profile occurred during the study period, except for changes in leadership positions (which is specified in the text in the intervention section). All of the 43 frontline healthcare professionals (12 physicians, 24 registered nurses, and 7 nursing assistants) were invited to participate in the study. A total of 41 participated in the 6-h initial team training. Normal turnover among nurse staff and physicians caused changes in the sample size.

The intervention

The intervention was conducted according to the TeamSTEPPS implementation plan, which comprises three phases, that are based on Kotters change model [32] and aligns with the Clinical Human Factors Group recommendation for team training interventions [41].

Phase 1. Set the stage and decide what to do - assessment and planning

A site assessment was conducted and an overview of TeamSTEPPS was provided to the leadership of the surgical department and the leaders of the selected ward. After the leaders had decided that their unit was ready for the TeamSTEPPS program, an intervention plan was developed jointly by a project group consisting of the researchers and the leaders of the ward. The leaders consisted of the chair

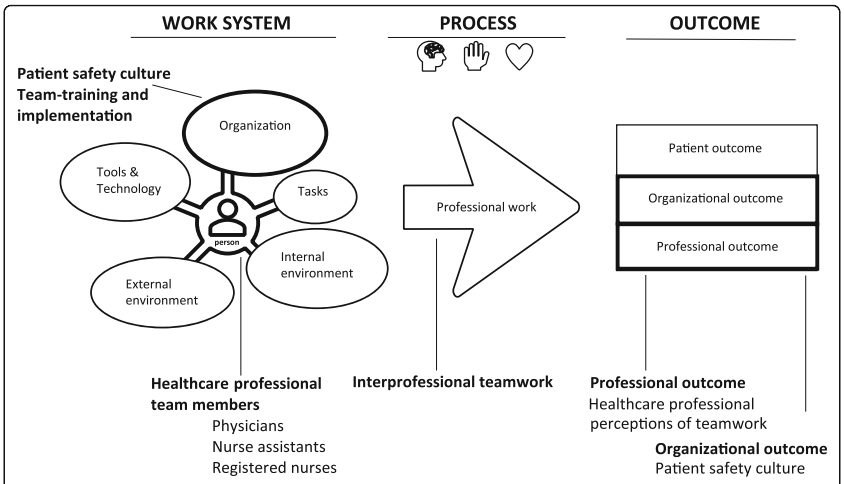

Fig. 1 A modified SEIPS 2.0 model adapted from Holden et al. [39]. The components with the bold lines illustrate the input and outcome in this study from a human factors system perspective

of the surgical department, the unit nurse manager, and the two head surgeons (urology and gastrointestinal surgery). In advance of the intervention start, the physicians and nursing staff attended information meetings conducted by the researchers.

Phase 2. Make it happen - training, planning and implementation

The onset of the intervention was a mandatory 6-hour interprofessional TeamSTEPPS training distributed over 3 days in a period of 3 weeks. In advance of the training, TeamSTEPPS leaflets and pocket-guides were distributed to all healthcare personnel, which they were asked to read in preparation for the training. The training was conducted in a simulation center at a university and delivered by the master trained nurses and physician leaders in the surgical ward. The team training was a combination of didactics, videos, role play and high-fidelity simulation training. The simulation training included debriefing sessions with a focus on interprofessional teamwork. The first lecture, held by the chair of the surgical department, aimed to create a sense of urgency by presenting the hospital's reports of adverse events. At the end of the training, the healthcare professionals were asked to identify patient safety issues in the ward and to suggest TeamSTEPPS tools to solve the problems. Immediately after the training, the participants responded to the "The TeamSTEPPS Course Evaluation Survey". The evaluation results were very good, both regarding training satisfaction and learning outcomes [42].

After the training, an interprofessional change team was established. The change team consisted of 12 members representing all levels in the organization, including a former patient and one of the researchers (ORA), and it was led by the unit nurse manager. The researcher coached the change team. Based on the identified safety issues, the change team developed an action plan, according to which they implemented tools and strategies into daily practice. The vision of the action plan was "Zero errors", and the specific goals were aligned with the organizational goals of the surgical department. The unit nurse manager, the clinical nurse specialist, and the two head surgeons, led the implementation in collaboration with the other members of the change team.

Five tools were implemented in the ward during the first 6 months of the study period, at a rate of approximately one tool per month (Table 3). The tool of the month was communicated through weekly newsletters and staff meetings and implemented in daily practice. A description of the selected tools and strategies implemented in the ward is displayed in Table 2, and an overview of the start times of a new tool to be implemented is displayed in Table 3. Refresher training for the nursing

Table 1 Unit profile data

	Baseline	6 months	12 months
Beds and *nurse/bed* ratio			
Number of patient beds	20	20	20
Nurse/bed ratio	1.16	1.16	1.16
Full-time equivalent positions			
Physicians	13	12	12
Registered nurses	17.25	19.25	20.25
Nursing assistants	4.95	3.1	2.1
Unit nurse director	1.0	1.0	1.0
Clinical nurse specialist	1.0	1.0	1.0
Change in positions			
Clinical nurse specialist	–	No	No
Unit nurse manager	–	No	Yes
Physician leader gastrointestinal surgery	–	No	No
Physician leader urology	–	No	Yes
Chair of the surgical department	–	No	Yes
Patient data and sick leave (previous 6 months)			
Number of patient admissions per month	192	174	173
Length of stay (mean days)	3.46	3.63	3.62
Occupied beds	87%	96%	89%
Emergency admissions	64%	65%	66%
Sick leave nursing staff	13.22%	5.05%	7.58%
Sick leave physicians	3.55%	1.47%	2.58%
Registered adverse events by year	**2015**	**2016**	**2017**
Numbers of reported adverse events	38	42	52

Table 2 Explanation of the selected tools and strategies implemented in study period [32]

TeamSTEPPS tools and strategies	Explanation
Closed-loop	Using closed-loop communication to ensure that information conveyed by the sender is understood by the receiver as intended
ISBAR	A technique for communicating critical information that requires immediate attention and action concerning a patient's condition
I-PASS	Strategy designed to enhance information exchange during transitions in care
Brief	Short session prior to start to share the plan, discuss team formation, assign roles and responsibilities, establish expectations and climate, anticipate outcomes and likely contingencies
Huddle	Ad hoc meeting to re-establish situational awareness, reinforce plans already in place, and assess the need to adjust the plan
Debrief	Informal information exchange session designed to improve team performance and effectiveness through lessons learned and reinforcement of positive behaviors
Task assistance	Helping others with tasks builds a strong team. Key strategies include: Team members protect each other from work overload situations, Effective teams place all offers and requests for assistance in the context of patient safety, Team members foster a climate where it is expected that assistance will be actively sought and offered
The two- challenge rule	Empowers all team members to "stop the line" if they sense or discover an essential safety breach. When an initial assertive statement is ignored: It is your responsibility to assertively voice concern at least two times to ensure that it has been heard, The team member being challenged must acknowledge that concern has been heard, If the safety issue still hasn't been addressed: Take a stronger course of action; Utilize supervisor or chain of command
Cross monitoring	A harm error reduction strategy that involves: Monitoring actions of other team members, Providing a safety net within the team, Ensuring that mistakes or oversights are caught quickly and easily, "Watching each other's back"
STEP	Tool to help assess health care delivery situations

Table 3 Time of implementation of the selected TeamSTEPPS tools and strategies

The teamwork competencies	May 2016	June 2016	August 2016	September 2016	October 2016	January 2017	February 2017	March 2017	May 2017
Communication	Closed-loop	ISBAR[1]							I-PASS[3]
Leadership			Briefs	Huddles		Debriefs			
Situation Monitoring					Cross monitoring		STEP[2]		
Mutual Support						Task assistance		Two Challenge rule	

[1]ISBAR = Identification, Situation, Background, Assessment, Request/Recommendation – Use by exchange of critical information
[2]STEP=Status of the patient, Team members, Environment, Progress toward the goal – Used by focusing on updated electronic care plans
[3]I-PASS=Illness severity, Patient summary, Action list, Situation awareness and contingency planning, Synthesis by receiver – Systematic handoffs with focus on patient safety risks

staff (75 min), and for physicians (20 min) were conducted 5 months after the initial team training.

After 8 months of intervention, some changes in the wards' leadership occurred. The master trained head surgeon of urology left employment at the hospital. The chair of the department moved to a higher position in the hospital organization, and the head surgeon of the gastrointestinal surgery section assumed the position of chair. The unit nurse manager was allocated to a position as assistant chair of the surgical department, and the clinical nurse specialist assumed the role of the leader of the change team (Table 1).

Phase 3. Make it stick – sustainment

Rather than reducing the intervention pressure, it was maintained, and the implementation of tools and strategies continued. Five more tools were implemented during the last 6 months of the 12-month study period (Table 3). Achievements were celebrated along the way. When conducting whiteboard patient safety huddles after rounding every day, 30 days in a row, they celebrated with a whiteboard-themed cake.

After 11 months, another refresher training session was held for the nursing staff (75 min), but not for the physicians (due to busy work schedules). Other than the missed refresher training, the intervention was conducted as intended, with the interprofessional change team and leadership leading the change, and with a project group that had meetings every second month throughout the project period [43].

Measurements

Three questionnaires were used to evaluate the intervention. For measuring the professional outcomes (teamwork), the TeamSTEPPS Teamwork Perceptions Questionnaire (T-TPQ) and the Collaboration and Satisfaction about Care Decisions in Teams (CSACD-T) were used, and for measuring organizational outcomes (patient safety culture), the Hospital Survey of Patient Safety Culture Questionnaire (HSOPS) was used.

The T-TPQ is a 35-item questionnaire [44, 45] that measures individuals' perception of the level of teamwork that exists in their work unit. Participants responded using a 5-point Likert scale of agreement (5 = strongly agree to 3 = neutral to 1 = strongly disagree). The T-TPQ measures five teamwork dimensions addressed in the TeamSTEPPS program; there are seven items for each of the following five dimensions: "Team structure", "Leadership", "Mutual Support", "Situational Monitoring" and "Communication".

The CSACD-T is a questionnaire measuring clinical decision making in teams. It is composed of seven items with statements regarding collaboration in team decision making about patient care and two items about satisfaction with decision making. The participants responded by using a 7-point Likert scale of agreement (from 1 = strongly disagree to 7 = strongly agree), global collaboration (from 1 = no collaboration to 7 = complete collaboration), and satisfaction about care decisions (from 1 = not satisfied to 7 = very satisfied). The questionnaire was developed from the original nurse-physician "Collaboration and Satisfaction about Care Decisions" questionnaire [46].

The HSOPS [47] is a questionnaire that assesses the extent to which healthcare professionals' organizational culture supports patient safety. It is recommended for evaluating the cultural impact of team training and patient safety interventions [47]. The full HSOPS comprises 2 single items and 12 patient safety culture dimensions. Each dimension is composed of three or four items [47]. The two single items ("Number of Events Reported" and "Patient Safety Grade") and two of the dimensions ("Overall Perceptions of Patient Safety" and "Frequency of Events Reported") are regarded as outcome measures. Three dimensions are regarded as hospital-level measures [48]. Because we only studied one unit, we excluded the hospital-level section of the questionnaire (11 items – 3 dimensions) and used the 2 single items and the remaining 33 items of the nine unit-level dimensions: "Teamwork Within Unit", "Manager's Expectations & Actions Promoting Patient Safety",

"Organizational Learning - Continuous Improvement", "Feedback and Communication About Error", "Communication Openness", "Staffing", "Nonpunitive Response to Errors", "Overall Perceptions of Patient Safety", and "Frequency of Events Reported" [48]. The participants responded by using a 5-point Likert scale of agreement (from 1 = strongly disagree to 5 = strongly agree, with "neither" in the middle) or frequency (from 1 = very seldom to 5 = very often). The single item "Patient Safety Grade", which asks participants to provide an overall grade on patient safety for their unit, has the following five response options: A = Excellent, B = Very Good, C = Acceptable, D = Poor, E = Failing. The single item "Number of Events Reported", which indicates the number of adverse events the participants have reported over the past 12 months, has six response options: 1 = No events, 2 = 1 to 2 events, 3 = 3 to 5 events, 4 = 6 to 10 events, 5 = 11 to 20 events, 6 = 21 events or more [47].

All three questionnaires were translated into Norwegian and psychometrically tested [49–51]. In addition to the questionnaires, participants' background information was solicited (sex, age group, profession group, and employee time in the unit).

Data collection

An electronic survey (SurveyXact) was distributed by email to the healthcare professionals to evaluate the effect of the TeamSTEPPS program. Data collection was conducted at baseline (February–March 2016) and after 6 months (November–December 2016) and 12 months of intervention (June 2017). Unit profile data were collected from the unit nurse manager.

Statistical analyses

To test for statistically significant changes between baseline and 6 months and between baseline and 12 months, a paired t-test was applied on the healthcare professional's mean scores of the T-TPQ and HSOPS dimensions and the total score of the CSACD-T, and a Wilcoxon signed-rank test was applied on the two single items of the HSOPS [52]. A generalized linear mixed model (GLMM) [53] was used to investigate the outcome of TeamSTEPPS by estimating the associations among the nine HSOPS dimensions used as dependent variables and "Profession group" (nursing staff and physicians) and "Time" (baseline, after 6 and 12 months of intervention) as the two independent variables. A GLMM is a generalization of traditional linear regression that adjusts for the correlation between repeated measurements within each subject and finds the best linear fit to the data across all individuals. The model maximizes power by utilizing all data despite missing observations in some subjects [54, 55]. The GLMM was applied to the total sample ($n = 98$), and the results are reported as estimates with 95% confidence intervals. To test whether any of the three significant improved teamwork dimensions of the T-TPQ were associated with two of the patient safety culture outcomes ("Overall patient safety" and "Patient Safety Grade") after 12 months of intervention, multiple linear regression analysis was performed on all healthcare professionals ($n = 31$) who responded after 12 months of intervention [56]. A p-value < .05 was considered to be statistically significant for all analyses. Statistical Package for Social Sciences (SPSS) version 24 (Armonk, New York) and R 3.1.1 were used to analyze the data. The study adheres to the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) guidelines [57].

Results

Of the 43 invited healthcare professionals in the ward, 35 of them responded to the survey at baseline. After 6 months of the intervention, 32 healthcare professionals responded, of which 28 had also responded at baseline. After 12 months of the intervention, 31 healthcare professionals responded, of which 25 had responded at baseline. A total of 98 responses from all respondents were collected at the three time points. See Table 4 for an overview. The characteristics of the respondents are displayed in Table 5.

The mean scores on the T-TPQ, CSACD-T and HSOPS for those answered two times (baseline and after 6 months or baseline and after 12 months) are displayed in Table 6. None of the teamwork dimensions of the T-TPQ showed significant changes after 6 months. After 12 months of intervention, significant improvements were found in three teamwork dimensions, regarded as professional outcomes: "Situation Monitoring", "Mutual Support", and "Communication". No significant changes were found in the professional outcome "Team decision making" (CSACD-T) during the study period.

