



UiO • Universitetet i Oslo

# Teamwork in Medical Education: A Scoping Review

Mert Ugur and Maren Øglænd Torjusen

Project thesis

University of Oslo

<sup>1</sup>Department of Behavioral Medicine, Institute of Basic Medical Sciences and <sup>2</sup>Department of General Practice, Institute of Health and Society, Faculty of Medicine, University of Oslo.

Spring 2021

## Table of contents

<i>Abstract</i> .....	3
<i>Preface – About the project</i> .....	4
<i>Introduction</i> .....	6
<i>Research question</i> .....	7
<i>Materials and methods</i> .....	8
<i>Team theory and research</i> .....	9
<i>Why to implement teamwork in medical education?</i> .....	16
The arguments of pedagogy .....	16
The arguments of professionalism .....	17
<i>How to implement teamwork in medical education?</i> .....	19
Methods for team learning .....	19
Methods for team training .....	24
<i>Discussion</i> .....	30
<i>References</i> .....	33

## Abstract

Students studying and training together as teams is an increasingly important concept of medical education. Yet, the underlying arguments for *why* and the practical aspects of *how* to implement teamwork in a medical curriculum are complicated. Here we present a scoping review, which aims to address these questions and present a general framework for conceptualizing the purposes and modalities of teamwork in medical education. With regard to purpose, we show that there are two overarching arguments: On one hand, teamwork may be framed as a means to enhance learning, with the focus of attention directed towards the study program, the students' learning environment, and their academic performance. On the other hand, acquiring team competencies may be presented as a goal in its own right, thereby preparing the students for a career that demands professional and interprofessional collaboration. With regard to modalities, we show a corresponding duality in the way teamwork is implemented: On one hand, organizing the students in small groups or teams may be used as a pedagogical strategy, without particular attention to providing team competencies. On the other hand, the curriculum may involve courses specifically devoted to team training, often in an interdisciplinary context. Based on these classifications, we then discuss the different perspectives and approaches to teamwork and how they may be integrated. In conclusion, we provide a conceptual framework for understanding why teamwork is important to medical education and how it may be incorporated in the curriculum.

## Preface – About the project

The thesis statement, “Why and how to implement teams in medical education?”, was presented to us and two other medical students by Prof. Jarle Breivik, and we were immediately engaged by it. From the first day of medical school, we have been fascinated and concerned about how we and other students collaborate and support one another. We have worked in study groups and experienced how teams of professionals work together in the university hospitals. Based on this experience, we felt that it would be a great idea to work on a project about teamwork in medical education.

The plan was to write an article about teamwork in medical education and make an online course about teamwork for medical students. This would result in a total of two different project thesis. However, due to lack of time we decided not to create the online course. The online course was then replaced with the idea of writing an article about a closely related project: The planning, implementation, and evaluation of a two-day team seminar for first year medical students. This project was completed by the two other students of our team, Oda Baumann Heier and Emilie Ulvang, who wrote an article which has been submitted to the Journal for the Norwegian Medical Association.

We have been communicating, sharing files, and updating each other using Microsoft Teams as our digital communication platform. This has helped us organize all our survey material, documents, meeting records and drafts for this project thesis, all on one platform. We have used Microsoft Teams for communication, exchanging ideas and giving feedback to each other when physical meetings have been challenging. In the Covid-19 period, we mainly used Zoom for our meetings.

In the summer 2020, we split the team in two because of the guidelines given by the University of Oslo. There could only be two authors assigned to each project thesis. After the split, the two of us have continued work on the review project, which has resulted in this thesis. We further aim to develop this into a review article for an international journal.

### *Team-seminar for 1<sup>st</sup> year medical students*

Our supervisor presented us with the concept of a two-day team seminar for first year medical students inspired by Perelman School of Medicine (PSOM) in the autumn of 2019. The faculty at PSOM generously shared their experience and material on how their seminar was

carried out each year. This material was of great value when planning the implementation and gave us some substance when embarking on our first seminar.

Early January of 2020, we spent a week planning a two-day retreat for the first year medical students in Oslo. As part of the team-project, we also helped recruit and guide nine of our peers who would also take part in carrying out the seminar. They attended a three-hour “mentor program” held in advance, where we reviewed the program and gave them information about their role as a mentor/facilitator. A facilitator training-manual was also made in advance. The manual contained all the activities and lectures scheduled in the program. During the retreat, the four of us had two different presentations about teamwork for the first year medical students; one presenting the importance of teamwork, and the other explaining the tools needed for the teams. The goal was to introduce the students to the importance of teamwork in medical education as early as possible. After the retreat we carried out a survey. We had people from different semesters fill out the survey, to compare the data to that of the retreat-students. This was accomplished by us visiting the classes of medical students to engage them in participating in the survey. The retreat and data from the retreat was used as material when writing the other project thesis.

### *Trip to the United States*

We got the opportunity to visit Perelman School of Medicine at the University of Pennsylvania (PSOM). The main purpose of this visit was to explore and learn from their experience with team training for medical students and how they organized the students in learning teams throughout the four-year program.

The medical students at PSOM were divided in teams of eight students from their first day of medical school. The teams were randomly chosen. We had several meetings with the faculty and got the chance to participate in lectures and team sessions with the teams.

### *Our experience as a team*

Our own team was organized by our supervisor and we did not know the other team members in advance. The team consisted of three women and one man. Working and learning about different team theories was both challenging and exciting at the same time. In the beginning, we learned to know each other, and we worked to build trust and develop an effective team.

As a newly formed team we have experienced going through Tuckman’s stages of “Forming”, “Storming” and to a certain extent “Norming”, described below (1). The final

stage of “Performing” has been difficult, partly due to the Covid-19 pandemic and the fact that we split the team to work on two different projects.

During the project, we have learned about research and the effort it takes to do a literature review, parallel to working as a team. It has been challenging at times, but reading articles on the matter has helped us to better understand these challenges.

We had many interesting discussions, worked together to organize the team seminar, made a visit Perelman School of Medicine, and wrote the review. This work has developed us, both individually and as a team. The visit to Perelman School of Medicine also gave us the chance to see how one of the US’ most prestigious medical schools has implemented teamwork as an integrated educational strategy.

After splitting up the team, we started focusing on our respective projects. The four of us continued having digital meetings. The purpose of these meetings was to share updates on the progress and discuss challenges that we experienced in the writing process. Peer feedback also helped us improve our drafts. Working as a team helped us achieve more than we would have done individually, and the entire project has been a very interesting and rewarding learning experience.

## Introduction

Modern medicine is increasingly described as a ‘team sport’ (2), requiring people with different skills and expertise to work together towards the common goal of providing quality health care. Physicians are working as professional and inter-professional leaders, coordinators, and collaborators in medical practice as well as research. They are expected to provide patient-centered care, in which the patients are partners rather than recipients, and like all health care providers, physicians need a broad range of skills related to communication and collaboration. Teamwork is an integral element in all sections and levels of the healthcare system (3), and as stated by the guidelines of the Association for Medical Education in Europe (AMEE), the medical curriculum needs to adapt to this new reality (4). Moreover, the importance of team competencies are emphasized by the recently defined national guidelines for health care education, which pay special attention to interdisciplinary teamwork (5).

These developments, rooted in the needs of the workforce, coincide with new trends and expectations in teaching and learning. The traditional idea that higher education is about reading books and going to lectures is being replaced by new evidence-based pedagogical approaches. Over the past 60 years, there has been a gradual shift to more active learning strategies, involving concepts like collaborative, experienced-based, game-based, problem-based or team-based learning (6-9). This trend is also evident in Norwegian medical schools (10). Modern medical education emphasizes and relies on the students' ability to interact and collaborate. The students are expected to already have, or obtain during their studies, the skills to study and train as functional teams.

Combined, there are strong incentives for incorporating teamwork, team competencies and team training in the medical curriculum. These arguments for why medical education should provide team competencies are multifaceted, and different authors and stakeholders have emphasized different aspects related to pedagogy as well as clinical practice (11). Similarly, there is a miscellaneous repertoire of theories, methods, and strategies on how to implement teamwork in medical education, ranging from informal collaboration between students to comprehensive pedagogical strategies involving the entire curriculum. In this scoping review, we aim to clarify this complexity by systematically presenting the arguments for *why* and the methods for *how* to implement teamwork in the medical curriculum.

## Research question

Main goal: To clarify the role and function of teamwork in medical education by writing a scoping review addressing the questions of *why* and *how* teamwork has been implemented in the medical curriculum.

Sub goals:

- To make a site visit to a medical school which has implemented teambuilding and teamwork as an integral component of the curriculum.
- To participate in the planning, execution and evaluation of a two-day team seminar for 1<sup>st</sup> year medical students.
- To work as a team of medical students to achieve these goals.

