

# BMJ Open Learning practices of experienced healthcare teams and dyads in acute care settings: a scoping review

Katie Walker <sup>1</sup>, Maryam Asoodar <sup>1</sup>, Jenny Rudolph,<sup>2</sup> Michael Meguerdichian,<sup>3</sup> Tricia Yusaf,<sup>3</sup> Kimberly Campbell-Taylor,<sup>3</sup> Jeroen van Merriënboer<sup>1</sup>

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<sup>1</sup>The School of Health Professions Education, Maastricht University, Maastricht, The Netherlands  
<sup>2</sup>Center for Medical Simulation, Cambridge, Massachusetts, USA  
<sup>3</sup>Simulation Center, NYC Health + Hospitals, Bronx, New York, USA

## Correspondence to

Katie Walker;  
[k.walker@maastrichtuniversity.nl](mailto:k.walker@maastrichtuniversity.nl)

## ABSTRACT

**Objectives** To map the evidence on learning practices currently used by experienced healthcare teams and dyads. The hypothesis is that through reviewing the literature we will identify the number and array of current learning practices. Through the lens of collaboration, the authors' goal is to map current practice to guide future research, policy and practice.

**Setting** The review included studies from North America, Europe, Australasia and Asia. All studies were conducted in acute care settings such as operating rooms, emergency rooms, intensive care units and simulation centres.

**Participants** The participants were experienced healthcare professionals who work in acute care settings of any age or any sex. The group was interprofessional including two or more disciplines and/or professions. Characteristics of the participants who were excluded were students, novices, healthcare professionals who work in non-acute care settings and single profession studies.

**Primary and secondary outcome measures** Aligned to the protocol quantitative and qualitative analyses were conducted. Thematic analysis was used to evaluate and categorise the study findings. Secondary outcome measures were the different types of learning practices used together to produce excellence.

**Results** Most empirical studies were qualitative studies (46%), 31% were mixed methods and 23% were quantitative studies. There were also 24 reviews and 10 commentaries. The most frequent learning practices were structured observation and case scenarios (21%) followed by audio/video analysis and surveys (17%). Next was interviews and didactic presentations (12%) followed by prebriefing/debriefing and checklists (11%). Other learning practices accounted for less than 10%. Overall, 84 of the 86 publications, examined learning practices of teams larger than two participants.

**Conclusions** While the quality of studies was high, and there was a broad range of empirical studies, reviews and commentaries, there was no consensus on best practice in determining which learning practices to use and measurement of the effect of these practices.