The patient safety culture results (HSOPS), regarded as organizational outcomes, showed significantly improved scores in two dimensions after 6 months of intervention: "Organizational Learning & Continuous Improvement" and "Communication Openness". The three dimensions "Communication Openness", "Teamwork Within Unit" and

Table 4 Samples and respondents

	Sample	n	Response rate
Baseline	43	35	81%
After 6 months of intervention	42	32	76%
After 12 months of intervention	40	31	78%
In total		98	
Both baseline and after 6 months		28	
Both baseline and after 12 months		25	

Table 5 Characteristics of the respondents

	n = 28 6 months	*n* = 25 12 months
	n (%)	n (%)
Gender		
Female	23 (82)	22 (88)
Male	5 (18)	3 (12)
Profession		
Physicians	6 (21)	4 (16)
Assistant nurses	4 (14)	3 (12)
Registered nurses	18 (64)	18 (72)
Age		
≤ 30 years	6 (22)	4 (16)
31–50 years	12 (44)	12 (48)
≥ 51 years	9 (33)	9 (36)
Missing	1	
Time employed in the unit		
0–5 years	6 (25)	2 (8)
6–15 years	11 (46)	12 (50)
≥ 16 years	7 (29)	10 (42)
Missing	4	1

"Manager's Expectations & Actions Promoting Patient Safety" were significantly improved after 12 months.

The results of the GLMM estimates of organizational outcome (patient safety culture outcome) showed that both 'Organizational Learning and Continuous Improvement' and 'Communication Openness' had a significant effect after 6 months. Overall, physicians had a significant positive, as effect compared to nursing staff, on both 'Frequency of Events Reported' and 'Patient Safety Grade" (Table 7).

The multiple linear regression analysis of all respondents after 12 months ($n = 31$) found that the three improved teamwork dimensions "Situational Monitoring", "Mutual Support" and "Communication" (independent variables) explained 31.6% of the variance in the "Patient Safety Grade" after 12 months of intervention. The model reached statistical significance ($p = .012$). When analyzing which of the three independent variables contributed to the prediction of "Patient Safety Grade", the model showed that "Mutual Support" had the largest ß coefficient (ß = .76) and that the effect was significant ($p = .036$). When testing with the "Overall Perceptions of Patient Safety" as the dependent variable, the model reached statistical significance ($p = .021$). The three teamwork dimensions explained 24.3% of the variance in the "Overall Perceptions of Patient Safety" after 12 months of intervention but with a low ß-coefficient and without statistical significance.

Discussion

Regarding organizational outcomes as related to the SEIPS 2.0 model, improvements were found in two patient safety culture dimensions after the first 6 months of this comprehensive intervention. No improvement was found in professional outcome after the first 6 months, as measured by perceptions of teamwork. After the full 12 months, however, improvements were found in both professional and organizational outcomes. Improvement in professional outcomes were shown in three out of four perceptions of teamwork dimensions. Regarding organizational outcomes, improvements were found in three patient safety culture dimensions. These results indicate that the team training program had an effect after 12 months of implementation. The GLMM estimates demonstrated an effect of time on the patient safety culture dimensions (organizational outcome) "Organizational Learning and Continuous Improvement" and "Communication Openness" after 6 months, and the estimates also demonstrated that physicians had an overall positive significant effect compared to nursing staff on the patient safety culture dimensions "Frequency of Events Reported" and "Patient Safety Grade". Furthermore, the teamwork dimension "Mutual Support" was associated with "Patient Safety Grade" after 12 months of intervention.

No significant improvement after 6 months in T-TPQ measures may be explained by the fact that few of the TeamSTEPPS tools had been implemented by that point. However, we expected to find improvement in "Communication" after 6 months since the tools Closed-loop and ISBAR (Identification, Situation, Background, Assessment, Request/Recommendation) were implemented in the work system in an early phase of the intervention. After 12 months of intervention, however, the results showed improvement in three teamwork dimensions ("Situation Monitoring", "Mutual Support", and "Communication"). The cross-monitoring strategy was implemented after 5 months, and the STEP (Status of the patient, Team members, Environment, Progress toward the goal) tool was implemented after 9 months [58], so the improvement in "Situation Monitoring" may be due to the implementation of these tools. "Situation Monitoring" involves continuously scanning the environment for important information, watching out for other team members, exchanging relevant information, and jointly reevaluating patient goals [44]. The improved scores in "Mutual Support" may be a result of the "Task Assistance" and "Two Challenge Rule" strategies that were implemented in the work system during the study period [58]. "Mutual Support" is about cautioning each other about potentially risky patient safety situations and about assisting one another during high workloads [44]. When observing these improvements in teamwork

Table 6 Healthcare professional perceptions of teamwork and patient safety culture from baseline to 6 and 12 months of intervention

	n = 28				n = 25			
	baseline mean	6 months mean	change from baseline to 6 months		baseline mean	12 months mean	change from baseline to 12 months	
			t[1]	p[1]			t[1]	p[1]
T-TPQ[2] dimensions								
Team Function	3.93 (.40)	3.96 (.44)	.48	.638	3.95 (.43)	4.08 (.44)	1.71	.100
Leadership	4.24 (.40)	4.21 (.49)	−.39	.700	4.16 (.39)	4.15 (.63)	−.09	.926
Situation Monitoring	3.79 (.47)	3.98 (.56)	1.74	.094	3.70 (.43)	4.06 (.54)	4.70	**.001**
Mutual Support	3.85 (.44)	3.93 (.51)	.89	.382	3.83 (.44)	4.03 (.50)	1.04	**.027**
Communication	3.84 (.40)	3.94 (.50)	3.34	.345	3.81 (.39)	4.02 (.53)	2.66	**.015**
CSACD-T[3]								
Team Decision Making	4.73 (.89)	5.02 (1.09)	1.29	.207	4.69 (.92)	4.95(1.03)	1.32	.200
HSOPS[4] dimensions								
Teamwork Within Unit	3.87 (.54)	4.08 (.52)	1.80	.084	3.78 (.52)	4.05 (.51)	2.39	**.025**
Manager Expect. & Actions Promoting Pat. Safety	4.18 (.60)	4.29 (.50)	.91	.370	4.11 (.56)	4.39 (.52)	2.72	**.012**
Organizational Learning – Cont. Improvement	3.82 (.51)	4.05 (.61)	1.8	**.001**	3.76 (.51)	3.97 (.65)	1.78	.087
Feedback & Communication About Error	3.71 (.62)	3.85 (.70)	.04	.965	3.65 (.58)	3.90 (.60)	1.84	.078
Communication Openness	3.83 (.49)	4.07 (.60)	2.37	**.025**	3.77 (.59)	3.97 (.49)	2.58	**.017**
Staffing	3.52 (.46)	3.39 (.52)	−1.08	.292	3.81 (.49)	4.07 (.53)	.06	.955
Nonpunitive Response to Errors	2.90 (.69)	3.14 (.83)	1.38	.178	2.86 (.66)	3.01 (.84)	.97	.342
Frequency of Events Reported[5]	2.88 (.70)	3.13 (.84)	1.98	.059	3.49 (.45)	3.50 (.66)	1.09	.287
Overall Perceptions of Patient Safety[5]	4.12 (.51)	4.28 (.50)	.90	.375	4.13 (.49)	4.27 (.62)	1.94	.065
HSOPS[4] single items			z-score[6]	p[6]			z-score[6]	p[6]
Number of Events Reported[5]	2.11 (.83)	2.00 (.80)	−.63	.527	2.24 (.78)	2.15 (.72)	−.78	.439
Patient Safety Grade[5]	3.67 (.56)	3.79 (.59)	−.82	.414	3.67 (.57)	3.92 (.56)	−.1.9	.059

[1]Paired t-test
[2]T-TPQ = TeamSTEPPS Teamwork Perceptions Questionnaire (scale 1–5)
[3]CSACD-T = Collaboration and Satisfaction About Care Decisions in Teams Questionnaire (scale 1–7)
[4]HSOPS = Hospital Survey of Patient Safety Culture Questionnaire (scale 1–5)
[5]Patient Safety outcome measures
[6]Wilcoxon Signed Ranks Test

dimensions from a system perspective, they are seen as improved professional outcomes (see Fig. 1). Previous studies from the context of surgical wards that have measured self-reported teamwork have produced ambiguous results [59–61]. Paull, DeLeeuw [61] found improvement in all scores in their multicenter study when the scores were measured immediately after the training. Study results collected a short time after a team training may benefit from the positive experience the participants have just had and can be seen to reflect a strong Hawthorne effect [62]. The reason why we did not see improvements in team decision making in our study may be due to the time points selected for measurement. Previous studies that showed enhanced scores in decision making measured 2 weeks and 2 months after simulation training [63, 64]. Our results for team decision making may also be explained by the fact that the TeamSTEPPS program does not emphasize decision making, and therefore, there was not a focus on this important aspect of teamwork in the intervention. In the teamwork literature from Europe, where team competencies are referred to as team skills, decision making is one of the six skills in the definition of non-technical skills (NTS) [65]. Furthermore, decision making has also recently been emphasized in the teamwork literature, indicating significance for patient safety and patient outcomes [2, 34, 35].

The organizational outcome measured by patient safety culture showed improvement in "Organizational Learning & Continuous Improvement" and "Communication Openness" after 6 months of intervention, and improvement in the latter was sustained after 12 months, both of which are interesting results. "Communication

Table 7 Estimated Patient Safety Culture by "Time" and "Profession group" (n = 98)

Parameter	Estimate	95% Confidence Interval	p^1
Organizational Learning and Continuous Improvement			
Intercept	3.80	3.60, 4.00	.000
Baseline[2]	0[b]		
6 months of intervention	.33	.05, .60	**.020**
12 months of intervention	.18	-.09, .46	.193
Nursing staff[2]	0[b]		
Physicians	-.27	-.54, .00	.051
Communication Openness			
Intercept	3.80	3.63, 4,02	.000
Baseline[2]	0[b]		
6 months of intervention	.29	.02, .55	**.035**
12 months of intervention	.21	-.05, .48	.116
Nursing staff[2]	0[b]		
Physicians	-.12	-.38, .14	.366
Frequency of Events Reported			
Intercept	2.73	2.46, 3.00	.000
Baseline[2]	0[b]		
6 months of intervention	.26	-.11, .63	.164
12 months of intervention	.13	-.25, .51	.500
Nursing staff[2]	0[b]		
Physicians	.56	.19, .93	**.003**
Patient Safety Grade			
Intercept	3.60	3.41, 3.79	.000
Baseline[2]	0[b]		
6 months of intervention	.11	-.16, .38	.410
12 months of intervention	.25	-.02, .52	.074
Nursing staff[2]	0[b]		
Physicians	.40	.14, .66	**.003**

Openness" is a measure of whether staff freely speak up if they see something that may negatively affect a patient and if they feel free to question those with more authority than themselves [66]. This result is therefore of importance regarding the patient safety culture in the ward, as it may contribute to catching adverse events before it reaches a patient. Regarding whether the healthcare professionals reported diverse types of adverse events in our study, the average answer was "sometimes" at all data collection times, while the registered adverse events increased during the study period. An increase in adverse events is not desirable, but may be seen as an improvement in the reporting culture. The main purpose of reporting is to learn from adverse events [67], and learning is an important part of the human factors approach to patient safety. After 6 months, improvements were found in organizational outcomes (in two patient safety dimensions). After the full 12 months, improvements were found in both organizational outcomes (three patient safety culture dimensions) and professional outcomes (three teamwork dimensions). The mixed model estimates demonstrated that physicians had effects on two patient safety culture measures. Furthermore, the results showed that teamwork was associated with Patient Safety Grade [68]. The improvement in the HSOPS dimension "Organizational Learning – Continuous Improvement" (organizational outcome) may indicate that the healthcare professionals perceived their ward as a learning unit. This result also supports the mixed model estimate, which demonstrated that the time had an effect on "Organizational Learning & Continuous Improvement" after 6 months. The estimates also demonstrated that the healthcare professionals` perceptions of "Communication Openness" were affected by time (6 months), which corresponds with the results from the t-test analyses, where "Communication Openness" showed significant

improvements after both 6 and 12 months. The estimates from the mixed models that suggested that physicians had a positive effect on the intervention compared to nursing staff on two patient safety culture dimensions is an interesting finding since it is often challenging to involve physicians in interprofessional interventions in wards [69]. Although we cannot say for sure what caused what, we consider the interprofessional approach to training and implementation as crucial to success in the quality improvement of teamwork and patient safety work in hospital wards. The interprofessional approach may have influenced the professional and organizational outcomes in a positive way. In addition to the sustained improvement in "Communication Openness", two more dimensions of HSOPS were improved after 12 months: "Teamwork Within Unit" and "Manager's Expectations & Actions Promoting Patient Safety". As a part of an enabling work environment, management and leadership are important enablers in achieving effective teamwork and patient safety in complex organizations [70]. This teamwork and patient safety intervention, led by the leaders and the other members of the change team, may have contributed to improvements in these dimensions. The changes in leadership positions may also have accounted for the improvement, but this is uncertain. However, although the master trained nurse unit manager resigned from the unit, she continued to work in the administration of the department and continued to give support and guidance for the intervention from her new position.

Our improved patient safety culture results in three dimensions of the HSOPS (organizational outcome) are in line with those from previous research in diverse hospital contexts. Two multicenter studies found improvement in three HSOPS dimensions when measured after 12 months [71, 72], and Thomas and Galla [69] found improvements in three HSOPS dimensions after 2 years. Schwartz, Welsh [72] found a decrease from 6 to 12 months in their multicenter study, a decrease they explained with a need for early refresher training.

The improved professional outcome "Mutual Support" was associated with "Patient Safety Grade" at the end of the study period, which is interesting from a human factors perspective since this T-TPQ dimension Mutual Support encompasses items focus on patient safety and emphasizes the strong patient safety aspect of the TeamSTEPPS program.

The use of the conceptual framework contributed to an enhanced understanding of the system approach in our study, which is important to implement and sustain innovations [73]. When implementing teamwork tools, such as ISBAR, Closed-loop, and Cross-monitoring [58] in the work system, the use of the tools and strategies in the clinical work processes have influenced professional outcomes indicating that the teamwork competencies of the healthcare professionals improved during the study period. Transfer of the learning from team training is crucial to patient safety and interesting from a human factors perspective, as outcomes are influenced by the learning-to-transfer pathway [74]. The improvement in organizational outcomes (patient safety culture) may be due to the TeamSTEPPS intervention in the work system (see Fig. 1).

The implementation of teamwork tools that initiated new ways of working may in time lead to system changes, but that was beyond the scope of this study. The healthcare professionals in hospital wards are organized in silos and system changes and structural changes that promote teamwork and patient safety are warranted in the future [1].

Study limitations

The study has some limitations. The lack of randomization and controls may have threatened the internal validity, although a pre-post design is useful where there are practical barriers to a randomized design [75]. The study samples were small, but the response rates were satisfying, without risk of response bias. Because of the uncontrolled design, we cannot conclude that the improvements were due to the intervention. There are always secular trends that might be occurring at the same time in a surgical ward, and which may have influenced our results [76]. However, because of these study limitations, caution must be taken in generalizing the results.

Conclusions

This study showed the effect of a human factors team training intervention after 12 months of implementation in a surgical ward, an effect that was demonstrated by both professional and organizational outcomes in the SEIPS 2.0 model. More work needs to be done to investigate the effect of TeamSTEPPS interventions in surgical wards, and studies with larger sample sizes and stronger designs are preferred. Future studies testing the causal pathways identified by SEIPS 2.0 will be of special interest.