## Materials and methods

We performed a scoping review about why and how to implement teamwork in medical education. A scoping review differs from systematic reviews in its purpose and aims. Scoping reviews do not provide an answer to a specific question, but rather provide an overview of the literature available on a topic. This is a useful approach when the information on a topic has not been comprehensively reviewed. We used this method to explore the literature for answers to our overarching research questions of why and how teamwork is implemented in the medical curriculum. Our methodological approach is described in accordance with the framework that has been described for scoping reviews (12):

1. *Identification of a research question:* Our main goal was to write a literature review on why and how to implement teamwork in medical education.
2. *Identification of relevant articles about the topic in the existing literature:* We performed multiple literature searches, primarily in PubMed. Some articles were identified on Google Scholar and in books where that deemed relevant. The searches were performed between October 2019 and December 2020. We started out trying to formulate PICO questions, but these were difficult to use regarding the nature of our scoping review. Instead, we did multiple searches using MeSH terms to narrow our search. Apart from individual searches for specific topics such as PBL, TBL, CBL and IPE, the main inclusion criteria involved the MeSH terms: student, medicine, education, and team or teamwork. This search resulted in a substantial number of studies and led us to the next step in the reviewing process.
3. *Study selection:* We found a large number of articles and these needed to be assessed for relevance. The selection process included different exclusion criteria. We excluded articles not relevant to our topic of teamwork in medical education by reading the titles and abstracts. Not all articles were primarily about the MeSH terms even though they were mentioned in the title and/or abstract. We narrowed the search down to English and Norwegian articles. This may have contributed to a certain bias, leaving articles in other languages excluded from our search. We used EndNote X9 as a tool to organize our references, having four students working on the same project thesis. We were left with 105 references after the final draft. Some articles were automatically imported to EndNote, whereas others had to be manually encoded. This has also been a task that all four of us have been a part of. We also used Endnote to remove any duplicate publications since our results were from broad, less defined searches. The articles that made it through



so far were screened in detail to assess their relevancy. We read more than 25 articles each and brought these up for discussion before making a final decision. We also included articles that were identified from the reference list of other articles. The selection of literature was based on an inductive research approach where inclusion and exclusion criteria were modified as we gathered and reviewed information.

4. *Chart the data:* We explored the literature for answers to our overarching research questions of *why* and *how* teamwork has been implemented in the medical curriculum. Each article was assessed on a data charting form that specified which of the two questions (why or how) it addressed and how it addressed it. We found that the answers to each question could be further divided into sub-categories. Through the process of including and categorizing new articles, and discussing and refining this categorization, a framework for organizing the literature emerged.
5. *Collate, summarize and report the results:* The answer to our research question is structured in the Results below and further elaborated in the Discussion.
6. *Consultation exercise:* Our supervisor validated the articles from the scoping review as we progressed. He did also recommend some potentially relevant articles that we included in our final draft.

## Team theory and research

### *Definition of team*

In this scoping review we aim to clarify why and how teamwork is implemented in medical education. However, the use of the word “team” is unclear and differs between different contexts. We refer to a team as “an interdependent collection of individuals working towards a common goal where members share individual and mutual responsibility for the outcome (13).” Team members are mutually responsible for the product and therefore are able to delegate tasks. In order for a team to succeed, team members need to establish trust and be open to new perspectives, collaborate, communicate and share information continuously (14).

When trying to navigate in the different theories of group dynamics and team performance models, we have come across numerous articles describing the concept of working together. We therefore decided to take a closer look at how team research started and how it has developed. This gave us essential background information, not only for understanding team research, but to get a deeper understanding of how the different team-

based strategies used in medical education have developed. We have organized these theories into two categories that describe the different approaches used to study team performance: Descriptive models and action models (15). This arranged order, also depict the chronological development of how team research has evolved over the past 60 years.

### *Descriptive models*

Several ground-breaking descriptive models came to life in 1950-1970. These made it easier for researchers to define key factors that were essential for group dynamics. We have looked at two of the most influential researchers from this era: Joseph E. McGrath and Bruce W. Tuckman.

#### *J.E McGraths "Input-Process-Output" framework*

McGrath is known for creating a general framework for organizing team behavior. In 1964 he organized the variables of group processes, in what he called the "Input-Process-Output" framework (15). He is one of the first researchers, to put team-research on the agenda. His contribution to team-research and group behavior-research has been important for this specific field of research. It is a descriptive model of group behavior that is easy to understand. Here is an outlining of the "Input-Process-Output" framework:

- 1) Input: Individual-Level Factors (pattern of member skills, attitudes, personality and characteristics), Group-Level Factors (structure, level of "cohesiveness" and group size) and Environment-Level Factors (group task, characteristics, reward structure and level of environmental stress).
- 2) Group Interaction Process: The three factors mentioned above contribute to the "Group Interaction Process" which in turn results in an "Output".
- 3) Output: Performance Outcomes (such as performance quality, speed to solution and number of errors) and Other Outcomes (such as member satisfaction, group "cohesiveness", attitude change and sociometric structure)

The model is an easy way to understand which variables to account for, when creating a team. By generalizing complex group-dynamics, any team can apply the theory. However, teams are unique and task-dependent which makes the model counterproductive if relevant factors are not accounted for.

#### *Tuckman's "Stages of Group Development"*

Tuckman's "Stages of group development" has been an important contribution in regards to how we understand group-dynamics (1). Contrary to McGrath, Tuckman looked at group

development as a step-by-step process, where one has to accomplish one step to move on to the next. His catchy phrase of “forming, storming, norming and performing” has been used as a framework to understand how groups may turn into effective teams. Here are the different stages which Tuckman implies that groups go through (1):

1. **Forming:** The group is established, rules created, and group members establish interpersonal relationships, roles and leaders.
2. **Storming:** Conflicts arise, emotional response to task, the group polarizes and may become hostile towards each other. There may be a resistance to group influence and task requirements.
3. **Norming:** In this stage the group accepts their differences and cohesion develops. The group becomes an entity and avoids conflict to ensure harmony. Suppression of intimate, personal opinions.
4. **Performing:** The group is now functional and each member adapt their role to perform the task. Flexible roles and structure support task achievement.
5. In the 1977 update of the model Tuckman and Jensen added the fifth stage “adjourning” (16). The group has accomplished their task and either resolve or take a break before starting a new task.

It is also a descriptive model that helps groups understand where they are in the developmental stage and provides a framework that can be used as a platform for discussion and conflict resolution.

### *Action models*

Unlike descriptive models, an action model recognizes the fact that a team is a product of multiple interdependent factors and cannot simply be generalized into observational variables. It is a model that focus on the present situation and questions needed to address, instead of collecting retrospective information (15). These models date back to the 1970s and involve numerous researchers. In this section, we will look at some of the models still present in team-theory today from researchers such as Hackman, Drexler, Sibbet, Katzenbach and Smith.

### *Hackmans theory on Team-effectiveness*

The idea of an action model was first proposed by Richard Hackman in 1986 (15). He depicted an action model similar to the one he published 16 years later in his book (17). Hackman was inspired by McGraths “Input-Process-Output” model, but argues that it is too generalized (15). Teams can be managed and structured in many ways, and creating an effective team demands active decision-making at each stage of development. Each team

needs to take into consideration the cultural, political and technological realities at hand. Hackman therefore proposed a set of stages that a team needs to go through, that deal with certain questions needed to be answered, in order to go to the next step. In his book from 2002 he identifies five essential conditions which will increase the likelihood of effectiveness, in that a team (17):

- 1) is a real team rather than a team in name only. This refers to stability in membership over time, interdependence and clear boundaries.
- 2) has a compelling direction for its work. What is the common purpose of the team? Is the task at hand challenging, clear and consequential?
- 3) has an enabling structure that facilitates rather than impedes teamwork. Is the task, composition and norms created empowering for the work?
- 4) operates within a supportive organizational context. The team needs the necessary resources and support available in order to conduct their collective work.
- 5) has available ample expert coaching in teamwork. The team is dependent upon counselling and advice when managing complications and seizing opportunities that emerge (18).

#### [Drexler/Sibbet Team Performance Model](#)

In his book “Visual Teams”, David Sibbet explains how he further developed the Drexler model of team processes. Little is published on the matter, however his company “The Grove” is found online and is now offering guidance and tools to encourage the use of teams (19, 20). The model is based on 10 years of refining a comprehensive model of team performance and is a result of years spent guiding through principles and practices that has become clearer and stronger over the years. There is, however, no referenced research data available on his website.

The model is based on Drexlers teambuilding process where each step is a mental process illustrated by escalating questions (19):

- 1) “Why am I in this team?” This is the orientation phase where the team needs to find its purpose and team identity. Uncertainty and disorientation might be a challenge in this phase.
- 2) “Who is in this team with me?” This is the trust building phase where team-members learn to rely on one another and have mutual respect. They might be

challenged by mistrust and façade and need to resolve this in order to move on to the next step.

3) “What will we be doing in this team?” This is the goal clarification phase where the team finds a shared clear goal and explicit assumptions are brought to the table. The team needs to overcome any apathy, skepticism and irrelevant competition that might emerge in this phase.

4) “How will we do it?” This is the commitment phase where all team-members know their role, have the ability to allocate resources and make decisions. Some team-members might become too dependent, and some might be resistant, which will hinder the team in overcoming this phase.

It is possible to go to the next step, but then go back if your question is not answered or the challenges mentioned above are too big.

Sibbet took this model and turned it upside down, making it look like a bouncing ball. The process from the “Why” to the “How” was believed to be the cognitive process every team go through before acting on a task. The “Why” is believed to be closer to a thought process and the “How” closer to the action. From the bouncing ball analogy, the ball therefore cast a shadow and is ready to bounce back up when it reaches the “How”. Sibbet then further developed this model adding three more steps to the bouncing ball calling them:

5) “Who does what, when, where?”. This is the implementation phase where tasks are performed in a disciplinary manner, and there is a clear process. Challenges in this phase can be conflict and confusion, nonalignment and missed deadlines.