## INTRODUCTION

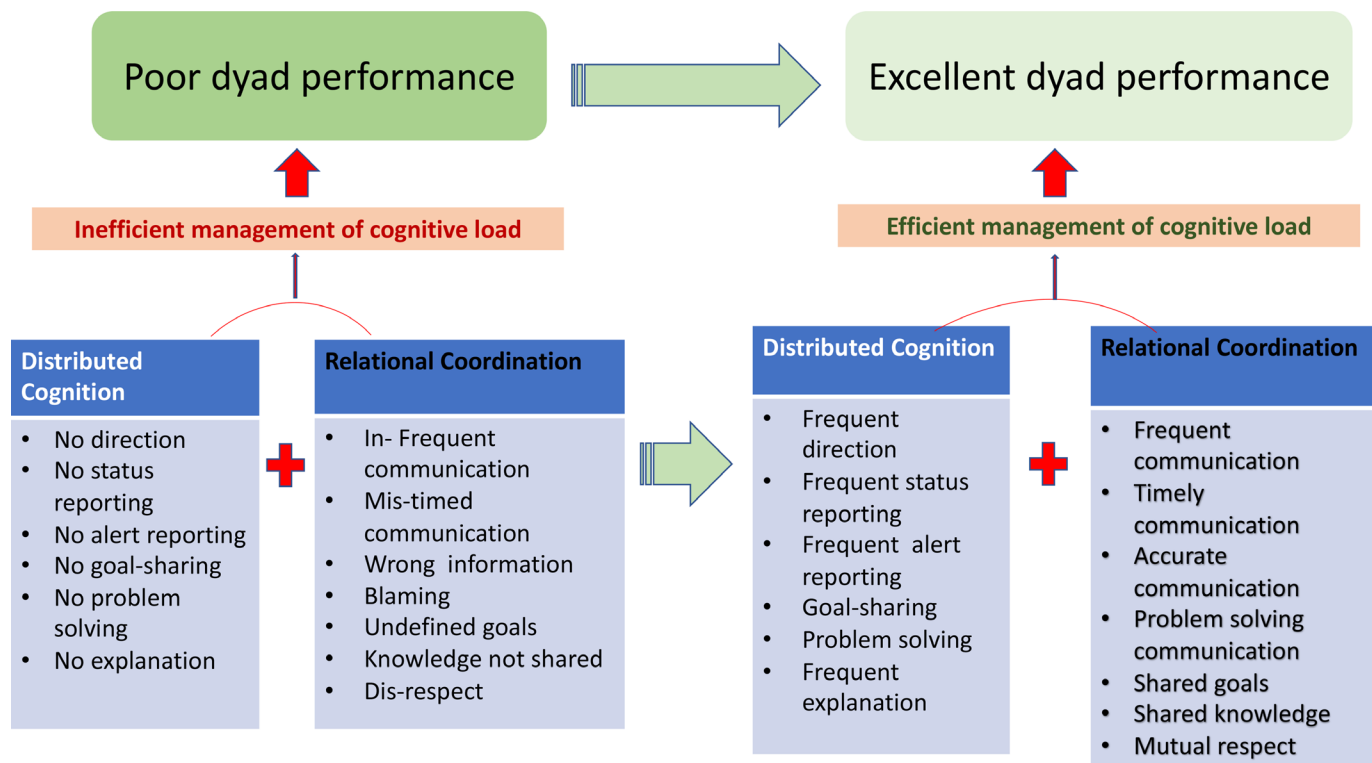
### Rationale

Medical error in healthcare, particularly in acute care environments, remains a major cause of morbidity and mortality. In 2019

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This review is comprehensive, including all study designs and grey literature from 2016 until 30 June 2021.
- ⇒ A detailed data extraction tool and a transparent, iterative team approach was employed.
- ⇒ The review is anchored in the established theories of distributed cognition, relational coordination and cognitive load theory.
- ⇒ The paucity and quality of literature addressing the learning practices of experienced healthcare dyads limited findings.

WHO<sup>1</sup> reported that unsafe surgical care interventions cause complications in up to 25% of the patients, resulting in 1 million deaths during or immediately after surgery annually. Cooper, in 2018,<sup>2</sup> specifically suggests the collaboration between each surgeon–anaesthesiologist dyad in the operating room, is perhaps the most critical element of overall operating room team performance. He says a well-functioning dyad is conducive to safe, effective care. Dysfunctional collaboration can promote unsafe conditions and contribute to an adverse outcome. Anecdotally, this appears to be true of teams and dominant dyads in other acute care settings such as the emergency room, labour and delivery, critical care and paediatrics. The goal of this scoping review is to understand the learning practices, that experienced teams and currently dyads use in acute care settings. The definition of learning practices for the purpose of this review is simply the activities that teams and dyads undertake to improve their team performance and develop and maintain their expertise. Finding the answer as to why there is no uniformity in exemplary performance may assist in averting medical errors and assist experienced larger teams and dyadic teams to function more routinely, with excellence. This will achieve the objective of the review and provide recommendations to inform



**Figure 1** Cognitive frameworks to build high performance dyadic collaboration.

best practice in experienced healthcare team and dyad learning practices. As there were so few studies related to purely dyadic learning practices, we extended the review to include learning practices of larger experienced healthcare teams in acute care settings. We reviewed all studies where learning practices informed best practice by experienced healthcare teams, in clinical acute care settings, or simulated environments.

This review is limited to experienced healthcare teams only. Avgerinos and Gokpinar, in 2017,<sup>3</sup> says that the team's expert function is dependent on the operation of the least experienced dyad in the team. They call this dyad 'a bottleneck pair' and suggest that in complex situations collaboration of these dyads dictate performance.

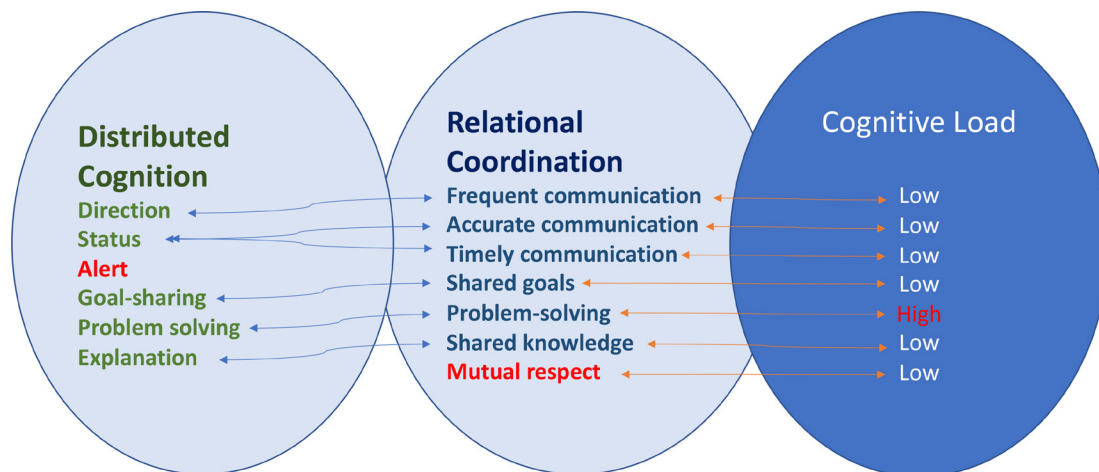
The unit of analysis that we are interested in, is the dyad, not individuals, and so we are only investigating collaboration in experienced dyads and larger teams.