Abbreviations

CSACD-T: Collaboration and Satisfaction with Care Decisions in Teams; GLMM: Generalized Linear Mixed Model; HSOPS: The Hospital Survey of Patient Safety Culture; ISBAR: Identification, Situation, Background, Assessment, Request/Recommendation; SEIPS: Systems Engineering Initiative for Patient Safety; STEP: Status of the patient, Team members, Environment, Progress toward the goal; I-PASS: Illness severity, Patient summary, Action list, Situation awareness and contingency planning, Synthesis by receiver; TeamSTEPPS: Team Strategies and Tools to Enhance Performance and Patient Safety; T-TPQ: TeamSTEPPS Teamwork Perceptions Questionnaire

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Authors' contributions
ORA, MLHL, SEH, and RB contributed to the conception and design and the writing and critical revision of the manuscript and approved the final version published.

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Availability of data and materials
The datasets used during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate
The study protocol was reviewed by the "Regional Committees for Medical Research Ethics - South East Norway" (ref. 2016/1013 C). The study was approved by the Norwegian Center for Research Data (ref. no. 46323), and conducted in accordance with the Helsinki Declaration [77]. Written information about the study was sent to all participants via SurveyXact with reference to the principle of autonomy addressed by confidentiality and voluntariness. Although the team training and implementation activities were compulsory during work hours, participating in the surveys was voluntary. Completion of the surveys was regarded as informed consent. For ethical reasons, we did not collect data about the non-responders.

Consent for publication
"Not applicable".

Competing interests
The authors declare that they have no competing interests.

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An interprofessional team training intervention with an implementation phase in a surgical ward: A controlled quasi-experimental study

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ABSTRACT

Despite a growing awareness of the importance of interprofessional teamwork in relation to patient safety, many hospital units lack effective teamwork. The aim of this study was to explore if an interprofessional teamwork intervention in a surgical ward changed the healthcare personnel's perceptions of patient safety culture, perceptions of teamwork, and attitudes toward teamwork over 12 months. Healthcare personnel from surgical wards at two hospitals participated in a controlled quasi-experimental study. The intervention consisted of six hours of TeamSTEPPS team training and 12 months for the implementation of teamwork tools and strategies. The data collection was conducted among the healthcare personnel in the intervention group and the control group at baseline and at the end of the 12 month study period. The results within the intervention group showed that there were significantly improved scores in three of 12 patient safety culture dimensions and in three of five perceptions of teamwork dimensions after 12 months. When comparing between groups, significant differences were found in three patient safety culture measures in favor of the intervention group. The results of the study suggest that the teamwork intervention had a positive impact on patient safety culture and teamwork in the surgical ward.

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Interprofessional teamwork; implementation; patient safety culture; TeamSTEPPS; team training; surgical healthcare personnel

Introduction

In complex hospital organizations, the quality of patient care depends upon professions working together in interprofessional teams (WHO, 2010). Despite a growing awareness of the importance of teamwork, many hospital units lack effective teamwork, with negative consequences for the patient (Leonard, Frankel, & Knight, 2012; O'connor et al., 2016). The complexity of surgical care, coupled with the limitations of human performance, make it critically important that healthcare personnel have efficient interprofessional teamwork (Yngman-Uhlin, Klingvall, Wilhelmsson, & Jangland, 2016). In this paper, the impact of a teamwork intervention in a surgical ward is studied

Background

Interprofessional teamwork involves different health professions which share a team identity, and work closely together in an integrated and interdependent manner to solve problems and deliver healthcare services (Reeves, Lewin, Espin, & Zwarenstein, 2010). To ensure effective teamwork, all healthcare professionals need competency in teamwork (Vincent, Burnett, & Carthey, 2014). Team competencies refer to the behaviors, cognitions and attitudes that individuals use to coordinate their efforts toward a shared goal (King et al., 2008). An effective method to improve healthcare personnel's teamwork competencies is team training (Salas, Paige, & Rosen, 2013). Team training is defined as "a set of tools and methods that form an instructional strategy," and is a methodology designed to educate team members with the competencies necessary for optimizing teamwork (Salas, Cooke, & Rosen, 2008, p. 1003). Reviews report that team training can positively impact teamwork, such as learning transfer measured by improved teamwork (O'Dea, O'Connor, & Keogh, 2014), patient safety culture (Weaver et al., 2013) and patient outcomes (Hughes et al., 2016). The majority of studies of interprofessional team training in hospitals have been conducted in special care units (Mayer et al., 2011; Sonesh et al., 2015) such as in the operating room (OR) (Armour Forse, Bramble, & McQuillan, 2011; Neily et al., 2010), where Neily et al. (2010) demonstrated an 18% reduction in mortality after OR team training. While special unit teams most often are gathered around the patient, the wards have a more geographic dispersion of team members (O'Leary et al., 2010). Surgical wards differs from medical wards in that surgeons are less available because they are often admitted to surgery (Yngman-Uhlin et al., 2016). Some studies on interprofessional team training have been conducted in medical wards, but

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there is limited research from the context of surgical wards (Aaberg & Wiig, 2017; Hughes et al., 2016). Furthermore, since surgical wards are an area of high risk of adverse events (de Vries, Ramrattan, Smorenburg, Gouma, & Boermeester, 2008) this is an important context to study. There are few studies from this context that have reported on the sustainability of the impact of teamwork interventions (Rosen et al., 2018). A post-training implementation is of importance for the transfer of the learning and development of patient safety culture in clinical practice (Weaver, Dy, & Rosen, 2014).

Several team training programs have been developed, but many of them are context- or discipline-specific (Teamwork and Communication Working Group, 2011). The Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) was chosen for this study because it is an evidence-based teamwork program (2014). Previous TeamSTEPPS studies have shown promising results regarding patient safety culture (Lisbon et al., 2014; Thomas & Galla, 2013) attitudes toward teamwork (Wong, Gang, Szyld, & Mahoney, 2016) and perceived teamwork (Budin, Gennaro, O'Connor, & Contratti, 2014; Tibbs & Moss, 2014). However, the impact on surgical wards is uncertain.

TeamSTEPPS aims to optimize team performance in all types of healthcare teams and contexts to integrate teamwork competencies into practice (2014). The overall aim of the program is to improve the patient safety and the quality of care (King et al., 2008; TeamSTEPPS 2.0, 2014). The TeamSTEPPS program is built on five key principles, which are team structure and four team competencies (Leadership, Situation Monitoring, Mutual Support and Communication (Alonso & Dunleavy, 2012; TeamSTEPPS 2.0, 2014). Each of the four team competencies has a set of tools or strategies that team members are supposed to utilize to ensure effective teamwork (King et al., 2008). Team decision-making is an additional team competency not included in the TeamSTEPPS program but is also pointed out as a key team competency in the literature (Reader, 2017; Salas, Cannon-Bowers, & Johnston, 2014).

The aim of this study was to explore if an interprofessional teamwork intervention in a surgical ward changed the healthcare personnel's perceptions of patient safety culture, perceptions of teamwork, and attitudes toward teamwork over 12 months.

Table 1. Baseline profiles of the two surgical wards.

	Intervention ward	Control ward
Specialties	Gastrointestinal surgery and Urology	Gastrointestinal surgery and Ear, nose and throat
Beds (n)	20	26
Occupied beds per year[1] (%)	87	91
Length of Stay (mean days)	3.46	3.50
Non-clinical nurses FTE[2] (n)	2.60 (3)	2.93 (3)
Nursing assistants FTE[2] (n)	4.95 (7)	3.26 (5)
Physicians FTE[2] (n)	13 (14)	12 (12)
Registered nurses FTE[2] (n)	17.25 (25)	25.5 (40)
Nurse/bed-ratio	1.1	1.1

[1]2015
[2]FTE = Full-time employees

Methods

Research design, setting and sample

The study had a controlled quasi-experimental design (Eccles, Grimshaw, Walker, Johnston, & Pitts, 2003) and was carried out in two surgical wards in two different hospital trusts in Norway. The intervention group consisted of healthcare personnel (nursing assistants, physicians and registered nurses) from a combined gastrointestinal surgery and urology ward, which was selected for convenience. The control group consisted of healthcare personnel from a combined gastrointestinal surgery and ear, nose and throat ward from another hospital. The control ward was selected based on similarity to the intervention group despite being at another location, which helped to avoid the contamination effect (Polit & Beck, 2017) (see Table 1 for profiles of the two study wards)

After obtaining consent from the management, all eligible healthcare personnel from the two wards were invited to participate in the study. The initial number of invited participants was 98; distributed as 43 from the intervention group and 55 from the control group (Figure 1).

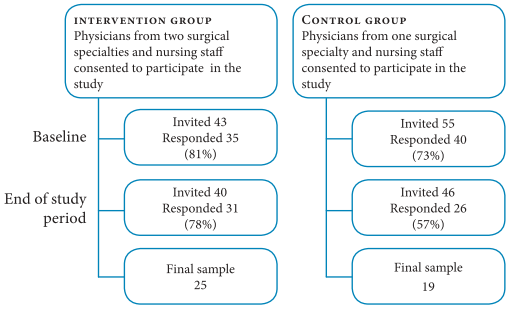

Figure 1. Flowchart of the study samples.

The intervention

The TeamSTEPPS program (2014) was translated into Norwegian by a translation agency, and the translated version was reviewed by the researchers. Kotter's model for leading change was used to guide the implementation in a stepwise fashion (Kotter, 2012). Kotter (2012) includes eight steps that are supposed to be followed in order to achieve success with the change work (see Figure 2). Each of these steps is organized into three phases that align with the TeamSTEPPS model of change, and the phases is described below. Further details of the intervention are described elsewhere (Aaberg, Hall-Lord, Husebo, & Ballangrud, 2019).

Phase 1 – set the stage and decide what to do – assessment and planning

Site assessments of the potential study sites were conducted (TeamSTEPPS 2.0, 2014), and the leaders of the intervention ward considered their ward`s readiness for the TeamSTEPPS program. Two of the authors (ORA, RB), two nurse leaders, and two physician leaders from the intervention ward attended master training and were certified as TeamSTEPPS instructors. The researchers and the leaders of the hospital ward jointly developed a plan for training and implementation.

Phase 2 – make it happen – training and implementation

A mandatory six-hour interprofessional team training (TeamSTEPPS fundamentals) was conducted for 41 participants during work hours over a three-week period (Aaberg & Ballangrud, 2017). All respondents in the intervention group participated in the six hours of initial team training. In addition to classroom training (lectures, videos and role play), the course consisted of two high-fidelity simulation sessions with a focus on communication and teamwork using one urology scenario and one gastrointestinal surgery scenario. In addition, champions from all professions and a former patient were identified and assigned as members of a Change Team. They developed a vision and an action plan based on identified patient safety issues in the ward and aligned with the organizational goals. One TeamSTEPPS tool was implemented approximately every month, and the "tool of the month" was communicated through weekly newsletters, staff meetings and posters. One of the authors (ORA) coached the implementation by giving and gathering input from site visits and e-mail communications with the leaders and the clinical nurse specialist, and as a member of the Change Team.

Phase 3 – make it stick – sustainment

The Change Team continued to meet, worked with different areas of patient safety and teamwork, and continued the implementation of tools and strategies. Milestones were celebrated along the way, and 75 minutes of classroom TeamSTEPPS refresher training was held for the nursing staff during work hours after 5 months and 11 months, and for physicians with a 20 minutes classroom refresher training after 5 months. The implemented tools and strategies became a part of the daily routines in the ward.

An overview of the intervention is illustrated in Figure 3. The control group received no formal team training activities during the study period.

Measurements

In addition to demographic information about respondents (gender, age, profession and time employed in the ward), data from four questionnaires were collected to explore the impact of the intervention.

The Hospital Survey on Patient Safety Culture (HSOPS) is a questionnaire for assessing healthcare personnel's perceptions of the patient safety culture within their workplace (Sorra & Dyer, 2010). It consists of 44 items, with 42 of the items composed into 12 dimensions. Nine dimensions aim to measure patient safety culture at the unit level: Teamwork Within the Unit, Communication Openness, Supervisor/Manager's Expectations and Actions Promoting Patient Safety, Staffing, Organizational Learning – Continuous Improvement, Feedback and Communication About Error, Nonpunitive Response to Errors, Frequency of Events Reported and Overall Perceptions of Patient Safety in the Unit. Three dimensions are measuring patient safety culture at the hospital level: Hospital Management Support for Patient Safety, Teamwork across Units and Handoffs and

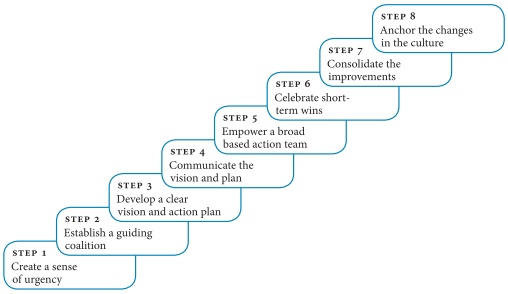

Figure 2. Kotter`s eight steps for organizational change (Kotter, 2012).

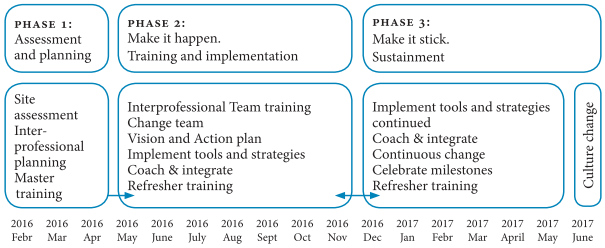

Figure 3. Model of the TeamSTEPPS intervention.

Transitions. These items use a 5-point Likert response scale of "agreement" or "how often," from 1 = "Strongly Disagree" to 5 = "Strongly Agree" or 1 = "Never" to 5 = "Always" (five choices with "neither" in the middle). In addition, there are two single items: Patient safety grade, which asks respondents to provide an overall grade on patient safety for their work unit (A = Excellent, B = Very Good, C = Acceptable, D = Poor, E = Failing), and Number of Events Reported, to indicate the number of adverse events they have reported over the past 12 months (No events, 1 to 2 events, 3 to 5 events, 6 to 10 events, 11 to 20 events or 21 events or more). A total of 18 items in the questionnaire are negatively worded (Sorra & Dyer, 2010). Overall Perceptions of Patient Safety, Number of Events Reported, Frequency of Events Reported, and Patient Safety Grade are defined as safety outcome measures (Jones, Skinner, Xu, Sun, & Mueller, 2008).

The TeamSTEPPS Teamwork Perceptions Questionnaire (T-TPQ) is a self-report questionnaire developed to measure individuals' perceptions of group-level teamwork in the workplace and it is related to the five key components of teamwork of the TeamSTEPPS program. It has 35 items composed of responses (from 1 = "Strongly agree" to 5 = "Strongly disagree on a 5-point Likert response scale) to seven statements into each of the five dimensions: Team structure, Leadership, Mutual Support, Situational Monitoring and Communication (Keebler et al., 2014).

The Collaboration and Satisfaction About Care Decisions in Team Questionnaire (CSACD-T) is composed of nine items regarding collaboration and satisfaction with team decision-making about patient care. This questionnaire was developed from the nurse-physician Collaboration and Satisfaction About Care Decisions Questionnaire (CSACD) (Baggs, 1994). The nine-item CSACD-T questionnaire has response options on a Likert scale ranging from 1 to 7. The first six items measure attributes of collaboration in teams, with response options ranging from 1 (strongly disagree) to 7 (strongly agree). The seventh item measures the level of global collaboration, with the response options ranging from 1 (no collaboration) to 7 (complete collaboration). The last two items consider satisfaction with team decisions and have response options ranging from 1 (not satisfied) to 7 (very satisfied) (Aaberg, Hall-Lord, Husebø, & Ballangrud, 2019).