6) “Wow!”. This is the high-performance phase where the team dynamic is straightforward and effortless. This phase might be challenged by overload and disharmony.

7) “Why continue?”. This is the renewal phase where the team can either sustain by recognition and celebration, or experience burnout and boredom.

#### The Katzenbach and Smith model

This team-performance model was meant as a help to managers of corporations to know when to encourage and how to use teams. Six key factors are required in order to develop team performance: small enough number of people, adequate levels of complementary skills, truly

meaningful purpose, specific goals, clear working approach and a sense of mutual accountability.

In their book from 1993 Katzenbach and Smith states: “A team is a small number of people with complementary skills who are committed to a common purpose, set of performance goals, and an approach for which they hold themselves mutually accountable” (21). The research data was collected through observations and interviews with more than 50 teams in companies, businesses, military operations and organized activities. Katzenbach and Smith emphasize the loose use of the word “team” getting in the way of learning and applying the discipline that leads to good performance. The book contains two important models called “The basics” and “The performance curve”.

The basics is illustrated by a triangle showing things team deliver in the vertices; performance results, collective work products and personal growth. The sides of the triangle enable what the team can deliver; skills, accountability and commitment.

The performance curve illustrates the different stages from a working group to performing as a team. It is a descriptive model referring to Tuckmans stages of development. It also refers to “The basics”, and how abandoning the principles of “The basics” will turn the group into a pseudo team. The development is as follows: working group – pseudo team – potential team – real team – high performance team (21).

Katzenbach and Smith believe in acting on the two models and engage little in the concept of teambuilding exercises. They believe that by acting according to certain collective rules and models, teambuilding will unfold as a result (22).

### Team-research of the 21<sup>st</sup> century – the road ahead

There is a lot of promising research being carried out today due to the technological progress of the 21<sup>st</sup> century (23). Former team-theories are revisited and constructively criticized in the light of new technology and the increasing popularity of organizational teams (14). There is a reason to believe that the preceding perception concerning descriptive models in the way that they are static, step by step models is not accurate for team development (14). Action models are also indirectly questioned regarding the methods previously used to determine which variables to account for (13, 14). Even though former team-theories are questioned, they are

still present in the medical curriculum today in teaching strategies like TBL (24). In this section we will look at some of the new discoveries made in the field of team-research.

### Communication patterns

Despite not being a team theory in the technical sense of the term, this method of measuring team performance sets a new stage for theories on teamwork. When taking a closer look at human nature and the complex ways we interact with other people, researchers have found a new way to quantify and analyze big data on the level of human-interaction. What used to be mere human observational studies and survey forms (14), have now been transformed by the technological era. The revealing of variables not previously attained or highlighted, are now possible to measure and analyze through big data accumulations (13).

Researchers have developed sociometric badges that can pick up the tone of voice, body language, whom people talk to and how much. By analyzing the data collected, they have discovered that team energy and engagement outside formal settings is directly associated with productivity (23). This shows that communication and strong ties between team-members is a good predictor of team performance (13). This method and technological approach to measure team-performance has made it possible to identify characteristics of a successful team (23):

- 1) The team-members talk and listen in an equal amount. When they talk, they don't elaborate but keep their contributions short.
- 2) They have energetic discussions using gestures and talking face-to-face.
- 3) All team-members interact with each other in an equal amount, not just singling out one person whom they spend the most time with.
- 4) Team-members communicate outside formal settings within the team. They have side conversations and carry backchannels.
- 5) They take breaks talking to other people and teams, only to come back to share the newly acquired information.

The key to these valuable communication patterns is the energy, engagement and exploration. Body language, and the type and number of interactions being performed (face-to-face ranking highest and e-mail ranking lowest) is related to energy. Engagement is the function of energy levels between members, where similar energy levels among members result in strong engagement. Exploration outside the team needs to be adjusted to energy within the team, but the two need to coexist (23).

What this research shows, is that human interaction is far more complex and highly influential on team dynamics, than accounted for in team-theories from the 20<sup>th</sup> century. Without the use of technology, these discoveries have not been made possible until today. As we have looked back at some of our great group-dynamic researchers, it is obvious that team-research has been a challenging task. Every team is unique, and generalizations about teams are challenging if crucial variables are not included. New technology makes it possible to not only quantify collected data, but also help the teams that struggle thrive by giving them feedback from the analyzed data. However, there are some implications concerning the new technological approach regarding resources. Tailored sociometric badges might be too expensive for school budgets, but a modified version using smartphones can be a solution.

## Why to implement teamwork in medical education?

Our study of the literature revealed a wide range of arguments for implementing teamwork in medical education. In essence, however, we found that there are two main perspectives: The arguments of pedagogy and the arguments of professionalism:

### The arguments of pedagogy

The purpose of teamwork in medical education may be framed in the context of pedagogy. While all are related to the students and the process of learning, there are several underlying arguments for educating students as teams:

#### *Knowledge retention*

Organizing education in small groups or teams is one of several active learning approaches, which has been demonstrated to enhance knowledge retention, as compared to the more passive approach of listening to a lecture and reading individually (25). Students who study collaboratively and explain information to their peers have been shown to increase their long-term ability to recall what they learned (26). In general, small group teaching improves students' acquisition of knowledge, skills (27) and motivation (28).

#### *Academic support*

Students working as a team can collect and combine more information than they would be able to as individuals. Such peer-support and sharing of learning resources can help the team members work more efficiently regarding the content as well as the context of their studies (29, 30). In addition to learning from their teachers and the study material, they will learn from each other. Indeed, learning by teaching others is a well-established pedagogical



principle, and research indicate that the more complex the teaching activity is, the more opportunities there are to learn by teaching (31).

#### *Critical thinking*

Building on similar research and the same line of argument, pedagogical approaches that facilitates discussion between students activate higher-level thinking skills and provide a deeper understanding of an issue (32-34). Teamwork is an efficient method to bring up different perspectives and stimulate critical reflection about a problem or an issue, especially when there are no simple answers (35). Students who explain information to their peers, engage in a process that forces them to reconcile inconsistencies in their understanding, thereby increasing their learning (36). Moreover, team-based may increase intellectual curiosity and interprofessional openness (33).

#### *Social support*

A team of students, who have established a certain level of mutual trust, also represents a means of social support. Several studies have found that medical students experience high levels of stress and loneliness during their education, in which they are generally assessed for their individual attainments (32, 33). A group of trusted peers provides an arena to discuss concerns and anxieties and may help students to find balance between their studies and their personal life (37-39). Team spirit have been noted as a stress reducer, involving opportunities to discuss conflicts and ethical dilemmas one may encounter as a medicals student (40). Moreover, social support and peer tutoring may help at-risk students successfully finishing their course (24).

#### *Student satisfaction*

Several studies report that students studying as teams have a greater sense of satisfaction compared to student in more traditional lecture-based programs (34, 41, 42). The team format stimulates higher level of in-class learner engagement (34, 42), and overall, it appears that most students prefer to study in teams rather than going to lectures and reading alone.

#### **The arguments of professionalism**

Alternatively, the purpose of teamwork in medical education may be framed in terms of professionalism. This perspective focuses on different aspects of how teamwork contributes to personal and professional development of future medical practitioners:

### *Interpersonal skills*

Working together as teams help students develop interpersonal skills, which are transferable to the collegial as well as the clinical context (43). This includes the ability to relate to, communicate with and understand people with different personalities and different ethnical, cultural and socioeconomical backgrounds (44). Moreover, studying and training as teams develops general communication skills, including the ability to listen and provide information in an understandable and sensitive manner (45).

### *Leadership*

The ability to lead and coordinate is increasingly emphasized as an important aspect of medical education (46). The need for leadership training to work effectively and collaboratively with colleagues is well recognized (47). Development of leadership skills requires opportunities for leadership practice by working in teams (46).

### *Less burnout*

As medical professionals are particularly at risk of burnout, demotivation, and other negative stress-related consequences, it is important that attention is given to potential mitigations (48). The members of good teams are significantly less stressed than others. Better teamwork and lower stress levels are generally associated with happier, more productive employees who stay longer in their positions (49).

### *Better working environment*

Attention to teamwork has been related to increased job satisfaction as well as general well-being of medical professionals (50). High levels of teamwork predicted greater role clarity, higher job satisfaction, and fewer Health & Safety incidents (50). Psychological safety, described as giving other the benefit of the doubt when you have asked for help, or admitted a mistake, is also an important aspect of the learning environment. It is to be found in interpersonal relationships and can be addressed in medical education teamwork. However, it is often a part of the “hidden curriculum” (51).

### *Reduction of preventable errors*

Another important, and highly concrete argument for team training in medical education is that it reduces the number of medical errors (52). Medical errors in patient care will not cease to exist so long as we live in a world where treatment at any level, is performed by humans. This is partly due to the unpredictable elements of social cognition and communication patterns that people exhibit (53). Health professionals who develop great teamworking skills

can reduce these errors and assure quality in patient care (52, 54). However, teams who fail to collaborate often lead to medical errors (54). Assuming that people's level of communication not only varies but depend on personal traits, former experience and culture, team-training is necessary in order to create a well-functioning team.