Figure 1 demonstrates cognitive frameworks to build high performance dyadic collaboration from poor to excellent performance. The framework represents the elements of distributed cognition and relational coordination that influence cognitive load in the dyad and in turn the level of performance in complex situations.

Distributed cognition was first described by Hutchins and Hutchins in 1995.<sup>4</sup> He realised that cognitive science until the mid 1990's had taken the individual agent as its unit of analysis and that in most human pursuits, outcomes were the result of two or more experts interacting and usually with multiple technical devices as well. This concept grew and Hazlehurst *et al*, in 2007,<sup>5</sup> performed a study in the operating room during the management of

cardioplegia, where the surgeon and perfusionist's role is to coordinate activities during open heart surgery. This is a complex situation that requires each member of the dyad and the other team members to perform at their best. Using data from this distributed cognition study, Hazlehurst *et al* agreed on six factors that promote robust team performance. These are (1) frequent direction, (2) status reporting, (3) alert reporting, (4) goal-sharing, (5) problem solving and (6) frequent explanation. From the authors' analysis of this empirical study, they were able to prove that when healthcare professionals practice these elements of performance in the clinical environment, their performance was better.

Relational coordination<sup>6</sup> is a process whereby there is mutual reinforcement of communication and relating for the purpose of task integration. The concepts of shared goals, shared knowledge and mutual respect are deployed to achieve the highest work performance. This concept was first identified from a study of flight departures within the commercial aviation industry by Gittell in 2001 and 2002.<sup>7,8</sup> Comparisons are often drawn between the generic competencies required in aviation and healthcare, and subsequent studies have been conducted in healthcare.<sup>6,9</sup> Analysing learning practices through the lenses of distributed cognition and relational coordination enables identification of strengths and weaknesses of dyad performance. This may be where deliberate practice<sup>10</sup> could be incorporated to address dyadic weaknesses. Deliberate practice is the result of adaptation to extended and intense practice activities of weaknesses in performance.



**Figure 2** Mapping the elements of distributed cognition with relational coordination and cognitive load theory.

Cognitive load is typically seen as the load imposed on working memory by the task (intrinsic), irrelevant factors (extraneous) and the voluntary effort of learning (germane).<sup>11</sup> Cognitive load theory purposes to explain how the load it takes to process new information can affect the learner's ability to process that information and to embed the new knowledge in long-term memory. If the dyad is an expert team, they may have enough free-working memory resources to address the increased load. If the dyad is inexperienced, and is confronted with a complex issue, the cognitive load may become too high, hampering learning and transfer. In order to promote learning and transfer, cognitive load is best managed in such a way that cognitive processing irrelevant to learning is minimised and cognitive processing germane to learning is optimised, always within the limits of available cognitive capacity.<sup>12</sup> Figure 2 demonstrates mapping the elements of distributed cognition with relational coordination and cognitive load theory and how cognitive load may be affected in complex situations. Highly complex tasks can best be performed by a team, because the intrinsic load of a complex task might be too high to be performed by one individual, but it can be performed by a (well-trained) team.<sup>13</sup>

Salas *et al*, in 2007,<sup>14</sup> defines an expert team as team members who are interdependent, each having expert-level knowledge, skills and experience related to the task they are performing. These teams can also adapt, coordinate and cooperate as a team, and are able to produce sustainable and repeatable expert performance. The hypothesis is that these excellent teams are characterised by their ability to undertake activities to improve their team performance and develop their expertise.

Four authors of this review have worked in acute healthcare settings in large hospital systems for more than 20 years and have been involved in case review during that time. This group of four developed the data extraction tool and extracted the data. Case review casts a spotlight on cases where patient care has been suboptimal, and improvement is needed. It also illustrates cases where the patient care was excellent, and the healthcare team

performed as an expert team. The authors agree that from reflecting on these case reviews, when there is a breakdown in collaboration, the failure is usually between two specific members of the healthcare team, the dominant dyad. We believe that by focusing on the collaboration in healthcare dyads, we may derive how expert dyads operate as opposed to weak ones and the learning practices experts use.