The TeamSTEPPS Teamwork Attitude Questionnaire (T-TAQ) measures individuals' general attitudes of teamwork in healthcare, and includes the five components of teamwork: Team Structure, Leadership, Mutual Support, Situational Monitoring and Communication. It has 30 items that are statements for which the individuals give their agreements on each item on a Likert scale (1 = "Strongly disagree" to 5 = "Strongly agree"). Four items are negatively worded (Baker, Amodeo, Krokos, Slonim, & Herrera, 2010).

The Norwegian versions of the questionnaires were used. The T-TPQ (Ballangrud, Husebø, & Hall-Lord, 2017), CSACD-T (Aaberg et al., 2019), and T-TAQ (Ballangrud, Husebø, & Hall-Lord, 2019) were translated into the Norwegian language in line with back translation procedures and psychometrically tested among Norwegian hospitals' healthcare personnel, conducted by the study team (Ballangrud et al., 2017). The HSOPS questionnaire was translated and psychometrically tested by Olsen (2008).

Data collection

The surveys were distributed through e-mail using a web-based platform (SurveyXact). The leaders in the two study groups provided e-mail addresses. An information e-mail was sent one week prior to the distribution of the surveys, and reminders were sent to those who had not responded after one week, two weeks and three weeks. The surveys were distributed at baseline (February-March 2016) and at the end of the 12 month study period (June 2017).

Data analysis

To explore the impact of the intervention, scores from respondents who had answered at both baseline and at the end of the 12 month study period were included. Negatively worded items of HSOPS and T- TAQ were reversed. The items of the questionnaires were computed according to the defined dimensions (Sorra et al., 2016) by adding the mean to a total score, and dividing the score by the number of items in the dimension. The data was analyzed by using SPSS version 24 (IBM, Armonk, NY). In order to test for statistically significant differences between the intervention and control group at baseline, a Mann Whitney U-test was performed for each dimension and forthe single items. The mean total score of CSACD-T and the mean scores of each dimension of

the HSOPS, T-TPQ and T-TAQ were analyzed through the use of a paired t-test to check for changes from baseline to the end of the 12 month study period within both groups. To assess the magnitude of the improved dimensions, effect sizes (ES) were calculated by the mean score at the end of study period subtracted by the mean baseline score, and then divided by the baseline standard deviation (Durlak, 2009). We applied Cohen's standards for effect size as follows: small effect 0.2, medium effect 0.5, and large effect 0.8 (Cohen, 1988). The two single items of HSOPS were analyzed with a Wilcoxon Signed Rank test within groups and with a Mann Whitney U-test between groups. Linear mixed effects models were used to compare differences between the two groups (Bolker et al., 2009). The models had terms for group, time, the interaction between group*time and with a person random effect. A p-value of $< .05$ was considered to be statistically significant for all analyzes.

Ethical considerations

The Norwegian Center for Research Data approved the study (ref. no. 46323), and approvals from the hospital administrations were given. The study was conducted according to the Declaration of Helsinki's ethical principles for research (The World Medical Association, 2013). The survey included information about the aim of the study, confidentiality and voluntary participation, whereas completion of the surveys was regarded as informed consent. The study protocol was registered retrospectively with registration date 2017/05/30 and trial registration number ISRCTN13997367 (Ballangrud et al., 2017).

Results

The number of participants who responded to the surveys at both baseline and at the end of a 12 month study period was 44, distributed as 25 from the intervention group and 19 from the control group. Demographics of the respondents are reported in Table 2. There was one significant difference between the two samples at baseline: employment time in the ward.

Only 6% of the healthcare personnel in the control group had worked on the ward for more than 16 years, whereas 42% of the healthcare personnel in the intervention group had worked there for that long a period of time.

The baseline mean scores and comparisons between intervention group and control group are shown in Table 3. Only 4 of 25 measures were significantly different between the groups: the HSOPS measures Supervisor/Manager Expectations & Actions Promoting Patient Safety, the Patient Safety Grade, and the T-TPQ Situation Monitoring and Leadership dimensions.

Patient safety culture

Results within the intervention group showed significantly higher scores in the three dimensions, Teamwork Within Unit, Communication Openness, and Supervisor/Manager Expectations and Actions Promoting Patient Safety, at the end of the 12 month study period. There were no significant changes in any of the patient safety culture measures within the control group (Table 4). Significant differences between the two groups were found in three patient safety culture measures: Teamwork Within Unit, Overall Perceptions of Patient Safety, and Patient Safety Grade, all in favor of the intervention group (Table 4 and Table 5).

Table 2. Demographic information about respondents.

	Intervention group	Control group	p[1]
	n = 25	n = 19	
Profession			.99
Nursing assistants	3 (12)	2 (10)	
Physicians	4 (16)	3 (16)	
Registered nurses	18 (72)	14 (74)	
Age			.18
≤ 30 years	4 (16)	4 (22)	
31–50 years	12 (48)	12 (67)	
≥51 years	9 (36)	2 (11)	
Missing		1	
Sex			.09
Female	22 (88)	16 (89)	
Missing		1	
Employment time in the ward			**.03**
0–5 years	2 (8)	7 (39)	
6–15 years	12 (50)	10 (55)	
≥16 years	10 (42)	1 (6)	
Missing	1		

[1]Pearson Chi square test

Table 3. Baseline scores and comparisons between the two study groups.

	Intervention group	Control group	p[2]
	Mean (SD[1])	Mean (SD[1])	
HSOPS[3]			
Teamwork Within Unit	3.78 (.52)	4.07 (.63)	.08
Communication Openness	3.81 (.49)	3.89 (.51)	.75
Supervisor/Manager Expectations & Actions Promoting Patient Safety	4.11 (.56)	3.81 (.62)	**.02**
Staffing	3.52 (.46)	3.26 (.69)	.20
Learning and Continuous Improvement	3.76 (.51)	3.88 (.57)	.41
Feedback and Communication About Error	3.77 (.59)	3.72 (.62)	.20
Nonpunitive Response to Errors	4.13 (.49)	4.05 (.71)	.40
Frequency of Events Reported	2.86 (.66)	3.13 (.79)	.15
Overall Perceptions of Patient Safety	3.65 (.58)	3.90 (.51)	.35
Hospital Management Support for Patient safety[4]	3.28 (.60)	3.14 (.61)	.74
Handoffs and Transitions[4]	3.49 (.45)	3.55 (.27)	.88
Teamwork Across Units[4]	3.40 (.53)	3.35 (.47)	.82
Number of Events Reported[5]	2.24 (.78)	2.42 (1.07)	.10
Patient Safety Grade[5]	3.67 (.57)	4.00 (.47)	**.04**
T-TPQ[6]			
Team structure	3.95 (.43)	4.03 (.56)	.05
Leadership	4.16 (.39)	3.64 (.73)	**.001**
Situation monitoring	3.70 (.43)	3.97 (.51)	**.02**
Mutual support	3.83 (.44)	3.86 (.52)	.06
Communication	3.81 (.39)	3.94 (.42)	.05
CSACD-T[7]			
Team decision-making	4.69 (.92)	4.80 (.89)	.16
T-TAQ[8]			
Team structure	3.84 (.32)	3.88 (.41)	.80
Leadership	4.34 (.36)	4.26 (.49)	.23
Situation monitoring	4.05 (.44)	4.06 (.33)	.72
Mutual support	3.94 (.45)	4.04 (.35)	.26
Communication	4.04 (.39)	3.91 (.30)	.14

[1]Standard Deviation
[2]Mann Whitney U-test
[3]HSOPS = Hospital Survey of Patient Safety Culture Questionnaire
[4]Hospital level dimensions (HSOPS)
[5]Single items (HSOPS)
[6]TeamSTEPPS Teamwork Perceptions Questionnaire
[7]Collaboration and Satisfaction about Care Decisions in Team Questionnaire
[8]TeamSTEPPS Teamwork Attitudes Questionnaire

Table 4. Patient safety culture dimension scores.

	Intervention group n = 25				Control group n = 19				Difference between groups
	Mean (SD[1]) after 12 months	Mean change from baseline to 12 months (95% CI[2])	p^3	ES[4]	Mean (SD[1]) after 12 months	Mean change from baseline to 12 months (95%CI[2])	p^3	ES[4]	p^5
HSOPS[6]									
Teamwork Within Unit	4.06 (.48)	.27 (.04, .51)	**.03**	.54	3.93 (.51)	−.13 (−.36, .10)	.24	−.22	**.02**
Communication Openness	4.02 (.53)	.26 (.05, .47)	**.02**	.43	3.92 (.61)	.00 (−.29, .29)	1.0	.06	.13
Supervisor/Manager Expectations & Actions Promoting Patient Safety	4.33 (.51)	.28 (.07, .49)	**.01**	.39	3.92 (.59)	.11 (−.20, .41)	.47	.18	.33
Staffing	3.52 (.62)	.01 (−.23, .25)	.96	.00	3.38 (.60)	.12 (−.20, .44)	.44	.14	.55
Organizational Learning & Continuous Improvement	3.93 (.61)	.21 (−.03, .45)	.09	.33	3.79 (.58)	−.09 (−.31, .14)	.42	−.16	.08
Feedback Communication About Error	3.97 (.46)	.20 (−.02, .42)	.08	.34	3.81 (.62)	.07 (−.20, .34)	.57	.15	.46
Nonpunitive Response to Errors	4.29 (.60)	.13 (−.15, .42)	.34	.33	4.00 (3–5)	.00 (−.23, .37)	.63	−.07	.76
Frequency of Events Reported	2.96 (.82)	.12 (−.11, .36)	.29	.15	3.37 (.48)	.18 (−.27, .62)	.41	.30	.81
Overall Perceptions of Patient Safety	3.92 (.57)	.25 (−.02, .52)	.07	.47	3.67 (.66)	−.24 (−.62, .15)	.21	−.45	**.03**
Hospital Management Support for Patient Safety[7]	3.20 (.77)	−.03 (−.29, .24)	.84	−.13	2.78 (.87)	−.32 (−.71, .08)	.11	−.59	.20
Handoffs and Transitions[7]	3.34 (.57)	−.22 (−.45, .01)	.08	−.33	3.50 (3–4)	−.15 (−.41, .11)	.23	−.19	.81
Teamwork Across Units[7]	3.31 (.54)	−.08 (−.28, .12)	.42	−.17	3.14 (.55)	−.21 (−.48, .06)	.11	−.45	.40

[1]Standard Deviation
[2]Confidence Interval
[3]Paired t-test
[4]Effect size
[5]Linear Mixed Effect Models
[6]Hospital Survey of Patient Safety Culture Questionnaire
[7]Hospital level dimensions

Table 5. Patient safety culture single item scores.

	Intervention group n = 25			Control group n = 19			Difference between groups
	Mean (SD[1]) baseline	Mean (SD[1]) after 12 months	p^2	Mean (SD[1]) baseline	Mean (SD[1]) after 12 months	p^2	p^3
HSOPS[4]							
Number of Events Reported	2.24 (.78)	2.15 (.72)	.44	2.42 (1.07)	2.78 (1.22)	.31	.15
Patient Safety Grade	3.67 (.57)	3.92 (.56)	.06	4.00 (.47)	3.71 (.85)	.10	**.01**

[1]Standard Deviation
[2]Wilcoxon Signed Rank test
[3]Linear Mixed Effect Models
[4]Hospital Survey of Patient Safety culture

Teamwork

The results within the intervention group showed significantly higher scores after 12 months in three T-TPQ dimensions: Situation Monitoring, Mutual Support, and Communication. Within the control group there was a significantly higher score in the T-TPQ Leadership dimension after 12 months. No significant changes were found in CSACD-T and T-TAQ neither within the groups nor between the groups (Table 6).

Discussion

Results from the study suggest that the TeamSTEPPS intervention had a positive impact on healthcare personnel's perceptions of teamwork and patient safety culture in some domains. The improved patient safety and teamwork dimensions with medium to large effect size indicate a practical effect of the intervention (Sun, Pan, & Wang, 2010). The impact of the intervention was also demonstrated by positive differences between the groups in three patient safety culture measures, while the perceptions of the T-TPQ Leadership dimension was significantly different in favor of the control group. However, the heterogeneity of the impact also defines some areas for future research.

The improved measures of the HSOPS indicate a change in the safety culture in the intervention ward. Two outcome measures, Overall Perceptions of Patient Safety and Patient Safety Grade, differed significantly between the groups in favor of the intervention group. Together with the improved scores in Teamwork Within Unit, the results suggests a benefit to the patient safety culture due to the intervention.

Seen in light of the patient safety focus in the TeamSTEPPS intervention, the increased score in Communication Openness within the intervention group is particularly interesting. Communication Openness is about speaking up freely if seeing something that may negatively affect a patient, and it is also about questioning team members with more authority when necessary (Sorra et al., 2016). The hierarchy within hospital organizations is a common problem in patient safety, in which healthcare personnel have not always felt that they can speak up across professional boundaries (Leape, 2015).

Table 6. Teamwork dimension scores.

	Intervention group n = 25				Control group n = 19				Difference between groups
	Mean (SD[1]) after 12 months	Mean change from baseline to 12 months (95% CI[2])	p^3	ES[4]	Mean (SD[1]) after 12 months	Mean change from baseline to 12 months (95% CI[2])	p^3	ES[4]	p^5
T-TPQ[6]									
Team Structure	4.08 (.44)	.13 (−.03, .30)	.10	.30	4.03 (.34)	−.00 (−.27, .26)	.98	.00	.33
Leadership	4.15 (.63)	−.01 (−.20, .18)	.93	−.03	4.01 (.60)	.38 (.01, .74)	**.04**	.51	**.04**
Situation Monitoring	4.06 (.54)	.40 (.22, .58)	**.001**	.84	4.13 (.36)	.12 (−.05, .38)	.13	.31	.08
Mutual Support	4.03 (.50)	.21 (.03, .39)	**.03**	.45	4.03 (.45)	.17 (−.05, .39)	.11	.32	.80
Communication	4.02 (.53)	.26 (.06, .47)	**.02**	.54	3.99 (.26)	.05 (−.13, .23)	.58	.12	.12
CSACD-T[7]									
Team decision-making	4.95 (1.03)	.26 (−.15, .66)	.20	.28	5.10 (1.16)	.30 (−.26, .86)	.28	.34	.90
T-TAQ[8]									
Team Structure	3.96 (.46)	.12 (−.05, .29)	.16	.38	3.87 (.55)	−.05 (−.26, .17)	.65	−.02	.21
Leadership	4.41 (.55)	.07 (−.15, .29)	.51	.19	4.35 (.64)	.07 (−.29, .43)	.69	.18	.99
Situation Monitoring	4.26 (.51)	.21 (−.04, .46)	.09	.48	4.10 (.43)	.03 (−.15, .20)	.75	.12	.25
Mutual Support	4.05 (.47)	.11 (−.05, .27)	.17	.28	4.08 (.89)	.04 (−.12, .20)	.61	.11	.53
Communication	3.99 (.60)	−.06 (−.30, .19)	.65	−.13	3.99 (.49)	.08 (.11, .28)	.38	.27	.39

[1]Standard Deviation
[2]Confidence Interval
[3]Paired t-test
[4]Effect size
[5]Linear Mixed Effect Models
[6]TeamSTEPPS Teamwork Perceptions Questionnaire
[7]Collaboration and Satisfaction About Care Decisions in Team Questionnaire
[8]TeamSTEPPS Teamwork Attitudes Questionnaire

Our results are in line with Spiva et al. (2014), who found increased scores in Teamwork Within Unit and Communication Openness in the two intervention wards. The results in the present study are also supported by results from other hospital contexts (Jones, Skinner, High, & Reiter-Palmon, 2013; Mayer et al., 2011; Thomas & Galla, 2013). Although different contexts, the results in the present study seem to be similar and may therefore be generalizable.