#### *Increase of patient satisfaction*

Employees who thrive at work have a positive impact on the people surrounding them. Having a teamwork culture in a hospital setting is highly associated with patient satisfaction (55, 56). This can be indirectly explained by job satisfaction (57). Well-functioning team processes shape positive employee attitudes and promotes higher level of performance and patient satisfaction. These positive outcomes from working in a team, not only benefits the patient but also benefit the employees themselves (57).

### **How to implement teamwork in medical education?**

Our analysis of the literature identified a broad range of methods where medical students study together in small groups or teams. Similar to the arguments for *why* to implement teamwork in medical education, we found that these methods could also be divided into two different categories: Methods where teamwork is used primarily as a learning method (team learning) and methods where the goal is to facilitate personal and social development related to team skills (team training).

#### **Methods for team learning**

##### *Case Based Learning (CBL)*

In 1912, a pathology professor at the University of Edinburgh by the name of James Lorrain Smith introduced a new teaching strategy for medical students. It was called the 'case method of teaching pathology' and offered an alternative to the traditional format involving lectures and seminars (58). The method has since been implemented across the entire range of educational institutions and is in use worldwide today (59).

CBL can also be termed a 'guided inquiry method' (58). Instead of passively absorbing a stream of information, as in lecture-based learning, students study the preparatory material, engage their clinical reasoning skills to connect the theory to the practical situation, and come to a logical conclusion. There is no specific learning theory or philosophy attached to CBL (58). Instead, CBL is popularized by consistent positive feedback from students (60) and the results show that students who take part in CBL programs achieve higher grades in

certain areas (60). Chéron *et al.* (61) state the most common learning goals for students within CBL programs as self-directed learning, clinical reasoning, clinical problem-solving and decision making.

Every CBL program employs slightly different methods in creating and developing the groups, and also in facilitating the learning process. CBL programs are typically delivered by a facilitator, normally a professor, to a number of small groups who work independently on a case before comparing results with the larger group afterwards (58).

Yale University's Poorvu Center for Teaching and Learning offers a summary of CBL methodology within a medical setting. The medical students are presented with a case involving a patient with specific symptoms. Students in small groups decide which questions to ask the patient to get more information. The case unfolds and the students use clinical reasoning, propose relevant tests, suggest differential diagnosis and a plan of treatment (62). The students place themselves in the role of the decision maker as they read through the medical history and identify the problem they are faced with. To get the most out of the cases, students read and reflect on the case individually, and then meet in their small group before class to be prepared and discuss their findings with other classmates. In class – under questioning and guidance of the facilitator – students probe underlying issues, compare different alternatives, and finally suggest courses of action in the light of the organization's objectives. As the case unfolds in class, the students do 85 percent of the talking, as the facilitator steers the conversation by making occasional observations and asking questions (63).

Thistlethwaite *et al.* (58) found that student feedback regarding CBL programs was very positive and the majority indicated that “CBL stimulated academic challenge, bolstered personal interest and involvement in the subject matter”. A study on the effects of CBL versus lecture-based learning performed among fourth year dental students suggested that the students instructed by the use of CBL had better developed clinical decision-making skills than their lecture-based learning instructed fellow students (64).

The Thistlethwaite study also cites complaints from students regarding increased workload and excessive use of time. Faculty also tend to be somewhat less positive than students in their feedback. One study quotes a majority of teachers in describing CBL as overly demanding on teacher time, resources, and school infrastructure (65). Hansen *et al.* (60) found that CBL's greatest challenge was in convincing senior lecturers to change their

working habits, and that faculty considered lecture-based learning more successful than CBL in holding the attentiveness of students and for meeting the goals of the course.

### *Problem Based Learning (PBL)*

Problem-based learning is a method for organizing the curriculum of education; the binding principle of which is that the students work and learn together in groups. Invented over 50 years ago, PBL methods were employed in over 500 institutions worldwide as of 2019 (66).

Despite competing theories, it is generally accepted that PBL was first introduced as a whole-curriculum concept by Howard S. Barrows for McMaster University's new medical program in the late 1960s (67, 68). Extraordinary developments were made in the fields of medical research and biomedicine during this time period and the curriculum planners recognized that a new teaching style was required to incorporate the new knowledge areas and empower the medical students with greater learning abilities (69). It took years of trial and error before the highly structured pre-clinical curriculum method that we call PBL was fully implemented at McMaster (66, 69).

The development of PBL was not guided by unifying educational theory, nor was it supported by a broad body of empirical research. There was a recognized need for a new approach, and following a great deal of trial and error, the system now known as PBL filled that need.

At the most basic level, PBL comprises a group of students working together to solve faculty-designed problems. A faculty member is serving as a tutor, and their main task is to facilitate the learning process. The problems should be designed as realistic clinical cases and guide students towards relevant parts of the basic science curriculum. The process consists of three phases (67, 70, 71):

Phase 1: The first group session. The small group of students are presented with a realistic clinical problem. Students then analyze and define important aspects, activating their prior knowledge. They reflect further and recognize what knowledge they already possess and what knowledge they need to obtain to solve the problem.

Phase 2: Self-directed learning. Each individual student puts in the time and effort to find the resources to diagnose their learning needs, formulate learning goals and evaluate learning outcomes. Self-directed learning is an important aspect and skill of the PBL.

Phase 3: Second group session. Students apply their newly acquired knowledge, through self-directed study, to the problem and discuss their hypothesis from the first session. They re-assess their understanding of the problem and fill in the gaps from session one as well as help fill in each other's gaps.

Tutors were intended to have an active role, but should not lecture or make students passive (70). A way to achieve this was to use non-expert tutors (66, 71). It was reasonable at the time, during the development of the first PBL at McMaster, that content experts would be overly tempted to lecture the students, thus taking away students' opportunity to apply their own knowledge to the problem. However, in the latest curriculum reform at McMaster in 2005, they acknowledged that learning and the transfer of concepts requires feedback from tutors. Greater emphasis has been placed on requiring tutors with content knowledge of the curriculum, even though the students now sit written exams (69).

Problem-based learning was initially a whole-curriculum design meant for the pre-clinical years (70, 71). The idea is that the work put down in pre-clinical years, will benefit the students in clinic, both as students and professionals, because of their well-developed problem-solving skills.

Students who follow a PBL curriculum feel better prepared in interpersonal skills compared to students from a conventional curriculum (72), and are better prepared for their role in professional practice than those who have not followed a PBL curriculum (72). PBL can offer high quality and effective teaching of students without a patient, especially relevant for developing countries where resources are limited.

Several studies show that the students will retain knowledge for longer (71, 73). A review of outcomes of PBL found that students score higher than students from a conventional program on clinical exams (74), to which Kirchner *et al.* (75) adds that PBL graduates order more unnecessary tests at a higher cost. It is also expected that students will develop skills and attitudes expected from a competent and reflective practitioner by following the PBL method (72). In addition they will develop team-skills and problem-solving skills, which are key in good clinical work (71).

PBL is very demanding of faculty hours (human resources) (student-teacher ratio 5-8:1), and therefore more expensive in comparison to traditional lectures (example student-teacher ratio 150:1). This can be a challenge because more faculty hours are spent on research and less on educating students (76).

Students are not equally motivated for the level of independent study called for at a PBL program. Students at a hybrid PBL at Harvard complained they had to teach themselves (70). The tutor's role is crucial in PBL. One of the greatest problems with PBL is the variation in quality of teachers.

### *Team based learning (TBL)*

TBL was developed in the 1970s by faculty member Larry Michaelsen. He was inspired by the work of Richard Hackman (77) and other group-dynamic researchers like Tuckman and McGrath (24). One of the main goals of the TBL is to improve learning and promote the development of self-managed learning teams. By doing so, the students will enhance their conceptual and procedural knowledge. To ensure that the students take responsibility and evolve into cohesive learning teams, four elements are needed; group forming, student accountability, frequent feedback and applicable course content assignments (24).

The TBL starts out with individual work handed out one week prior to the TBL session. The students prepare themselves by studying the course content. On the first day of the TBL, an Individual Readiness Assurance Test (iRAT) is completed individually before the assigned teams come together to answer the same questions in a Group Readiness Assurance Test (gRAT). Corresponding to students' performance on final examination, the iRAT can also be used as a mean to detect and follow up at-risk students (78). The students get immediate feedback on the gRAT, which is considered critically important in TBL. After completing the test as a team, the answers from the gRAT are presented in class with the ability to appeal any questions considered inadequate or misinterpreted. After the appeals, the facilitator presents a mini lecture to cover difficult topics and clarify misperceptions. The remainder of the time, which is the vast majority of the TBL, is spent working as a team and applying the course content on assignments to practice their newly acquired knowledge (24). The group work can be divided into separate in-class problem solving activities spread out in the period assigned for each major topic, usually covering a two-to-three-week block time. The assignments are designed to ensure the students in-group interaction. Simple form answers are required in order to avoid delegating tasks and working individually. Assignments are meant to challenge knowledge around course concepts and create a discussion amongst team-members. The major topic ends in an in-class culminating team project or exam. The grade achieved in class is a sum of one's individual performance (iRAT), group performance (gRAT and group work) and peer evaluations throughout the

semester. This contributes to participation where the student is dependent on individual conceptual knowledge as well as teamworking skills in order to support team members (24).