The positive changes within the intervention group in Supervisor/Manager Expectations and Actions Promoting Patient Safety indicate that the healthcare personnel experienced that their leaders had a focus on patient safety during the project period. Leaders have a special responsibility to facilitate a teamwork climate characterized by psychological safety (Salas et al., 2008). The importance of leaders in implementation studies, which also includes leadership from physicians, is well documented in the literature (Ginsburg & Tregunno, 2005; Rosen et al., 2018).

The improvement in three out of four teamwork dimensions within the intervention group suggests a benefit to teamwork due to the intervention. The teamwork tools and strategies implemented in the ward targeted these three areas of teamwork. Previous TeamSTEPPS studies that have utilized the T-TPQ have heterogeneous results. In a study from an oncology unit, improvements were found in two dimensions (Gaston, Short, Ralyea, & Casterline, 2016), whereas Tibbs and Moss (2014) found no changes in their study from the OR. The negative result of the Leadership dimension in the present study, can be explained by a lower baseline score in the control group. This should be further studied to determine its cause and importance.

As in Spiva et al. (2014) we did not find improvements in any of the teamwork attitude scores. Our results can be explained by that the respondents in both groups having favorable attitudes toward teamwork at baseline. High baseline scores may indicate a ceiling effect and leave little room for improvements, which may be due to a lack of sensitivity in the measurement tool (Polit & Beck, 2017). Even though attitudes is a predictor of individual`s behavior (Glasman & Albarracin, 2006), changes in teamwork and patient safety are dependent on many other factors. More sensitive measures may be needed to evaluate the attitudinal outcomes.

Previous studies that have utilized Kotter have reported difficulties with maintaining a sense of urgency throughout the change period, with the most challenging being to anchor the change in the culture (Baloh, Zhu, & Ward, 2017). In spite of that all the steps by Kotter were followed during the 12 month study period, the improvements in teamwork and patient safety of culture were relatively modest in the current study. One explanation for the results may be related to context (Ginsburg & Tregunno, 2005). The surgical ward is a context with a high activity level, where healthcare personnel work under very high pressure (Yngman-Uhlin et al., 2016), thus making it hard to find time for change work in their daily practice. Another explanation is a resistance to change, which is well known as a challenge in improvement work (Suter et al., 2013). Additionally, stress caused by requirements of new behaviors may serve as a barrier to change (Ginsburg & Tregunno, 2005). Motivational issues rooted in professional cultures and hierarchical systems (Ginsburg & Tregunno, 2005) may also have influenced the study results.

Realist synthesis reviews have identified underlying causal mechanisms in implementation studies and found that active engagement from physicians as the most preferable mechanism for success (Gillespie & Marshall, 2015). In the present study, physicians were involved from the planning phase to facilitating the team training, as well as being members of the change team. However, the physicians in surgical wards are also members of other teams, e.g., in the OR and outpatient clinics. Because the other units did not receive the intervention, the physicians could not use the new tools in those teams, which may have influenced the results of this study.

The Kotter model has been criticized for only focusing on organizational and situational change, and does not address the personal behavior that accompanies change (Clay-Williams & Braithwaite, 2015). According to Clay-Williams and Braithwaite (2015), change is also psychological, as organizational change may impact the professional identity of the individual healthcare personnel.

Study limitations

There are limitations that may affect this study and the interpretation of the results. The two samples of healthcare personnel were small, based on convenience, and not randomized. For practical reasons randomization is not always possible in complex intervention studies (Taylor, Ukoumunne, & Warren, 2015). The major challenge in non-randomized studies is to be certain that the observed effect is caused by the intervention and not explained by other factors (Groenwold, Hak, & Hoes, 2009). An unequal distribution of participant characteristics in the groups may hinder the comparability of outcome and lead to confounding bias (Deeks et al., 2003). However, the only demographic variable that differed between the two groups of healthcare personnel in our study was the employment time in the ward. Since long-term employees may persist more with organizational changes, they may need more time to adapt to the changes (Cullen, Edwards, Casper, & Gue, 2014). The effect of participating in research, the Hawthorne effect, may have influenced the results and contributed to study bias (McCambridge, Witton, & Elbourne, 2014). Another possible bias is the attrition of the samples which was less of a problem in the intervention group than in the control group. In addition to drop-outs, natural exchanges in employees may explain parts of the attrition, which is a common problem with longitudinal studies in healthcare (Ployhart & Vandenberg, 2010). Another limitation was that only self-reported measurements were used in this study. Although self-report questionnaires are a common method for measuring teamwork in healthcare (Rosen et al., 2012), not all changes may be captured. For ethical reasons we did not collect demographic information about the non-responders. Furthermore, as researchers we had no control on secular changes in the study wards during the study period, and time alone may have influenced the study results (Chen, Hemming, Stevens, & Lilford, 2016; Craig et al., 2008). Because of the study limitations, caution must be taken in generalizing the results.

Conclusions

The results of the study suggest that TeamSTEPPS is a useful program in a surgical ward context for improving healthcare personnel´s scores in patient safety culture and perceptions of teamwork after a 12 month study period. The findings indicate that the TeamSTEPPS training and implementation had significance for the healthcare personnel in this surgical ward, which may give further motivation to implement TeamSTEPPS in surgical wards. There is a need for additional studies to examine whether these results have significance. Moreover, investigating factors influencing the results, and studies investigating the impact on patient outcomes, are desirable.

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Declaration of interest

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Appendices

Appendix 1 – ***The 5 key principles of TeamSTEPPS and the tools & strategies – Study II***

Tools & strategies	**Explanation**
COMMUNICATION	
ISBAR	Use in systemic communication by e.g. patient deterioration: **I**dentification **S**ituation **B**ackground **A**ssessment **R**equest/ Recommend
I-PASS	Handoff tool: **I**llness severity -- **P**atient summary **A**ction list **S**ituation awareness and planning **S**ynthesis by and check back (closed-loop)
Call-out	A call-out is a strategy used to communicate important or critical information (e.g. in trauma teams): • Informs all team members simultaneously during situations. • Helps team members anticipate next steps. • Directs responsibility to a specific individual assigned to carrying out the task. Uses people's names
Closed-loop	Using closed-loop communication to ensure that information conveyed by the sender is understood by the receiver as intended (check-back)

LEADERSHIP	
Briefing	Short session prior to start to share the plan, discuss team formation, assign roles and responsibilities, establish expectations and climate, anticipate outcomes and likely contingencies
Huddling	Ad hoc meeting to re-establish situational awareness, reinforce plans already in place, and assess the need to adjust the plan
Debriefing	Informal information exchange session designed to improve team performance and effectiveness through lessons learned and reinforcement of positive behaviors
SITUATIONAL MONITORING	
Cross monitoring	A error and harm reduction strategy that involves: ▪ Monitoring actions of other team members, ▪ Providing a safety net within the team, ▪ Ensuring that mistakes or oversights are caught quickly and easily, ▪ "Watching each other's back"
STEP	Tool to help assess health care delivery/patient situations. Use in patient work (as e.g. in the trauma team.) **S**tatus of the patient **T**eam members **E**nvironment **P**rogress toward goal
I'M SAFE	A checklist for own safety: **I** `=Ill **M**=Medicine **S**=Stress **A**=Alcohol and drugs **F**=Fatigue **E**=Elimination and eating

MUTUAL SUPPORT	
Task Assistance	Helping others with tasks builds a strong team. Key strategies include: Team members protect each other from work overload situations, Effective teams place all offers and requests for assistance in the context of patient safety, Team members foster a climate where it is expected that assistance will be actively sought and offered.
Feedback	Information provided to team members for the purpose of improving team performance. Feedback should be: • *Timely*—given soon after the target behavior has occurred. • *Respectful*—focus on behaviors, not personal attributes. • *Specific*—relates to a specific task or behavior that requires correction or improvement. • *Directed* towards improvement—provides directions for future improvement. • *Considerate*—consider a team member's feelings and deliver negative information with fairness and respect.
Advocacy & Assertion	Advocate for the patient - invoked when team members' viewpoints don't coincide with that of the decisionmaker. Assert a corrective action in a *firm* and *respectful* manner • Make an opening • State the concern • State the problem (real or perceived) • Offer a solution • Reach agreement on next steps
The Two-Challenge Rule	Empowers all team members to “stop the line” if they sense or discover an essential safety breach. When an initial assertive statement is ignored: ▪ It is your responsibility to assertively voice concern at least two times to ensure that it has been heard, The team member being challenged must acknowledge that concern has been heard, ▪ If the safety issue still hasn’t been addressed: Take a stronger course of action; Utilize supervisor or chain of command

CUS	The use of assertive statements to correct an unsafe situation. I am **C**oncerned I am **U**ncomfortable This is a **S**afety issue! or: I don't feel like this is **S**afe!
DESC-script	An approach for managing and resolving conflict. **D**escribe, **E**xpress, **S**uggest, **C**onsequences
TEAM STRUCTURE	
Core team	A group of care providers who work interdependently to manage a set of assigned patients from point of assessment to disposition. The patient is seen as a member of the team. Strategies for involving patients in their care: • Embrace patients and their families as valuable and contributing partners in patient care • Provide patients with tools for communicating with their care team
Contingency Team	has a time-limited team formed for emergent or specific events and composed of members from various teams
Ancillary & Support Services	provide direct, task-specific, time-limited care to patients. Support services provide indirect service-focused tasks which help to facilitate the optimal health care experience for patients and their families.
Administration & Top Management	• Establish and communicate vision • Develop policies and set expectations for staff related to teamwork • Support and encourage staff during implementation and culture change • Hold teams accountable for team performance • Define the culture of the organization

Appendix 2 – *The simulation scenarios – Study II*

Målgruppe:	**Leger , sykepleiere og hjelpepleiere / helsefagarbeidere ved kir 19B CASE 1**				Side 1 av 4			
Tema	Teamarbeid ved akutt forverring av sykdomstilstand hos postoperativ gastroenterologisk pasient							
Fokus:	Akutt forverring postoperativ pasient som er operert for hemicolectomi							
Læringsutbytte:	• Observerer systematisk etter ABCDE-prinsippet (identifisering av pasientens problem). Bedømmer og angir MEWS. • **Benytter ISBAR prinsippet ved rapportering til lege**. • **Benytter closed-loop kommunikasjon** • Vurderer, prioriterer og iverksetter relevante tiltak							
Tidsramme i min:	Forberedelse:		Briefing:		Simulering:	15 min	Debrifing:	30 min
Forutsetter:								
Litteratur/undervisning:	TeamSTEPPS undervisningsopplegg							
Roller for deltakere:	Vakthavende kirurg Hjelpepleier/helsefagarbeider (Pasientansvarlig) sykepleier							
Forberedelse av pasientsimulator og miljø:	Pasientskjorte, dameparykk, flatt sengeleie, innlagt PVK og Ringer 1000 ml pågår (få dråper)							
Tilgjengelig utstyr:	BT-apparat, stetoskop, TP mål, pulsoxymeter, O_2, brillekateter, mobiltelefon, pussbekken, cellestoff, sprøyter, kanyler, Ketorax iv og Perfalgan 1 g iv som smertestillende og Afipran som kvalmestillende.							
Annet: (dokumenter, vedlegg, pasientkurve, lab.ark,....)	Medikamentkurve med ordinasjon av smertestillende og O_2							
Husk funksjonskontroller av alt utstyr du skal bruke!								

HØGSKOLEN I GJØVIK
Simuleringssenteret

Målgruppe:	**Leger, sykepleiere, sekretærer og hjelpepleiere/helsefagarbeidere ved kir. 10B, CASE2**				Side 1 av 4			
Tema	Teamarbeid ved pasient med urosepsis							
Fokus:	Urosepsis							
Læringsutbytte:	• Teamledelse • Situasjonsovervåking • Vurdere, prioritere og igangsette relevante tiltak • Kommunikasjon. Benytte ISBAR og closed-loop prinsippet ved kommunikasjon i teamet • Gjensidig støtte							
Tidsramme i min:	Forberedelse:		Briefing:		Simulering:		Debrifing:	
Forutsetter:								
Litteratur/undervisning:	TeamSTEPPS undervisningsopplegg							
Roller for deltakere:	Visittlege Hjelpepleier/helsefagarbeider Sykepleier Postsekretær							
Forberedelse av pasientsimulator og miljø:	Pasient ligger i sengen, har kastet opp, skjelver og fryser, innlagt PVK							
Tilgjengelig utstyr:	BT-apparat, stetoskop. TP mål, pulsoxymeter, O2, brillekateter, pussbekken, cellestoff, sprøyter og kanyler, mobiltelefon, varme tepper, kvalmestillende Afipran, Ketorax iv og perfalgan 1 g som smertestillende som smertestillende.							
Annet: (dokumenter, vedlegg, pasientkurve, lab.ark,....)	Medikamentkurve							
Husk funksjonskontroller av alt utstyr du skal bruke!								