Feedback on attendance and individual test scores are correlated to team performance. Several feedback systems are evaluated and set as a solid foundation for the way TBL implements feedback. A focus on encouraging member's pre-class preparation, minimizing social loafing (79-81), creating conditions that foster group self-management (82) and timely feedback (24), results in an impact on team member's behavior when having a feedback system.

TBL is resource effective by educating larger groups with few instructors (83, 84). The students experience an increase in perception and motivation with TBL versus traditional lectures (85). Michaelsen's experience is that "99,9% of nearly sixteen hundred teams has outperformed their own best member by an average of nearly 11%" (24). This results in a greater insight as a learner and team member, and ultimately keeps the at-risk students from failing the program (24).

The model has no focus on team-training prior to the sessions. It is expected that by being in the same team over time, holding each other mutually accountable and being motivated by immediate feedback, this will result in group development (24, 44).

TBL is often modified when used in medical school (83). Studies show that the participants in the TBL may be selected into groups based on profession (83, 86), gender (85, 87), age (85) and randomization (42). This inconsistent forming of groups is unproductive according to the original aim to avoid coalition and subgroups from forming, as described by Michaelsen (24).

A challenge for teachers is to transition to a more pedagogical approach where they go from teacher-centered to learner-centered teaching. The teachers tend to be more focused on how they teach instead of how to enhance student learning (24).

## Methods for team training

### *Interprofessional team training and TeamSTEPPS*

Interprofessional education (IPE) is a program where medical students team up with students from other health professions such as nursing, social work and law (88). The students collaborate in different educational approaches to improve healthcare outcome for patients by teaching the students how to work in a team, and how to understand their own role as well as that of their colleague (89). It can be integrated in medical education with various amounts of



impact on the existing curricula. Two principally different approaches are described by Barr *et al.* (90). They distinguish between an “extracurricular model” where interprofessional efforts compliments the existing curricula and happen outside regular classes, and a “crossbar model” as a more integrated model. This may include shared classes with different professions in the beginning of the subject, before profession specific classes divide the groups (91).

The readiness amongst healthcare students to engage in interprofessional team-learning has been shown to be highest at the beginning of the education (92). Capitalizing this readiness may also be an argument to introduce team training at an early stage. Some argue that even though it is important with an early introduction to teamwork, it is equally important with an ongoing reinforcement throughout the education (91).

Students who have a negative attitude towards teamwork also gain the least from the team learning efforts, and for these students it may even strengthen their negative perceptions (92). Interaction is seen as a necessity for developing a team in IPE, which can be implemented using TBL in a one-day session (83, 86). One study shows that TBL is one potential reason for the improved readiness for interprofessional learning when comparing multi-professional and uni-professional teams (86).

### TeamSTEPPS

Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) is an established interprofessional training program (93). It is designed to be incorporated into the daily activities of patient care provision to reduce clinical errors and improve patient outcomes and patient and staff satisfaction (94).

The TeamSTEPPS curriculum provides tools and strategies to increase team awareness. It consists of many instructions to help drive a successful teamwork and the initiative occurs in three phases (93):

Phase 1: Assessment. The goal of this phase is to set the stage for the course. A site assessment entails identifying opportunities for improvement of the team that is already existing. This is a process for identifying teamwork deficiencies so that training programs can be developed to address those fails. This information is then applied in training objectives.

Phase 2: Planning, training and implementation of TeamSTEPPS. The next step is the planning and execution of TeamSTEPPS. Usually, there is a two-day program for

training course-instructors. This session provides expected TeamSTEPPS skills integrated into the scenarios, case studies and simulations. It assesses what the teams will be trained in and what level of training they will receive. TeamSTEPPS facilitators conduct training and then they work with the teams to make improvements in teamwork.

Phase 3: Sustainment. The goal is to make the teams stick. It is important that the established teams get the opportunity to practice the teamwork skills after the initiative. Furthermore, the teams should be provided regular feedbacks and coaching.

There is an article written by Bethany Robertson about how to implement TeamSTEPPS in medical education (95). It is a description about their adaptation of TeamSTEPPS for use as an educational intervention for medical and nursing students. The philosophy is to develop a culture around the importance of interprofessional teams and its role in the taking care of patients. The faculty of medicine and school of nursing cooperated to bring students together for a half-day program that focused on teaching team skills. Two hundred thirteen students participated in a half-day workshop. The day was composed of a lecture followed by small group team training exercises and ended with a summary lecture.

The teams were formed by medical and nursing students, and were led by a nurse and physician facilitator. A group of ten interprofessional students worked together along their facilitators. The facilitators were recruited and they attended a two-hour “trainer program” held in advance so that they could prepare themselves. A facilitator training-manual was also made in advance. The manual contained all the activities and lectures.

The participants improved their knowledge of vital team skills, attitude towards working as a team and were able to identify effective team skills. After the TeamSTEPPS half-day workshop, the interprofessional students from medical and nursing schools had higher knowledge of team skills. This particular study proved that interprofessional teamwork education improved the knowledge, skills and attitudes needed for safe patient care.

Interprofessional Education Activity describes another way of using TeamSTEPPS training, followed by four medical error simulations (96). The simulations were framed using TeamSTEPPS competencies. Expected TeamSTEPPS skills such as leadership, situation monitoring, mutual support and communication were integrated into the scenario structure. The primary goals of this project were to enhance teamwork skills of medical, nursing and pharmacy students, and promote a good attitude towards interdisciplinary teamwork in

healthcare using simulated medical scenarios. Studies show that using this kind of simulation training as an education model enhance the patient safety (97). In addition, the Robert Wood Johnson Foundation (RWJF) related the lack of good teamwork between health professionals to high rates of medical errors in the US (98). RWJF and other organizations continue to promote interdisciplinary teamwork training, emphasizing the need to implement this in the medical curriculum.

#### *Other team-training initiatives*

Team-training prior to medical school is rarely seen in the literature, however some papers write about new interventions implemented. Team trainings aim to foster the teamwork competencies required by medical doctors, rather than focusing on teamwork as a learning modality for the students to attain knowledge. The literature reveals many different approaches, described with various amounts of details, and many papers lack a description of how many students are in a team or how the teams have been formed. Because of the variability and inconsistency, this section will try to categorize and sum up the experiences from several medical education institutions, bringing forth a few illustrative examples.

South Carolina School of Medicine Greenville has implemented a program in an attempt to incorporate early clinical experiences and integrate bio-clinical sciences in the curriculum. The program aims to expose the students to interprofessional healthcare providers and teams by engaging in two simulations followed up by psychomotor skill and written components of the National Registry of EMTs examination (EMT = Emergency Medical Technician). Throughout the first two years of medical school, the students are then required to complete at least one ambulance shift each month. The paper also refers to similar interventions made at other schools which reports increased confidence in patient care and team building skills. The students are required to write critical reflections twice a semester, which work as transformative feedback on the curriculum for curriculum planners. The student reflections fall under four broad themes: patientcare, professionalism, system-based practice and interpersonal and communication skills, which all align with the Accreditation Council for Graduate Medical Education core competencies (99).

When teamwork is integrated in the curriculum, without the aim of the students attaining theoretical knowledge, the focus may be on attaining team skills and learning about team dynamics. This approach may derive from the idea that when attained, teamwork competencies can be utilized in many different situations (100).

There is no team theory unifying team training in medical education. However, a general focus seems to lie on the developing functional team and creating viable team members. Parallels can be drawn to existing theories on team effectiveness and team performance.

In their 2016 paper, Banerjee *et al.* (101) described Vanderbilt University's "Teamwork Day" where they introduced first year medical students to teamwork principles. There were five broad goals that they wished to introduce to the students:

- 1) What teamwork is and why it is important to them and to healthcare
- 2) The essential characteristics of teams
- 3) The essential dimensions of teamwork
- 4) What effective teams do (and don't do)
- 5) The core knowledge, skills and attitudes of teamwork that they will need throughout their medical career

Vanderbilt University used several different exercises throughout the day, each aiming to highlighting different aspect of teamwork, such as interpersonal assumptions and individual difference, communication skills, team decision-making, conflict resolution and negotiation. The complexity of the exercises increased throughout the day, starting with strictly non-medical team building exercises and finishing with more complex tasks where team competencies must be utilized. The exercises focused on team competencies, and a few of them were simulated scenarios that students may encounter in their professional careers; communication was practiced in a scenario of a medical team on a humanitarian mission, conflict resolution was practiced in a scenario with limited hospital funding, negotiation skills were practiced with a standardized patient (101). This may have been an effort to make the day relevant for medical students without requiring preexisting knowledge.

However, the fact that some of the exercises focused solely on the team building aspect, emphasizes the fact that the day was created to develop team competencies. An example of such an exercise is the Colourblind® team building exercise (102). Though originally created for air traffic controllers, it is just as relevant for medical students. The exercise was created in 1991 for RSVP Design by Dr. Geoff Cox to foster verbal communication and teamwork. In the exercise, the team must identify two missing pieces in a set of 30 abstract shapes. The team members are all blindfolded which makes them rely entirely on verbal communication (102).