HØGSKOLEN I GJØVIK
Simuleringssenteret

Appendix 3 – ***Evaluation of the 6-hour interprofessional team training – Study II***

PROFESJON		**Syke-pleier**	**Lege**	**Hjelpe-pleier**	**Missing**
41 (97%) n=39		24 (61.5)	10 (25.6)	4 (10.3)	1 (2.6)
FORBEREDELSE		**Nei**	**Delvis**	**Ja**	**Missing**
Lest gjennom bokkapitelet om TeamSTEPPS på forhånd		10 (25.6)	10 (25.6)	18 (46.2)	1 (2.6)
TILFREDSHET					
1 ="ikke fornøyd i det hele tatt". 5 = "svært fornøyd	**1**	**2**	**3**	**4**	**5**
Kursbolkene, inkl. bruk av power point, film, og rollespill	-	1 (2.6)	4 (10.3)	17 (43.6)	17 (43.6)
Simuleringssesjonene, inkl. debrifing	-	1 (2.6)	3 (7.7)	20 (51.3)	15 (38.5)
Økter og pauser, servering, lokaler	-	-	1 (2.6)	14 (35.9)	24 (61.5)
		Uenig	**Nøytral**	**Enig**	
Kurset var velorganisert og fulgte tiden		-	5 (12.8)	34 (87.2)	
Kurset presenterte praktisk og nyttig kunnskap		-	4 (10.3)	35 (89.7)	
Kurset var aktuelt for dagens praksis og problemstillinger		-	4 (10.3)	35 (89.7)	
Instruktørene var kunnskapsrike, velorganiserte		1 (2.6)	-	38 (97.4)	
LÆRING					
1 = "ikke i stand til". 5 = "absolutt i stand til og helt trygg på"	**1**	**2**	**3**	**4**	**5**
Pasientsikkerhet					
Beskrive årsaker til at feil skjer og konsekvenser av uønskede hendelser	-	1 (2.6)	6 (15.8)	25 (65.8)	6 (15.8)
Forklare hvordan teamarbeid kan påvirke pasientene	-	-	5 (13,2)	29 (76,3)	4 (10,5)
Teamarbeid					
Forklare hva som gjør et team bra	-	1 (2.7)	6 (16.2)	25 (67.6)	5 (86.5)
Beskrive forskjellige typer teamledere, og hva som gjør en leder effektiv (god)	-	2 (5.4)	10 (27.0)	21 (56.8)	4 (10.8)

Beskrive Situasjonsovervåking	-	5 (13.5)	11 (29.7)	18 (48.6)	3 (8.1)
Forklare Gjensidig støtte	-	1 (2.7)	8 (21.6)	23 (62.2)	5 (13.5)
Beskrive To-gangers bekymringsregelen	-	1 (2.7)	3 (8.1)	16 (43.2)	17 (45.9)
Definere SOS og når du vil bruke det	-	2 (5.4)	10 (27.0)	14 (37.8)	11 (29.7)
Kunne nevne to barrierer for effektiv (god) kommunikasjon	-	2 (5.4)	8 (21.6)	15 (40.5)	12 (32.4)
Kunne nevne to TeamSTEPPS teknikker som forbedrer kommunikasjon	-	1 (2.8)	8 (22.2)	16 (44.4)	11 (30.6)
Kunne beskrive TeamSTEPPS programmet	-	-	16 (41.0)	18 (46.2)	5 (12.8)

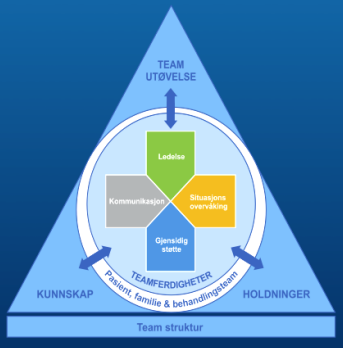
Appendix 4 – ***Patient safety poster in the surgical ward – Study II***

Vår avdeling har fokus på teamarbeid og pasientsikkerhet

Viktig melding til deg som pasient og evt. pårørende:

- Ta kontakt med helsepersonellet hvis du har spørsmål
- Etterspør prøvesvar
- Ta kontakt om du ser noe som du reagerer på
- Meld fra om du oppdager at noe ikke er som det skal
- Meld fra om feil
- Si fra om du er misfornøyd
- Gi oss gjerne ros

Fokus på pasientsikkerhet og teamarbeid innebærer at vi:



- jobber sammen som ett team; interprofesjonelt
- har klar og tydelig kommunikasjon
- støtter hverandre ved å gi og tilby hjelp
- kryssovervåker - sier fra
- gir hverandre feedback

NTNU
Kunnskap for en bedre verden

Appendix 5 – ***The questionnaire - Study I***

SPØRRESKJEMA
Samarbeid og tilfredshet ved kliniske beslutninger (CSACD-T)

Disse spørsmålene/påstandene er knyttet til tverrfaglig samarbeid i team og beslutninger om pasientbehandling. Vennligst svar på følgende spørsmål ved å sette en ring rundt det tallet som angir svaret ditt. Selv om det ofte kan være situasjons og/eller personavhengig, forsøk å svare ut fra hva som best representerer din vurdering av beslutningene som gjøres i den enheten du i hovedsak er tilknyttet nå. Med pasientbehandling/pleie menes: legebehandling, sykepleie, fysioterapi, ergoterapi etc.

1. Team-medlemmene samarbeider om planleggingen når det skal tas beslutninger om pasient-behandling/pleie.

1	2	3	4	5	6	7
Svært uenig						Svært enig

2. Det foregår en åpen kommunikasjon mellom team-medlemmene når det tas beslutninger om pasientbehandling/pleie.

1	2	3	4	5	6	7
Svært uenig						Svært enig

3. Team-medlemmene har et felles ansvar når det gjelder å ta beslutninger for pasienters behandling og pleie.

1	2	3	4	5	6	7
Svært uenig						Svært enig

4. Team-medlemmene samarbeider når det tas beslutninger om pasientbehandling/pleie

1	2	3	4	5	6	7
Svært uenig						Svært enig

5. Når det skal tas beslutninger, tas det hensyn til alle team-medlemmenes vurderinger om pasientenes behov.

1	2	3	4	5	6	7
Svært uenig						Svært enig

6. Beslutninger om pasienter koordineres mellom team-medlemmene.

1	2	3	4	5	6	7
Svært uenig						Svært enig

7. Hvor mye samarbeid er det mellom team-medlemmene når det tas beslutninger om pasientbehandling/pleie?

1	2	3	4	5	6	7
Ikke samarbeid						Svært bra samarbeid

8. Hvor fornøyd er du med måten beslutningene tas på, det vil si med beslutnings-prosessen, ikke nødvendigvis med selve beslutningene?

1	2	3	4	5	6	7
Ikke fornøyd						Veldig fornøyd

9. Generelt, hvor fornøyd er du med beslutningene som er tatt om pasientene?

1	2	3	4	5	6	7
Ikke fornøyd						Veldig fornøyd

*Deltar pasienten i beslutninger som angår egen behandling/pleie?

1	2	3	4	5	6	7
Ingen deltakelse						Fullstendig deltakelse

*Tilleggsspørsmål spesifikt for denne studien.

Appendix 6 – ***The questionnaires - Study II***

Norwegian versions of T-TPQ, CSACD-T, HSOPSC, and T-TAQ

INNLEDNING

Team kan defineres som en gruppe på to eller flere enkeltpersoner som er avhengig av hverandre i arbeidet mot et felles mål, og hvor det kreves samordning av innsats og ressurser for å oppnå et felles ønsket resultat og hvor alle deltagere har spesifikke roller eller funksjoner.

I dagens helsevesen jobber man oftest i team. Ved sengeposter kan et team bestå av en lege og en sykepleier (f. eks. ved legevisitt), og/eller flere leger, sykepleiere og helsefagarbeidere, enhetsleder etc. Team sammensetningen kan variere utfra hvilke oppgaver som skal løses.

Denne undersøkelsen består av 4 spørreskjema.

Du må scrolle helt ned på hver side for å kunne trykke "Neste" og dermed komme videre til neste side i spørreundersøkelsen. Du kan også gå tilbake til forrige side hvis ønskelig. Fint hvis du svarer på alle spørsmålene, men hvis du ikke kan svare på et spørsmål, eller hvis spørsmålet ikke er aktuelt for deg, kan du la det stå åpent.

OPPFATTELSE AV TEAMARBEID (T-TPQ)

Vennligst svar på disse utsagnene ved å velge det svaralternativet som **best** stemmer overens med **din oppfattelse** av teamarbeid i enhet 10B. Selv om det ofte kan være situasjons og/eller personavhengig, forsøk å svare ut fra hva som er hovedoppfatningen din.

Team struktur

1. Kompetansen til helsepersonellet er tilstrekkelig overlappende slik at enkelte arbeidsoppgaver kan deles på når det er nødvendig.

Svært enig Enig Nøytral Uenig Svært uenig

❑ ❑ ❑ ❑ ❑

2. Helsepersonellet blir holdt ansvarlig for egne handlinger.

Svært enig Enig Nøytral Uenig Svært uenig

❑ ❑ ❑ ❑ ❑

3. Helsepersonellet i enheten deler informasjon på en måte som gjør det mulig for pasientens behandling/pleieteam å ta beslutninger i rett tid.

Svært enig Enig Nøytral Uenig Svært uenig

❑ ❑ ❑ ❑ ❑

4. I enheten utnyttes ressursene på en hensiktsmessig måte.

Svært enig Enig Nøytral Uenig Svært uenig

❑ ❑ ❑ ❑ ❑

5. Helsepersonellet har en klar oppfattelse av egne roller og ansvar.

Svært enig Enig Nøytral Uenig Svært uenig

6. Enheten har klart formulerte mål.

Svært enig Enig Nøytral Uenig Svært uenig

7. Enheten fungerer på en hensiktsmessig måte.

Svært enig Enig Nøytral Uenig Svært uenig

Ledelse

8. Min leder vurderer innspill fra helsepersonellet i enheten når det tas beslutninger vedrørende pasientbehandling/pleie.

Svært enig Enig Nøytral Uenig Svært uenig

9. Min leder legger til rette for å diskutere enhetens opptreden etter en hendelse som kunne ha ført til, eller førte til unødig skade hos en pasient.

Svært enig Enig Nøytral Uenig Svært uenig

10. Min leder tar seg tid til å møte helsepersonellet i enheten for å utvikle planer for pasientbehandling/pleie.

Svært enig Enig Nøytral Uenig Svært uenig

11. Min leder sørger for at det er tilstrekkelig ressurser tilgjengelig (eks. bemanning, utstyr).

Svært enig Enig Nøytral Uenig Svært uenig

12. Min leder håndterer konflikter på en god måte.

Svært enig Enig Nøytral Uenig Svært uenig

13. Min leder er en god rollemodell når det gjelder teamadferd.

Svært enig Enig Nøytral Uenig Svært uenig

14. Min leder sørger for at helsepersonellet i enheten er oppmerksomme på situasjoner eller endringer som kan påvirke pasienters behandling og pleie.

Svært enig Enig Nøytral Uenig Svært uenig

Situasjonsovervåking

15. Helsepersonellet er flinke til å forutse hverandres behov.

Svært enig Enig Nøytral Uenig Svært uenig

16. Helsepersonellet observerer hverandre i utførelse av arbeidsoppgaver.

Svært enig Enig Nøytral Uenig Svært uenig

17. Helsepersonellet utveksler relevant informasjon så fort den blir tilgjengelig.

Svært enig Enig Nøytral Uenig Svært uenig

18. Helsepersonellet følger nøye med på alt i omgivelsene rundt pasienten for å innhente viktig informasjon.

Svært enig Enig Nøytral Uenig Svært uenig

19. Helsepersonellet deler informasjon om potensielle problemer som kan oppstå (eks. endringer i pasientens tilstand, full avdeling etc.)

Svært enig Enig Nøytral Uenig Svært uenig

20. Helsepersonellet kommer sammen og revurderer planen for pasientens behandling og pleie når tilstanden og/eller situasjonen har endret seg.

Svært enig Enig Nøytral Uenig Svært uenig

21. Helsepersonellet korrigerer hverandres feil slik at enhetens prosedyrer blir fulgt.

Svært enig Enig Nøytral Uenig Svært uenig

Gjensidig støtte

22. Helsepersonellet hjelper hverandre når det er mye å gjøre.

Svært enig Enig Nøytral Uenig Svært uenig

23. Helsepersonellet spør om hjelp fra kollegaer når de føler at det blir for mye for dem.

Svært enig Enig Nøytral Uenig Svært uenig

24. Helsepersonellet advarer hverandre om potensielt faretruende situasjoner.

Svært enig Enig Nøytral Uenig Svært uenig

25. Tilbakemeldinger gis til hverandre på en måte som fremmer Positivt samarbeid og som fører til fremtidige forbedringer.

Svært enig Enig Nøytral Uenig Svært uenig

26. Helsepersonellet taler pasientens sak, selv når det kommer i Konflikt med det som hevdes av en «senior» kollega i enheten.

Svært enig Enig Nøytral Uenig Svært uenig

27. Når helsepersonellet er bekymret for pasientsikkerheten, sier de tydelig i fra til hverandre og gir seg ikke før de er sikre på at de er blitt hørt.

Svært enig Enig Nøytral Uenig Svært uenig

28. Helsepersonellet løser konflikter seg imellom, også når konfliktene er personlige.

Svært enig Enig Nøytral Uenig Svært uenig

Kommunikasjon

29. Informasjon om pasientbehandling/pleie blir formidlet til pasientene og deres pårørende på en forståelig måte.

Svært enig Enig Nøytral Uenig Svært uenig

30. Helsepersonellet formidler relevant informasjon til pasienter og deres pårørende så fort som mulig.

Svært enig Enig Nøytral Uenig Svært uenig

31. Når helsepersonellet kommuniserer med pasientene, sørger de alltid for at det er tid og rom for spørsmål.

Svært enig Enig Nøytral Uenig Svært uenig

32. Helsepersonellet bruker felles terminologi/fagspråk når de kommuniserer med hverandre.

Svært enig Enig Nøytral Uenig Svært uenig

33. Helsepersonellet gir verbal bekreftelse på mottak av viktig informasjon fra hverandre.

Svært enig Enig Nøytral Uenig Svært uenig

34. Helsepersonellet følger en standardisert metode for o verføring av informasjon ved overlevering av pasienter (eks. vaktskifte, overflytting).

Svært enig Enig Nøytral Uenig Svært uenig

35. Helsepersonellet innhenter informasjon fra alle tilgjengelige kilder (eks. pasienten, pårørende, teamet, journal).

Svært enig Enig Nøytral Uenig Svært uenig

SAMARBEID OG TILFREDSHET VED KLINISKE BESLUTNINGER (CSACD-T)

Disse spørsmålene/påstandene er knyttet til teamarbeid og beslutninger om pasientbehandling/pleie. Selv om det ofte kan være situasjons og/eller personavhengig, forsøk å svare ut fra hva som **best** representerer **din vurdering** av beslutningene som gjøres i enheten.

Med pasientbehandling/pleie menes: legebehandling, sykepleie, fysioterapi, ergoterapi etc.

1. Team-medlemmene samarbeider om planleggingen når det skal tas beslutninger om pasientbehandling/pleie.

☐ 1. Ikke samarbeid ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. Svært bra samarbeid

2. Det foregår en åpen kommunikasjon mellom teammedlemmene når det tas beslutninger om pasientbehandling/pleie.

☐ 1. Svært uenig ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. Svært enig

3. Teammedlemmene har et felles ansvar når det gjelder å ta beslutninger for pasienters behandling og pleie.

☐ 1. Svært uenig ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. Svært enig

4. Teammedlemmene samarbeider når det tas beslutninger om pasientbehandling/pleie.

4. Når det skal tas beslutninger, tas det hensyn til alle teammedlemmenes vurderinger om pasientenes behov.

6. Beslutninger om pasienter koordineres mellom teammedlemmene.

7. Hvor mye samarbeid er det mellom teammedlemmene når det tas beslutninger om pasientbehandling/pleie?

8. Hvor fornøyd er du med måten beslutningene tas på, det vil si med beslutningsprosessen, ikke nødvendigvis med selve beslutningene?

9. Generelt, hvor fornøyd er du med beslutningene som er tatt om pasientene?

10. Deltar pasienten i beslutninger angående egen behandling/pleie?

OPPFATTELSE AV PASIENTSIKKERHETSKULTUR I SYKEHUS (HSOPS)

En **uønsket hendelse** er en utilsiktet hendelse som følge av medisinsk undersøkelse og/eller behandling. Den har ikke alltid uønskede følger, men kan ofte ha uønskede følger som: forverring av symptomer og plager, forlenging av sykdom og behandlingstid, invaliditet eller død. **Nærhendelse** er en hendelse som ikke førte til skade, fordi den ble oppdaget eller korrigert i forkant.

Vennligst svar ved å velge det svaret som stemmer **best** overens med din grad av enighet.

Vær oppmerksom på at utsagnene kan være både positivt og negativt ladet, så svaret "uenig" er noen ganger positivt ment, og andre ganger negativt.

Din enhet (sengepost)

Hvor enig eller uenig er du i følgende uttalelser?

1. I vår enhet støtter vi hverandre.

Helt uenig Uenig Både/og Enig Helt enig

2. Vi er tilstrekkelig personell til å håndtere arbeidsmengden.

Helt uenig Uenig Både/og Enig Helt enig

3.Når det er mange oppgaver som skal gjøres raskt arbeider vi sammen som et team for å løse oppgavene.

Helt uenig Uenig Både/og Enig Helt enig

4. I vår enhet behandler vi hverandre med respekt.

Helt uenig Uenig Både/og Enig Helt enig

5. I vår enhet jobber vi lengre vakter enn hva som er best for pasientene.

Helt uenig Uenig Både/og Enig Helt enig

6. Vi jobber aktivt for å forbedre pasientsikkerheten.

Helt uenig Uenig Både/og Enig Helt enig

7. Vi bruker flere vikarer enn det som er til det beste for pasientbehandlingen.

Helt uenig Uenig Både/og Enig Helt enig

8. Ansatte føler at feil blir brukt mot dem.

Helt uenig Uenig Både/og Enig Helt enig

9. Feil (og uønskede hendelser) er blitt brukt for å få til positive forandringer her.

Helt uenig Uenig Både/og Enig Helt enig

10. Det er kun en tilfeldighet at det ikke skjer flere alvorlige feil her i enheten.

Helt uenig Uenig Både/og Enig Helt enig

11. Når ett område i enheten er overbelastet hjelper andre i enheten til.

Helt uenig Uenig Både/og Enig Helt enig

12. Når en uønsket hendelse blir rapportert, føles det som om personen, og ikke problemet, kommer i sentrum.

Helt uenig Uenig Både/og Enig Helt enig

13. Når vi har gjennomført endringer for å forbedre pasientsikkerheten, evaluerer vi effekten.

Helt uenig Uenig Både/og Enig Helt enig

14. Vi arbeider i "krisemodus" hvor vi forsøker å gjøre for mye, alt for raskt.

Helt uenig Uenig Både/og Enig Helt enig

15. Pasientsikkerhet blir aldri nedprioritert for å få unna mer arbeid.

Helt uenig Uenig Både/og Enig Helt enig

16. Ansatte er bekymret for at feilene de gjør blir registrert i deres personalmapper.

Helt uenig Uenig Både/og Enig Helt enig

17. Vi har problemer med pasientsikkerheten i vår enhet.

Helt uenig Uenig Både/og Enig Helt enig

18. Våre prosedyrer og systemer fungerer godt for å forhindre uønskede hendelser.

Helt uenig Uenig Både/og Enig Helt enig

Din nærmeste leder

Er du enig eller uenig i følgende utsagn om din nærmeste leder?

19. Lederen min uttrykker seg positivt når han/hun ser arbeidet blir utført i overensstemmelse med våre prosedyrer for å ivareta pasientenes sikkerhet.

Helt uenig Uenig Både/og Enig Helt enig

20. Lederen min vurderer personalets forslag om forbedringer av pasientsikkerheten.

Helt uenig Uenig Både/og Enig Helt enig

21. Når arbeidspresset øker, ønsker vår leder at vi arbeider raskere selv om det kan bety at man må ta "snarveier".

Helt uenig Uenig Både/og Enig Helt enig

22. Lederen min overser problemer med hensyn til pasientenes sikkerhet selv om en hendelse skjer gang på gang.

Helt uenig Uenig Både/og Enig Helt enig

Kommunikasjon

Hvor ofte skjer følgende innenfor din enhet?

23. Vi får tilbakemeldinger om endringer som blir igangsatt basert på rapporterte uønskede hendelser (eks. TQM).

Aldri Sjelden Av og til Ofte Alltid

24. Ansatte snakker åpent ut hvis de ser noe som kan påvirke pasientbehandlingen i negativ retning.

Aldri Sjelden Av og til Ofte Alltid

25. Vi blir informert om uønskede hendelser som skjer i vår enhet.

Aldri Sjelden Av og til Ofte Alltid

26. Ansatte kan fritt stille spørsmål vedrørende beslutninger
og handlinger tatt av personer med mer autoritet.

Aldri Sjelden Av og til Ofte Alltid

27. I denne enheten diskuterer vi hvordan vi kan forebygge
at de samme uønskede hendelsene gjentas.

Aldri Sjelden Av og til Ofte Alltid

28. Ansatte er redde for å stille spørsmål når det er noe som virker feil.

Aldri Sjelden Av og til Ofte Alltid

Uønskede hendelser

Tenk på din enhet

29. Hvor ofte blir nærhendelser rapportert - det vil si hendelser
som blir oppdaget og avverget så pasienten ikke rekker å bli skadet?

Aldri Sjelden Av og til Ofte Alltid

30. Hvor ofte blir hendelser som på ingen måte kan skade en pasient
rapportert?

Aldri Sjelden Av og til Ofte Alltid

31. Hvor ofte blir potensielt skadevoldende hendelser rapportert – det
vil si hendelser som kunne skade pasienten, men som ikke gjorde det?

Aldri Sjelden Av og til Ofte Alltid

32. Hvor mange meldinger om uønskede hendelser har du utfylt
og sendt inn de siste 12 månedene?

Pasientsikkerhetsvurdering

33. Gi en generell vurdering av pasientsikkerheten i din enhet.

 A Fremragende  B Meget god  C Akseptabel  D Dårlig  E Meget dårlig

Om sykehuset

Er du enig eller uenig i følgende utsagn om sykehuset? Tenk på sykehuset som helhet

34. Sykehusledelsen tilrettelegger for et arbeidsklima som fremmer pasientsikkerheten.

Helt uenig Uenig Både/og Enig Helt enig

35. Enhetene ved sykehuset er ikke flinke til å koordinere seg med hverandre.

Helt uenig Uenig Både/og Enig Helt enig

36. Ting "faller mellom to stoler" når pasienter blir overflyttet fra en enhet til en annen.

Helt uenig Uenig Både/og Enig Helt enig

37. Samarbeidet fungerer godt mellom enheter som har behov for å jobbe sammen.

Helt uenig Uenig Både/og Enig Helt enig

38. Informasjon som er viktig i pasientbehandlingen går ofte tapt ved vaktskiftet.

Helt uenig Uenig Både/og Enig Helt enig

39. Det er ofte vanskelig å arbeide sammen med personale fra andre enheter.

Helt uenig Uenig Både/og Enig Helt enig

40. Det oppstår ofte problemer i forbindelse med utveksling av informasjon mellom enheter.

Helt uenig Uenig Både/og Enig Helt enig

41. Sykehusledelsens handlinger viser at pasientsikkerheten har topp prioritet.

Helt uenig Uenig Både/og Enig Helt enig

❑ ❑ ❑ ❑ ❑

42. Sykehusledelsen virker kun interessert i pasientsikkerhet etter at en uønsket hendelse har skjedd.

Helt uenig Uenig Både/og Enig Helt enig

❑ ❑ ❑ ❑ ❑

43. Sykehusets enheter arbeider godt sammen for å sikre at pasienten får den beste behandlingen.

Helt uenig Uenig Både/og Enig Helt enig

❑ ❑ ❑ ❑ ❑

44. Vaktskifter er problematisk for pasientene på sykehuset.

Helt uenig Uenig Både/og Enig Helt enig

❑ ❑ ❑ ❑ ❑

HOLDNINGER TIL TEAMARBEID (T-TAQ)

Vennligst svar på utsagnene ved å hukke av det som stemmer best overens med **din grad av enighet** – fra «Svært uenig» til «Svært enig».

Vær oppmerksom på at utsagnene kan være både positivt og negativt ladet, så svaret ”uenig” er noen ganger positivt ment, og andre ganger negativt.

Begrepsavklaring teamleder:
Det finnes to hovedtyper teamledere, forhåndsbestemte ledere og

situasjonsbetingede ledere. Forhåndsbestemte teamledere er f.eks. visittgående lege, teamsykepleier eller avdelingssykepleier. Situasjonsbetinget ledere kan knyttes til teamledelse av her og nå situasjoner hvor flere er involvert, som for eksempel mobilisering av pasient eller akuttsituasjoner.

Teamstruktur

1. Det er viktig å be om tilbakemelding på behandling og pleie fra pasienter og deres pårørende.

Svært uenig Uenig Nøytral Enig Svært enig

2. Pasienten er en viktig del av behandlings/pleie teamet.

Svært uenig Uenig Nøytral Enig Svært enig

3. Avdelingens ledelse har innflytelse på hvorvidt de som jobber i direkte pasientkontakt lykkes i arbeidet.

Svært uenig Uenig Nøytral Enig Svært enig

4. Teamets mål er viktigere enn de enkelte teammedlemmers individuelle mål.

Svært uenig Uenig Nøytral Enig Svært enig

5. Dyktige teammedlemmer kan forutse hva de andre i teamet trenger (eks. assistanse og hjelp i gjennomføring av oppgaver).

Svært uenig Uenig Nøytral Enig Svært enig

6. Høyt spesialiserte team i helsetjenesten har mange fellestrekk med høyt spesialiserte team innen andre bransjer.

Svært uenig Uenig Nøytral Enig Svært enig

Ledelse

7. Det er viktig at teamledere deler informasjon med teammedlemmene.

Svært uenig Uenig Nøytral Enig Svært enig

8. Teamledere bør legge til rette for uformelle arena hvor teammedlemmer kan utveksle informasjon.

Svært uenig Uenig Nøytral Enig Svært enig

9. Dyktige teamledere ser på uønskede hendelser som en mulighet for å lære.

Svært uenig Uenig Nøytral Enig Svært enig

10. Det er en teamleders ansvar å opptre som en god rollemodell når det gjelder teamadferd.

Svært uenig Uenig Nøytral Enig Svært enig

11. Det er viktig at teamledere tar seg tid til å diskutere planen for hver enkelt pasient med de aktuelle team-medlemmene.

Svært uenig Uenig Nøytral Enig Svært enig

12. Teamledere bør sørge for at teammedlemmene hjelper hverandre når det er nødvendig.

Svært uenig Uenig Nøytral Enig Svært enig

Situasjonsovervåking

13. Alt personell kan bli opplært til å se etter viktige signaler i omgivelsene som kan ha betydning for pasientens situasjon.

Svært uenig Uenig Nøytral Enig Svært enig

14. Observasjon av pasienter er et viktig bidrag til et godt teamarbeid.

Svært uenig Uenig Nøytral Enig Svært enig

15. Alt personell, også de som ikke er en del av helsepersonellteamet, bør oppfordres til å se etter og melde fra om endringer i pasientens tilstand.

Svært uenig Uenig Nøytral Enig Svært enig

16. Det er viktig å være oppmerksom på de andre teammedlemmenes emosjonelle og fysiske tilstand.

Svært uenig Uenig Nøytral Enig Svært enig

17. Det er riktig av et teammedlem å tilby hjelp til en annen kollega som kan være for sliten eller for stresset til å utføre en oppgave.

Svært uenig Uenig Nøytral Enig Svært enig

18. Teammedlemmer som er bevisste på sin emosjonelle og fysiske tilstand når de er på jobb, løser oppgavene sine bedre.

Svært uenig Uenig Nøytral Enig Svært enig

Gjensidig støtte

19. For å gjøre en god jobb bør teammedlemmene ha innsikt i arbeidet til de andre i teamet.

Svært uenig Uenig Nøytral Enig Svært enig

20. Å spørre om hjelp er et uttrykk for at vedkommende ikke vet hvordan han/hun skal gjøre jobben sin på en god måte.

Svært uenig Uenig Nøytral Enig Svært enig

21. Å hjelpe andre teammedlemmer, er et uttrykk for at den som hjelper ikke har nok å gjøre selv.

Svært uenig Uenig Nøytral Enig Svært enig

22. Å tilby og hjelpe et annet teammedlem med hans/hennes arbeidsoppgaver, er en god måte å forbedre teamarbeidet på.

Svært uenig Uenig Nøytral Enig Svært enig

23. Dersom du er bekymret for pasientsikkerheten, er det riktig å si tydelig fra, helt til du er sikker på at du har blitt hørt.

Svært uenig Uenig Nøytral Enig Svært enig

24. Personlige konflikter mellom teammedlemmer påvirker ikke pasientsikkerheten.

Svært uenig Uenig Nøytral Enig Svært enig

Kommunikasjon

25. Det er betydelig større risiko for at det kan oppstå feil i team som ikke kommuniserer godt.

Svært uenig Uenig Nøytral Enig Svært enig

26. Dårlig kommunikasjon er en av de vanligste årsakene til rapporterte uønskede hendelser.

Svært uenig Uenig Nøytral Enig Svært enig

27. Uønskede hendelser kan reduseres gjennom god informasjonsutveksling

med pasientene og deres pårørende.

Svært uenig Uenig Nøytral Enig Svært enig

28. Jeg foretrekker å jobbe sammen med teammedlemmer som stiller spørsmål om informasjonen som jeg gir.

Svært uenig Uenig Nøytral Enig Svært enig

29. Det er viktig å ha en standardisert metode for rapportering ved overlevering av pasient (eks. vaktskifte, overflytting).

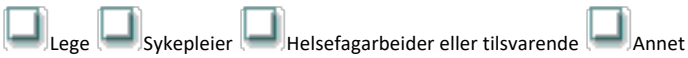
Svært uenig Uenig Nøytral Enig Svært enig

30. Det er nesten umulig å lære personer hvordan de skal bli bedre til å kommunisere.

Svært uenig Uenig Nøytral Enig Svært enig

BAKGRUNNSDATA

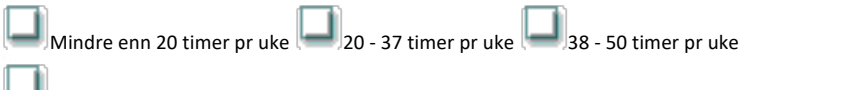
Til slutt følger noen spørsmål om din bakgrunn.
Hva jobber du som?


Lege Sykepleier Helsefagarbeider eller tilsvarende Annet

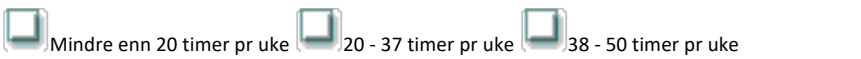
Hvor lang tid har du arbeidet ved denne enheten?


Mindre enn ett år 1-5 år 6-10 år 11-15 år 16-20 år 21 år eller mer

Hvor mange timer i uken arbeider du gjennomsnittlig ved dette sykehuset?


Mindre enn 20 timer pr uke 20 - 37 timer pr uke 38 - 50 timer pr uke
Mer enn 50 timer pr uke

Hvor mange timer i uken arbeider du gjennomsnittlig ved denne enheten?


Mindre enn 20 timer pr uke 20 - 37 timer pr uke 38 - 50 timer pr uke

❑ Mer enn 50 timer pr uke

Hvor fornøyd er du med din nåværende jobb relatert til denne enheten?

❑ Svært misfornøyd ❑ Misfornøyd ❑ Moderat fornøyd ❑ Svært fornøyd

Hvilken aldersgruppe tilhører du?

❑ Under 31 år ❑ 31-50 år ❑ 51 år eller mer

Kjønn

❑ Kvinne ❑ Mann

Har du hatt undervisning om teamarbeid innen helsevesenet (forelesning, gruppearbeid, video etc)?

❑ Ja ❑ Nei

Hvis du svarte JA, når var det sist?

❑ Det siste året ❑ 2 - 3 år siden ❑ 4 - 5 år siden ❑ 6 år eller mer siden

Har du deltatt i team-trening innen helsevesenet (f.eks. HLR, traumeteam, simulering)?