Cardiff University School of Medicine illustrates another initiative created to teach medical students teamwork competencies. They used already existing team-based planning exercises made to foster both leadership and teamwork as used by the Army Officer Selection Board (103). It is a written theoretical exercise with conceptual problem-solving. The students must address a complex problem, extract information, prioritize tasks and work together. There is not only one correct way of completing the exercise, but many ways of achieving a desired outcome. Requiring no prior knowledge of medicine or team training, this approach is an exercise to develop teamwork competencies as a skill set that is applicable in different settings. The exercise began with stressing the importance of leadership and teamwork amongst healthcare workers and how the planning exercise can help get there. After the exercise was completed, the teams gave their groups and its individuals verbal feedback and discussed the team process with a neutral observer. This is an important element of all team building models.

To assess the initiative, each student was asked to complete a questionnaire and the questionnaire counted as registration for the session. Though the results showed that two participants questioned how suitable it was for military personnel to be involved in civilian medical training, the results were mainly positive. Participants found the course enjoyable, particularly the practical aspect of working in a group as opposed to a traditional lecture (103).

Clark *et al.* (103) describes the aims in such an initiative to revolve around communication, team building, team roles, leadership, utilization of team resources, giving feedback and mutual accountability/interdependence. An advantage of this approach may be that it requires no prior medical knowledge, meaning it can be integrated at any stage in the curriculum. A disadvantage can be that the students may find it difficult to see the relevance for their own future practice and thus be less willing to engage in the initiative.

The discrepancy in the perception of teamwork amongst practicing physicians and medical students have been used as an argument for an early introduction to teamwork. Teamwork is regarded as less valuable amongst the students, which has been argued to suggest a need for it to be integrated at an early stage (50).

In the belief that a strong, early impact would have a lasting effect, Vanderbilt University created a full-day course to entering medical students (101). They created an

engaging, experimental learning approach focusing on teamwork and interpersonal communication, using simulation exercises with medical and non-medical context.

There are many examples of team training interventions later in medical education and amongst healthcare professionals. Examples of late programs include an assessment of the effectiveness on a team training initiative for fourth year medical students in management of simulated critically ill patients (104), and a leadership and teamwork program used for third year medical students (105). Whilst the early initiatives generally focus on generic teamwork competencies, the later interventions can be more targeted towards teamwork competencies requires by medical doctors and specific medical situations.

## Discussion

### *Strengths and weaknesses*

In this scoping review, we have aimed to organize a broad range of research related to teamwork in medical education. We found that this is a highly complex topic, and our literature search became an inductive and somewhat chaotic process moving between different fields of research and context. Yet, guided by our specific research question of why and how to implement teamwork in medical education, we found that the different perceptive and approaches could be organized in a simple framework. We believe that this organizing principle proves clarity to the issue, and that this structure is the major strength of our study.

Writing a scoping review can contribute to a selective collection of data, however broad we have attempted to do our searches. Our research has included English and Norwegian articles, which presents a certain language bias and exclusion of articles that might have been relevant in other languages. There is a limitation concerning the quality of the sources we have included due to the nature of the method in scoping reviews.

Moreover, the field of team-research is still unorganized due to terminology variations. Historically terms like “group-dynamics” and “social psychology” have been used about the present understanding of a team, however gradually transitioning into terms like “team-based” and “teamwork”. This might have contributed to a selection bias, where other terms are likely to concern the same topic.

### *A conceptual framework*

In this scoping review we have explored the arguments for *why* and the methods for *how* to implement teamwork in medical education. Overall, we found that there are two different perspectives regarding the purpose of teamwork.

First, there is the pedagogical perspective, which sees teamwork as a mean to facilitated learning. The underlying arguments are that teamwork enhances knowledge retention, provides academic support, and stimulates critical thinking. Moreover, studying together in teams provides social support and increases student satisfaction.

Second, there is the professional perspective, which sees teamwork as a mean to develop social and collaborative skills among future healthcare providers. In this perspective, it is argued that studying and training in teams improves the students' interpersonal skills, which are needed as leaders, collaborators and health care providers. This again, fosters a better working environment and prevents burnout in their future role as health professionals. In the long term, team training of medical students is argued to prevent medical errors and increase patient satisfaction in the healthcare system.

With regard to methods for implementing teamwork, we believe it is important to recognize that medical students have always studied together and learned from each other. The traditional lecture-based curriculum has been complemented by clinical rotations, usually in small teams, and many students have organized private study groups. Voluntary initiatives of social and academic support between peers and near peers has been, and still is, an important aspect of medical education. The primary difference, is that today's medical programs, increasingly aim to structure the level of support and collaboration between their students, thereby assuring quality and making sure that no one is left out.

As expected, the literature revealed a wide variety of methods for educating and training medical students in small groups or teams. This complexity was further increased by the fact that the methods had evolved over time, branching off in different directions and were implemented in different contexts. Overall, however, we found that there were two overarching approaches to implementing teamwork in medical education.

First, there were the methods which main purpose is to facilitate collaborative learning. Presented in order of increasing level of structure and organizational complexity, the main concepts are CBL, PBL, and TBL. All three methods organize the students in small

groups to facilitate discussion and sharing of knowledge but with different strategies and pedagogical approaches to reach this goal. The focus of attention was on learning the subject matter, whereas matters of communication, interpersonal skills and group dynamics were secondary or inexplicit.

Second, there were the methods, which main purpose is to develop the students' ability to work in teams. Accordingly, the matter of attention is the actual teamwork. The students learn how teams work and how to build their own team. They work together in teams, analyze communication and team dynamics, and get feedback from each other. Such initiatives, specifically related to medical education, are rare to find in the literature. Most examples concern interprofessional education where medical students meet with students of other health professions for shorter courses to simulate a realistic working environment. A few reports, however, presents team training initiatives for medical students with the combined purpose of building learning teams, while also preparing them for a collaborative health care system.

### *Conclusion*

Traditional lectures have been the standard teaching strategy in medical school. Over the last 60 years, there has been a gradual shift from this passive teaching method to a more active learning strategy. Medical schools all over the world use active learning in their curriculum today. It has become a well-established pedagogical principle and is used in case-based learning, problem-based learning and team-based learning in Norwegian medical schools.

In this scoping review we have revealed a consensus on the need for team training in medical education. To make sure the medical curriculum does not "lag behind" rapid changes in the healthcare-sector, we urge the medical faculties in Norway to implement team-training from the beginning of medical school for all students. By giving the reader a structured representation on team theories, methods for team-learning and team-training, we aim to encourage other medical schools to incorporate team training. Based on our findings in this project thesis, we propose a two-day seminar program as already implemented at the University of Oslo, as a good start to incorporate team-training. With the potential of expanding, teamwork can be further integrated throughout the six years of medical school. This alternative to incorporate new findings from the field of team-research will make sure the medical curricula is updated according to science.



In conclusion, we believe that this scoping review provides a framework for analyzing and developing current and future initiatives for implementing teamwork in medical education. Specifically, we envision the development of an integrated model for team-based education in medical education, which purposefully combines team-training and team-learning to foster competent students and collaborative doctors in a patient centered health care system.

## References

1. Tuckman BW. Developmental Sequence in Small Groups. *Psychological Bulletin Journal*. 1965;63(6):384-99.
2. Mehta A, Fu B, Chou E, Mitchell S, Fessell D. Improv: Transforming Physicians and Medicine. *Medical Science Educator*. 2020.
3. Morrison G, Goldfarb S, Lanken PN. Team training of medical students in the 21st century: would Flexner approve? *Academic Medicine*. 2010;85(2):254-9.
4. Hammick M, Olckers L, Campion-Smith C. Learning in interprofessional teams: AMEE Guide no 38. *Medical Teacher*. 2009;31(1):1-12.
5. Kunnskapsdepartementet. Forskrift om nasjonal retningslinje for medisinstudenter i Norge: [www.lovdata.no](http://www.lovdata.no); 2021 [updated 13.01.2020; cited 2021 22.02.2021]. Available from: <https://lovdata.no/dokument/LTI/forskrift/2020-01-03-21>.
6. McCoy L, Pettit RK, Kellar C, Morgan C. Tracking Active Learning in the Medical School Curriculum: A Learning-Centered Approach. *Journal of Medical Education and Curricular Development*. 2018;5:2382120518765135.
7. Freeman S, Eddy SL, McDonough M, Smith MK, Okoroafor N, Jordt H, et al. Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences of the United States of America*. 2014;111(23):8410-5.
8. Stewart DW, Brown SD, Clavier CW, Wyatt J. Active-learning processes used in US pharmacy education. *American Journal of Pharmaceutical Education*. 2011;75(4):68.

9. Stuart G, Triola M. Enhancing health professions education through technology: building a continuously learning health system. In: Larson T, editor. New York, NY: Josiah Macy Jr.Foundation; 2015. p. 1-228.
10. Raaheim A, Mathiassen K, Moen V, Lona I, Gynnild V, Bunæs BR, et al. Digital assessment – how does it challenge local practices and national law? A Norwegian case study. *European Journal of Higher Education*. 2019;9(2):219-31.
11. Lerner S, Magrane D, Friedman E. Teaching Teamwork in Medical Education. *Mount Sinai Journal of Medicine*. 2009;76(4):318-29.
12. Sucharew H, Maurizio M. Methods for Research Evidencence Synthesis: The Scoping Review Approach. *Journal of Hospital Medicine*. 2019(7):416-8.
13. de Montjoye YA, Stopczynski A, Shmueli E, Pentland A, Lehmann S. The strength of the strongest ties in collaborative problem solving. *Science Reports*. 2014;4:5277.
14. Delice F, Rousseau M, Feitosa J. Advancing Teams Research: What, When, and How to Measure Team Dynamics Over Time. *Frontiers in Psychology*. 2019;10:1324.
15. Lorsch JW, Hackman R. The design of work teams. *Handbook of Organizational Behavior*. Prentice Hall: Englewood Cliffs, NJ; 1986. p. 315-42.
16. Tuckman BW, Jensen MC. Stages of small-group development revisited. *Group Facilitation: A Research and Applications Journal*. 2010(10):9.
17. Hackman JR. *Leading teams: setting the stage for great performances*. Boston, Mass: Harvard Business School Press; 2002. 336 p.
18. Hackman JR. *What makes for a great team?* American Psychological Association. 2004.
19. The Grove Consultants International. Drexler/Sibbet Team Performance Model 1977 [cited 2021 22.02]. Available from: [https://www.thegrove.com/methodology\\_drexlerSibbetTeamPerformanceModel.php](https://www.thegrove.com/methodology_drexlerSibbetTeamPerformanceModel.php).
20. International TGC. Team Performance Sketchtalk—April 2009 2012 [cited 2021 21.01.21]. Available from: [https://www.youtube.com/watch?v=WA3VkPHp2z0&feature=emb\\_logo](https://www.youtube.com/watch?v=WA3VkPHp2z0&feature=emb_logo)
21. Katzenbach JR, Smith DK. *The Wisdom of Teams Creating the High-Performance Organization*: McKinsey &Company, Inc.; 1993. 295 p.
22. Collins FS, Anderson JM, Austin CP, Battey JF, Birnbaum LS, Briggs JP, et al. Basic science: Bedrock of progress. *Science*. 2016;351(6280):1405.
23. Pentland A. *The New Science of Building Great Teams*. Harvard Business Review. 2012 April 2012.

24. Michaelsen L, Knight AB, Fink LD. *Team-Based Learning: A Transformative Use of Small Groups in College Teaching*: Stylus Publishing; 2004. 304 p.
25. Freeman S, Eddy SL, McDonough M, Smith MK, Okoroafor N, Jordt H, et al. Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*. 2014;111(23):8410.
26. Lazarowitz R KG. *Cooperative Learning and Students' Self-Esteem in Tenth Grade Biology Classroom*. New York: Praeger Publisher. 1990.
27. Guraya SY, Almaramhy HH. Small group teaching improves students' acquisition of knowledge and skills. *Saudi Medical Journal*. 2012;33(12):1304-9.
28. Fujikura T, Takeshita T, Homma H, Adachi K, Miyake K, Kudo M, et al. Team-based learning using an audience response system: a possible new strategy for interactive medical education. *Journal of Nippon Medical School*. 2013;80(1):63-9.
29. Chou CL, Teherani A, Masters DE, Vener M, Wamsley M, Poncelet A. Workplace learning through peer groups in medical school clerkships. *Medical Education Online*. 2014;19(1):25809.
30. Dressler R, Janek H, Sager L, Kountz DS, Gravdal J. Learning Collaboratives in Medical Education: Exploring the Impact of Collaboratives' Structure and Resources and Teams' Experience. *American Journal of Medical Quality*. 2019;35(4):297-305.
31. Duran D. Learning-by-teaching. Evidence and implications as a pedagogical mechanism. *Innovations in Education and Teaching International*. 2017;54(5):476-84.
32. Ruud N, Lovseth LT, Isaksson Ro K, Tyssen R. Comparing mental distress and help-seeking among first-year medical students in Norway: results of two cross-sectional surveys 20 years apart. *BMJ Open*. 2020;10(8):e036968.
33. Sletta C, Tyssen R, Lovseth LT. Change in subjective well-being over 20 years at two Norwegian medical schools and factors linked to well-being today: a survey. *BMC Medical Education*. 2019;19(1):45.
34. Punja D, Kalludi SN, Pai KM, Rao RK, Dhar M. Team-based learning as a teaching strategy for first-year medical students. *Australasian Medical Journal*. 2014;7(12):490-9.
35. Michaelsen LK, Watson WE, Black RH. A realistic test of individual versus group consensus decision making. *Journal of Applied Psychology*. 1989;74(5):843-39.
36. Kalra R, Modi JN, Vyas R. Involving postgraduate's students in undergraduate small group teaching promotes active learning in both. *International Journal of Applied and Basic Medical Research*. 2015;5:S14-S7.

37. Kotter T, Tautphaus Y, Obst KU, Voltmer E, Scherer M. Health-promoting factors in the freshman year of medical school: a longitudinal study. *Medical Education*. 2016;50(6):646-56.
38. Wallace JE, Lemaire J. On physician well being-you'll get by with a little help from your friends. *Social Science & Medicine*. 2007;64(12):2565-77.
39. Kjeldstadli K, Tyssen R, Finset A, Hem E, Gude T, Gronvold NT, et al. Life satisfaction and resilience in medical school - a six-year longitudinal, nationwide and comparative study. *BMC Medical Education*. 2006;6:48.
40. Radcliffe C, Lester H. Perceived stress during undergraduate medical training: a qualitative study. *Medical Education*. 2003;37(1):32-8.
41. Kazory A, Zaidi Z. Team-Based Learning Activities for First-Year Medical Students: Perception of the Learners. *Southern Medical Journal*. 2018;1(9):525-9.
42. Ozgonul L, Alimoglu MK. Comparison of lecture and team-based learning in medical ethics education. *Nursing Ethics*. 2019;1(3):903-13.
43. Warde CM, Vermillion M, Uijtdehaage S. A medical student leadership course led to teamwork, advocacy, and mindfulness. *Family Medicine*. 2014;46(6):459-62.
44. Watson WE, Kumar K, Michaelsen LK. Cultural Diversity's Impact on Interaction Process and Performance: Comparing Homogeneous and Diverse Task Groups. *The Academy of Management Journal*. 1993;36(3):590-602.
45. Duffy FD, Gordon GH, Whelan G, Cole-Kelly K, Frankel R, Physician APitAAo, et al. Assessing Competence in Communication and Interpersonal Skills: The Kalamazoo II Report. *Academic Medicine*. 2004;79(6):495-507.
46. Van Diggele C, Burgess A, Roberts C, Mellis C. Leadership in healthcare education. *BMC Medical Education*. 2020;20(2):456.
47. Matthews JH, Morley GL, Crossley E, Bhanderi S. Teaching leadership: the medical student society model. *The Clinical Teacher*. 2018;15(2):145-50.
48. Körner M, Wirtz MA, Bengel J, Göritz AS. Relationship of organizational culture, teamwork and job satisfaction in interprofessional teams. *BMC Health Services Research*. 2015;15(1):243.
49. Carter AJW, West M. Sharing the burden - teamwork in health care settings. In: Firth-Cozens IJ, Payne RL, editors. *Stress in health professionals : psychological and organisational causes and interventions*: John Wiley and Sons; 1999. p. 191-202.

50. Chandrashekar A, Mohan J. Preparing for the National Health Service: the importance of teamwork training in the United Kingdom medical school curriculum. *Advances in Medical Education and Practice*. 2019;10:679-88.
51. Torralba KD, Jose D, Byrne J. Psychological safety, the hidden curriculum, and ambiguity in medicine. *Clinical Rheumatology*. 2020;39(3):667-71.
52. Institute of Medicine Committee on Quality of Health Care in A. *To Err is Human: Building a Safer Health System*. In: Kohn LT, Corrigan JM, Donaldson MS, editors. *To Err is Human: Building a Safer Health System*. Washington (DC): National Academies Press (US) Copyright 2000 by the National Academy of Sciences. All rights reserved.; 2000.
53. Nendaz M, Perrier A. Diagnostic errors and flaws in clinical reasoning: mechanisms and prevention in practice. *Swiss Medical Weekly*. 2012;142:w13706.
54. Leonard M, Graham S, Bonacum D. The human factor: the critical importance of effective teamwork and communication in providing safe care. *Quality & Safety in Health Care*. 2004;13 Suppl 1(Suppl 1):i85-90.
55. Chakraborti C, Boonyasai RT, Wright SM, Kern DE. A systematic review of teamwork training interventions in medical student and resident education. *Journal of General Internal Medicine*. 2008;23(6):846-53.
56. Meterko M, Mohr DC, Young GJ. Teamwork culture and patient satisfaction in hospitals. *Medical Care*. 2004;42(5):492-8.
57. Ogonnaya C, Tillman CJ, Gonzalez K. Perceived Organizational Support in Health Care: The Importance of Teamwork and Training for Employee Well-Being and Patient Satisfaction. *Group & Organization Management*. 2018;43(3):475-503.
58. Thistlethwaite JE, Davies D. The effectiveness of case-based learning in health professional education. A BEME systematic review: BEME Guide No. 23. *Medical Teacher*. 2012.
59. McLean SF. Case-Based Learning and its Application in Medical and Health-Care Fields: A Review of Worldwide Literature. *Journal of Medical Education and Curricular Development*. 2016.
60. Hansen W, Ferguson K, Sipe C. Attitudes of faculty and students toward case-based learning in the third-year obstetrics and gynecology clerkship. *The American Journal of Obstetrics and Gynecology*. 2005.
61. Chéron M, Ademi M, Kraft F. Case-based learning and multiple choice questioning methods favored by students. *BMC Medical Education*. 2016.