❑ Ja ❑ Nei

Hvis du svarte JA, når var det sist?

❑ Det siste året ❑ 2 - 3 år siden ❑ 4 - 5 år siden ❑ 6 år eller mer siden

Her kan du skrive evt. kommentarer til undersøkelsen:

Tusen takk for at du tok deg tid til å svare. Dine svar er viktige. Trykk avslutt.

Appendix 7 – ***Approval from the Norwegian Social Science Data Service***

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

Harald Hårfagres gate 29
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
Fax: +47-55 58 96 50
nsd@nsd.uib.no
www.nsd.uib.no
Org.nr. 985 321 884

Oddveig Reiersdal
Avdeling for helse, omsorg og sykepleie NTNU i Gjøvik

2802 GJØVIK

Vår dato: 12.01.2016 Vår ref: 46323 / 3 / AGL Deres dato: Deres ref:

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 28.12.2015. Meldingen gjelder prosjektet:

46323	*Tverrfaglig teamarbeid i kirurgiske avdelinger - en Human Factors tilnærming til pasientsikkerhet.*
Behandlingsansvarlig	*NTNU, ved institusjonens øverste leder*
Daglig ansvarlig	*Oddveig Reiersdal*

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

Personvernombudets vurdering forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, ombudets kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/meldeplikt/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://pvo.nsd.no/prosjekt.

Personvernombudet vil ved prosjektets avslutning, 31.12.2020, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Vigdis Namtvedt Kvalheim

Audun Løvlie

Kontaktperson: Audun Løvlie tlf: 55 58 23 07
Vedlegg: Prosjektvurdering

Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.

Avdelingskontorer / *District Offices*:
OSLO: NSD. Universitetet i Oslo, Postboks 1055 Blindern, 0316 Oslo. Tel: +47-22 85 52 11. nsd@uio.no
TRONDHEIM: NSD. Norges teknisk-naturvitenskapelige universitet, 7491 Trondheim. Tel: +47-73 59 19 07. kyrre.svarva@svt.ntnu.no
TROMSØ: NSD. SVF, Universitetet i Tromsø, 9037 Tromsø. Tel: +47-77 64 43 36. nsdmaa@sv.uit.no

Appendix 8 – ***Information to respondents - Study I***

Forespørsel om deltakelse i forskningsprosjektet
Teamarbeid i sykehus,
Delstudie1, Psykometrisk testing av spørreskjema

Bakgrunn og hensikt
Dette er en invitasjon til deg om å delta i en studie som omhandler psykometrisk testing av spørreskjema og kartlegging av helsepersonells holdninger til teamarbeid, oppfattelse av teamarbeid og beslutningstaking i team, i relasjon til pasientsikkerhet. Studien inngår som en delstudie i forskningsprosjektet Teamarbeid i sykehus – en «human factors» tilnærming.

Teamarbeid er en integrert del av dagens spesialiserte og komplekse helsetjeneste og spiller en viktig rolle innen pasientsikkerhet. Behandlings- og pleieteam innen sykehus er ofte tverrfaglige og består av teammedlemmer med ulik kompetanse, er dynamiske og har et skiftende medlemskap. Med tverrfaglig team menes det i dette prosjektet team som kan bestå av leger og sykepleiere, videre hjelpepleiere, fysioterapeuter og ergoterapeuter, og som har felles mål og ansvar for en definert gruppe pasienter.

Høgskolen i Gjøvik har i samarbeid med Universitetet i Stavanger fått tillatelse fra Agency for Healthcare Research and Quality til å benytte spørreskjema hentet fra teamtreningsprogrammet TeamSTEPPS®. I USA er dette tatt i bruk som en nasjonal standard for trening av teamarbeid. Spørreskjemaene er nyttige verktøy til bruk i forskning og forbedringsarbeid i sykehus. Ved bruk av spørreskjemaene i en norsk kontekst kreves det at de testes for validitet og reliabilitet.

Hva innebærer studien?
Dersom du velger å delta i studien innebærer dette at du svarer på tre spørreskjema om teamarbeid, samt avslutningsvis på åtte spørsmål hentet fra et allerede testet spørreskjema som skal benyttes i testingen. Enkelte av dere vil få en ny henvendelse om å besvare spørsmålene på nytt etter ca. to-tre uker.

Mulige fordeler og ulemper
Besvarelse av spørreskjema kan bidra til kunnskap og bevissthet om teamarbeid i sykehus i relasjon til pasientsikkerhet. Dataene fra undersøkelsen vil bli brukt til forskning. Tid til å besvare spørreskjemaene er beregnet til ca. 15 minutter.

Hva skjer med informasjonen om deg?
Informasjonen som registreres om deg vil kun brukes slik som beskrevet i hensikten med studien. Alle opplysninger vil bli behandlet uten navn og direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger gjennom en navneliste. Det er kun undertegnede som har adgang til navnelisten og som kan finne tilbake til deg. Alle som er ansvarlige for gjennomføringen av studien har taushetsplikt. Det vil ikke være mulig å identifisere deg i resultatene i studien når disse publiseres. Du har rett til å trekke deg ut av studien når du selv vil. Data anonymiseres ved prosjektets slutt. Forskningsprosjektet planlegges avsluttet høsten 2018 og resultatet av studien vil bli publisert i to til tre artikler. Prosjektet er forankret ved Høgskolen i Gjøvik og gjennomføres i samarbeid med Universitetet i Stavanger, og er godkjent av Sykehuset Innlandet HF, Vestre Viken HF videre personvernombudet (Norsk samfunnsvitensskaplig datatjeneste) og personvernombud for forskning ved Sykehuset Innlandet HF og Vestre Viken HF.

Frivillig deltakelse
Det er frivillig å delta i studien. Utfylt spørreskjema legges i lukket konvolutt i merket boks i avdelingen. Dersom du har spørsmål til studien, kan du kontakte:

Randi Ballangrud
Førsteamanuensis, Høgskolen i Gjøvik
Tlf: 61 13 53 23. E-mail: randi.ballangrud@hig.no

Marie Louise Hall-Lord
Professor Høgskolen i Gjøvik
E-mail: marie.hall-lord@hig.no

Appendix 9 – ***Information to the respondents - Study II***

Informasjonsskriv – intervensjonsavdelingen

Din avdeling har takket ja til å delta i et forskningsprosjekt om "**Interprofesjonelt* teamarbeid og pasientsikkerhet i sengeposter"**. Du får derfor denne invitasjonen til å svare på en spørreundersøkelse. Studien er en del av et doktorgradsprosjekt tilknyttet Ph.D. programmet i Helse og medisin ved Universitetet i Stavanger (UIS) og NTNU i Gjøvik.

Det er frivillig å delta i studien. Dersom du velger å delta, oppfordrer vi deg til å svare på spørreundersøkelsen **innen 1 uke fra du mottok denne mailen**. Tid til å besvare spørreskjemaene er beregnet til 15-20 minutter, og avdelingens ledelse har godkjent at du kan gjøre det i arbeidstiden.

Hvis du blir avbrutt og må lukke/gå ut av spørreskjemaet før du er ferdig, kan du gå inn igjen via den samme linken og fortsette der du var. Vi ber deg derfor vente med å slette mailen med link til spørreskjemaet til du har fullført. Du kan videresende mailen til din privatmail, evt. til din mobiltelefon, og svare på undersøkelsen derfra. Ved svar på mobil, hold mobilen horisontalt for beste visning.

Klikk på linken til undersøkelsen:

Hvis du ikke har svart innen 1 uke så vil du få en påminnelse, og en ny påminnelse en gang til etter ytterligere 1 uke hvis du fortsatt ikke har svart.

Hensikten med studien er å utforske betydningen av teamarbeidsprogram ved en kirurgisk sengepost, med fokus på teamarbeid og pasientsikkerhet blant helsepersonell. Studien har en eksperimentell design, og din avdeling deltar som **intervensjonsavdeling**. Dere kommer til å få tilsendt denne spørreundersøkelsen nå og to ganger til. Neste gang etter ca. seks måneder og en gang til etter ca. 12 måneder. Dere vil få mer informasjon om prosjektet når den første undersøkelsen er ferdig.

Informasjonen du gir vil kun brukes slik som beskrevet i hensikten med studien. All informasjon vil bli behandlet uten navn og direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger gjennom en e-mail adresseliste/navneliste, og kodenøkkelen er skjult i dataprogrammet som benyttes ved innsamling av data. Det vil ikke være mulig å identifisere deg i resultatene i studien når disse publiseres. Du har rett til å trekke deg ut av studien når du selv vil. Data de-identifiseres ved prosjektets slutt. Forskningsprosjektet planlegges avsluttet 2020 og resultatet av studien vil bli publisert i vitenskapelige tidsskrift. Prosjektet er godkjent av personvernombudet ved Norsk samfunnsvitensskaplig datatjeneste (NSD).

Hvis du har spørsmål til studien, kan du kontakte Oddveig Reiersdal.

Med vennlig hilsen

- *Oddveig Reiersdal,* Ph.D. stipendiat i Helse & medisin, UIS / NTNU i Gjøvik oddveig.reiersdal@ntnu.no Tlf: 61135438
- Hovedveileder *Marie Louise Hall-Lord* , Professor NTNU i Gjøvik marie.hall-lord@ntnu.no
- Biveileder *Randi Ballangrud* , Førsteamanuensis NTNU i Gjøvik randi.ballangrud@ntnu.no
- Biveileder *Sissel Eikeland Husebø* Førsteamanuensis UIS/ Forskningskoordinator Stavanger Universitetssjukehus sissel.i.husebo@uis.no

*Interprofesjonelt = tverrfaglig

Informasjonsskriv – kontrollavdelingen

Din avdeling har takket ja til å delta i et forskningsprosjekt om "**Interprofesjonelt* teamarbeid og pasientsikkerhet i sengeposter"**. Du får derfor denne invitasjonen til å svare på en spørreundersøkelse. Studien er en del av et doktorgradsprosjekt tilknyttet Ph.D. programmet i Helse og medisin ved Universitetet i Stavanger (UIS) og NTNU i Gjøvik.

Tid til å besvare spørreskjemaene er beregnet til 15-20 minutter, og avdelingens ledelse har godkjent at du kan gjøre det i arbeidstiden.

Hvis du blir avbrutt og må lukke/gå ut av spørreskjemaet før du er ferdig, kan du gå inn igjen via den samme linken og fortsette der du var. Vi ber deg derfor vente med å slette mailen med link til spørreskjemaet til du har fullført. Du kan også videresende mailen til din privatmail, evt. til din mobiltelefon, og svare på undersøkelsen derfra (Vi anbefaler at du holder din mobiltelefon horisontalt for beste visning).

Link til undersøkelsen:

Hvis du ikke har svart innen 1 uke vil du få en påminnelse, og en ny påminnelse en gang til hvis du fortsatt ikke har svart.

Hensikten med studien er å utforske betydningen av en interprofesjonell teamarbeidsintervensjon ved en kirurgisk sengepost, med fokus på teamarbeid og pasientsikkerhet blant helsepersonell. Studien har en eksperimentell design, og din avdeling deltar som **kontrollavdeling**. Dere kommer til å få tilsendt denne spørreundersøkelsen nå og to ganger til. Neste gang etter ca. seks måneder og en gang til etter ca. 12 måneder. Siden dere ikke mottar intervensjonen, vil denne avdelingen få tilbud om **et kurs om teamarbeid** i ettertid - som takk for at dere deltar i studien (for både leger og pleiepersonell).

Informasjonen du gir vil kun brukes slik som beskrevet i hensikten med studien. All informasjon vil bli behandlet uten navn og direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger gjennom en e-mail adresseliste/ navneliste, og kodenøkkelen er skjult i dataprogrammet som benyttes ved innsamling av data. Det vil ikke være mulig å identifisere deg i resultatene i studien når disse publiseres. Det er frivillig å delta i studien. Og du har rett til å trekke deg ut av studien når du selv vil. Data de-identifiseres ved prosjektets slutt. Forskningsprosjektet planlegges avsluttet 2020 og resultatet av studien vil bli publisert i vitenskapelige tidsskrift. Prosjektet er godkjent av personvernombudet ved Norsk samfunnsvitensskaplig datatjeneste (NSD).

Hvis du har spørsmål til studien, kan du kontakte Oddveig Reiersdal

Med vennlig hilsen

- *Oddveig Reiersdal,* Ph.D. stipendiat i Helse & medisin, UIS / NTNU i Gjøvik oddveig.reiersdal@ntnu.no Tlf: 61135438
- Hovedveileder *Marie Louise Hall-Lord* , Professor NTNU i Gjøvik marie.hall-lord@ntnu.no
- Biveileder *Randi Ballangrud* , Førsteamanuensis NTNU i Gjøvik randi.ballangrud@ntnu.no
- Biveileder *Sissel Eikeland Husebø* Førsteamanuensis UIS/ Forskningskoordinator Stavanger Universitetssjukehus sissel.i.husebo@uis.no

*Interprofesjonelt = tverrfaglig

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- Thanks to former Department Nurse Director **Elsa Penne Almås** – my best boss ever! After all these years – I am still thinking of you. We had so much fun and you were so skilled and wise. You made *me* a better leader.
- Thanks to cardiologist **Bjørn Wik,** SSHF, for inspiring me - by teaching and living that you as a doctor needed the inputs from the nurses in clinical decision making.
- Thanks to anesthesiologist and former college **Arthur Halvorsen**, for encouraging me to study nurse-physician collaboration in clinical decision making in ICU for my masters` degree.
- Thanks to Chair of the anesthesiology department, SSHF; MSc nurse **Grete Erdvik** and MSc nurse **Martin Hauge** (Security and Emergency Department, SSHF), that in June 2010 asked me to give a lecture for the anesthesiology department about interprofessional communication and collaboration. On that

evening I held my first lecture about TeamSTEPPS - but not my last!

- Thanks to anesthesiologist dr. med., former college and friend **Henrik Skovbon** (DK) for collaboration in the nutrition study in ICU and all the interprofessional evidence based procedures and protocols that you, me and our colleges developed jointly. After the suicide in that January night in 2012, I quit my job in ICU and started to work at a university.
- Thanks to MSc nurse **Jayne O'Leary** and professor **Lily Thomas** that provided a great experience for me at my site visit to Northwell Health Hospital at Long Island, New York in June 2015, to learn about TeamSTEPPS in clinical practice.
- Thanks to Chair of the anesthesiology department, **Randy Steadman** (Houston Methodist Hospital, Texas) that invited me to the UCLA Simulation center in January 2018, and to my ABC sister in LA, PhD **Yue-Ming Huang** (UCLA, Westwood, California) for generously sharing her office and becoming my travel partner, and to MSc **Heidi King** (AHRQ, Department of Defense, US), the lead architect of TeamSTEPPS, that connected all of us – through TeamSTEPPS. And thanks to all the young and fun people at the UCLA sim-center!
- Thanks to Principal Statistician MSc **Tristan Grogan**, UCLA Health, Ronald Reagan Hospital, Anesthesiology & Perioperative Medicine Department (Westwood, California).
- Thanks to all the **healthcare professionals** from the 16 hospital wards in the 5 hospitals that were included in the studies in this thesis. And a special thanks to clinical nurse specialist **Linda Bergestuen,** Chair of the department **Mari Einemo Grimsrud** and the lead surgeon **Thomas Moger.**
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