62. Poorvu Center for Teaching and Learning. Case-Based Learning 2012 [cited 2021 20.02.2021]. Available from: <https://poorvucenter.yale.edu/strategic-resources-digital-publications/strategies-teaching/case-based-learning>.
63. Harvard Business School. The HBS Case Method [cited 2021 20.02]. Available from: <https://www.hbs.edu/mba/academic-experience/Pages/the-hbs-case-method.aspx>.
64. Ilgüy M, Ilgüy D, Fişekçioğlu E, Oktay I. Comparison of case-based and lecture-based learning in dental education using the SOLO taxonomy. *Journal of Dental Education*. 2014.
65. Gade S, Chari S. Case-based learning in endocrine physiology: an approach toward self-directed learning and the development of soft skills in medical students. *American Physiological Society*. 2013.
66. Servant-Miklos V. Fifty Years On: A Retrospective on the World's First Problem-based Learning Programme at McMaster University Medical School. *Health Professions Education*. 2018;5.
67. Neufeld VR, Barrows HS. The "McMaster Philosophy": an approach to medical education. *Journal of Medical Education*. 1974;49(11):1040-50
68. Faisal R, Bahadur S, Shinwari L. Problem-based learning in comparison with lecture-based learning among medical students. *Journal of Pakistan Medical Association*. 2016;66(6):650-3.
69. Neville AJ, Norman GR. PBL in the undergraduate MD program at McMaster University: three iterations in three decades. *Academic Medicine*. 2007;82(4):370-4.
70. Taylor D, Mifflin B. Problem-based learning: Where are we now? *Medical Teacher*. 2008;30(8):742-63.
71. Barrows HS. Problem-based learning in medicine and beyond: A brief overview. *New Directions for Teaching and Learning*. 1996:3-12.
72. Bate E, Hommes J, Duviolier R, Taylor DCM. Problem-based learning (PBL): Getting the most out of your students – Their roles and responsibilities: AMEE Guide No. 84. *Medical Teacher*. 2014;36(1):1-12.
73. Neufeld VR, Barrows HS. The "McMaster Philosophy": an approach to medical education. *Journal of Medical Education*. 1974;49(11):1040-50.
74. Albanese M, Mitchell S. Problem-based learning: A review of literature on its outcomes and implementation issues. *Academic Medicine*. 1993;46.
75. Kirschner P, Sweller J, Clark R. Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching. *Educational Psychologist*. 2006.

76. Galey WR. What is the future of problem-based learning in medical education? *American Journal of Physiology*. 1998.
77. Gersick CJ, Hackman JR. Habitual routines in task-performing groups. *Organizational Behavior and Human Decision Processes*. 1990;47:65-97.
78. Carrasco GA, Behling KC, Lopez OJ. First year medical student performance on weekly team-based learning exercises in an infectious diseases course: insights from top performers and struggling students. *BMC Medical Education*. 2019;19(1):185.
79. Kerr NL, Brrun SE. Ringelmann Revisited: Alternative Explanations for the Social Loafing Effect. *Personality and Social Psychology Bulletin*. 1981;7(2):224-31.
80. Williams K, Harkins S, Latané B. Identifiability as a deterrent to social loafing: Two cheering experiments. *Journal of Personality and Social Psychology*. 1981(40):303-11.
81. Schnake ME. Equity in Effort: The "Sucker Effect" in Co-Acting Groups. *Journal of Management*. 1991;17(1):41-55.
82. Ancona DG, Caldwell DF. Bridging the Boundary: External Activity and Performance in Organizational Teams. *Administrative Science Quarterly*. 1992;37(4):634-65.
83. Wheeler S, Valentino AS, Liston BW, Li J, McAuley JW. A team-based learning approach to interprofessional education of medical and pharmacy students. *Currents in Pharmacy Teaching and Learning*. 2019;11(11):1190-5.
84. Lahoud J, Bazzi K, Waters E, Clyne P, Sinha SN. Team-based anatomy learning for medical students: preparing tomorrow's surgeons. *ANZ Journal of Surgery*. 2019;89(6):628-9.
85. Rezende AB, de Oliveira AGF, Vale TC, Teixeira LAS, Lima ARA, Lucchetti ALG, et al. Comparison of Team-Based Learning versus Traditional Lectures in Neuroanatomy: Medical Student Knowledge and Satisfaction. *Anatomical Sciences Education*. 2019;18:18.
86. Hamada S, Haruta J, Maeno T, Maeno T, Suzuki H, Takayashiki A, et al. Effectiveness of an interprofessional education program using team-based learning for medical students: A randomized controlled trial. *Journal of General and Family Medicine*. 2020;21(1):2-9.
87. Horst A, Schwartz BD, Fisher JA, Michels N, Van Winkle LJ. Selecting and Performing Service-Learning in a Team-Based Learning Format Fosters Dissonance, Reflective Capacity, Self-Examination, Bias Mitigation, and Compassionate Behavior in Prospective Medical Students. *International Journal of Environmental Research & Public Health*. 2019;16(20):16.

88. De Los Santos M, McFarlin CD, Martin L. Interprofessional education and service learning: a model for the future of health professions education. *Journal of Interprofessional Care*. 2014;28(4):374-5.
89. Bridges DR, Davidson RA, Odegard PS, Maki IV, Tomkowiak J. Interprofessional collaboration: three best practice models of interprofessional education. *Medical Education Online*. 2011;16.
90. Barr H, Koppel I, Reeves S, Hammick M, Freeth D. *Effective Interprofessional Education: Argument, Assumption and Evidence.*: Blackwell Publishing; 2005.
91. Curran V, Sharpe D. A Framework for Integrating Interprofessional Education Curriculum in the Health Sciences. *Education for Health Change in Learning and Practice*. 2007;20(3):93-.
92. Coster S, Norman I, Murrells T, Kitchen S, Meerabeau E, Sooboodoo E, et al. Interprofessional attitudes amongst undergraduate students in the health professions: A longitudinal questionnaire survey. *International Journal of Nursing Studies*. 2008;45(11):1667-81.
93. King H, Battles J, Baker D, Alonso A, Salas E, Webster J, et al. TeamSTEPPS: team strategies and tools to enhance performance and patient safety. In: Henriksen K, Battles JB, Keyes MA, et al, editors. *Advances in Patient Safety: New Directions and Alternative Approaches*. 32008.
94. Ferguson SL. TeamSTEPPS: integrating teamwork principles into adult health/medical-surgical practice. *MEDSURG Nursing*. 2008;17(2):122-5.
95. Robertson B, Kaplan B, Atallah H, Higgins M, Lewitt MJ, Ander DS. The use of simulation and a modified TeamSTEPPS curriculum for medical and nursing student team training. *Simulation in Healthcare*. 2010;5(6):332-7.
96. Motycka C, Egelund EF, Gannon J, Genuardi F, Gautam S, Stittsworth S, et al. Using interprofessional medication management simulations to impact student attitudes toward teamwork to prevent medication errors. *Currents in Pharmacy Teaching and Learning*. 2018;10(7):982-9.
97. Guraya SY, Barr H. The effectiveness of interprofessional education in healthcare: A systematic review and meta-analysis. *The Kaohsiung Journal of Medical Sciences*. 2018;34(3):160-5.
98. Robert Wood Johnson Foundation. What Can Be Done to Encourage More Interprofessional Collaboration in Health Care? 2011 [cited 2021 20.02.2021]. Available



from: <https://www.rwjf.org/en/library/research/2011/09/what-can-be-done-to-encourage-more-interprofessional-collaborati.html>.

99. Russ-Sellers R, Blackwell TH. Emergency Medical Technician Training During Medical School: Benefits for the Hidden Curriculum. *Academic Medicine*. 2017;92(7):958-60.

100. Riebe L, Roepen D, Santarelli B, Marchioro G. Teamwork: effectively teaching an employability skill. *Education + Training*. 2010;52(6/7):528-39.

101. Banerjee A, Slagle JM, Mercaldo ND, Booker R, Miller A, France DJ, et al. A simulation-based curriculum to introduce key teamwork principles to entering medical students. *BMC Medical Education*. 2016;16(1):295.

102. RSVP Design. Colourblind 1991 [cited 2021 20.02]. Available from: <https://shop.rsvpdesign.co.uk/colourblind>.

103. Clark J, Hall TF, O'Mahony K. Teaching medical students to recognise their strengths and limitations in leadership, teamwork and communication by military led tutorials. *Journal of the Royal Army Medical Corps*. 2013;159(4):274-7.

104. Runde D, Ha E, Jordan J, Stiner J, Jalali A, Huang YM, et al. Effects of team training on fourth-year medical student management of simulated critically ill patients. *Academic Emergency Medicine*. 2013;20(5):S329.

105. Cherr GS, Glaser K, Panchal A, Bowdish EA, Hassett JM. Results of a leadership/teamwork program for third-year medical students. *Journal of Surgical Research*. 2012;172 (2):220-1.