Out of the array of literature reviews available, (ie, narrative, or traditional literature reviews, systematic or realist reviews), we chose a scoping review methodology to provide a clear understanding of the extent of research completed in this area including published and unpublished scripts. Scoping reviews also help us identify gaps in the literature.<sup>15</sup> We examined learning practices that healthcare teams and dyads use to improve performance in healthcare teams.<sup>16</sup> In summary, in this scoping review we aimed to explore the breadth or extent of the literature, summarise the evidence and inform future research,<sup>17</sup> with the overarching objective of providing a 'map' of the available evidence on the range of learning practices. The authors considered it important to provide this evidence map to guide best practice in learning practices that expert teams and more specifically healthcare dyads or pairs deploy.

Collaboration in healthcare dyads is a complex phenomenon, and as shown in figure 2 three theoretical perspectives have been selected, that are relevant to this problem: cognitive load,<sup>11</sup> distributed cognition including shared mental models<sup>5</sup> and relational coordination theory.<sup>6</sup>

A deeper understanding of the three theories listed above, and how they interact and complement each other, may assist us to reflect on expert dyadic function. We reviewed this problem specifically in acute healthcare settings, and only manuscripts including expert, inter-professional, dyads and teams were examined. Student training, single discipline training and ambulatory care teams were not examined. A preliminary search of MEDLINE, the Cochrane Database of Systematic Reviews and *JB* Evidence Synthesis was conducted and no current

or underway systematic reviews or scoping reviews on the topic were identified.

<sup>18</sup> Sebok-Seyer *et al.*,<sup>19</sup> in 2021, published a scoping review on the approaches for measuring ‘interdependent’ collaborative performances and found a strong level of interdependence between dyads of trainees and their supervisors. Interdependence refers to the extent team members rely on each other for the functioning of the team. Although this was an interesting review of dyad performance, this scoping review focusses on expert dyadic team, not trainees.

Due to the limited research on the learning practices of experienced healthcare dyads, the scoping review was extended to include all teams rather than only the smallest team, the dyad.

### Objectives

The overarching objective of this scoping review was to assess the extent of literature with respect to identifying and characterising learning practices that experienced healthcare dyads and teams use in acute care settings to build excellent performance. The two main questions this scoping review aims to answer are: what are the learning practices that experienced healthcare dyads and teams use to optimise performance in acute settings? and how are the learning practices deployed?

## METHODS

### Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

### Protocol and registration

Our protocol was drafted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping review (PRISMA-ScR) tool.

Unlike a systematic review, scoping reviews do not tend to produce, and report results that have been synthesised from multiple evidence sources following a formal process of methodological appraisal to determine the quality of the evidence. Rather, scoping reviews aim to provide an overview or map of the evidence. As a result, an assessment of methodological limitations or risk of bias of the evidence was not performed. Systematic reviews normally inform the development of trustworthy guidelines and recommendations whereas scoping reviews provide an overview of the evidence or answer questions regarding the nature and diversity of the topic.

The final protocol was registered prospectively with the Open Science Framework on <https://osf.io/>.

The protocol, ‘Optimizing expert dyad performance in acute care settings: a scoping review protocol’ was published in *BMJ Open* and can be found at <http://dx.doi.org/10.1136/bmjopen-2020-047260>.

### Eligibility criteria

Described below are the population, concept, context and study designs eligibility criteria. The participants were

experienced healthcare professionals who work in acute settings of any age or any sex. The group was interprofessional including two or more disciplines and/or professions. Characteristics of participants who were excluded were students, novice healthcare professionals who work in non-acute care settings and single profession studies. Novice is defined by Benner<sup>20</sup> as a beginner with no experience. They are taught general rules to help perform tasks, and their rule-governed behaviour is limited and inflexible. This would include healthcare professionals in their orientation phase post registration for at least the first 6 months.

The concept was learning practices that drive expert performance of experienced healthcare team and dyads with a focus on cognitive load, distributed cognition and relational coordination. This also included learning practices that promote and inform future expertise. The exclusion criteria were learning practices for novices and students as well as individual psychomotor skill acquisition. The context includes all acute care settings in hospitals including the operating room, emergency room and critical care environments. Settings in all countries were included and there are no racial-based or gender-based exclusions. The exclusion criteria were all non-acute care settings including ambulatory care, behavioural health and home care. Only manuscripts from January 2016 to 30 June 2021 were included and only those written in English were reviewed. Our rationale for reviewing manuscripts from the past 6 years was that the research in this area is continually evolving and the data would be more contemporary from this more recent timeline (Manser, 2009).<sup>21</sup>

Table 1 describes the inclusion and exclusion criteria.

### Information sources

The databases we searched comprised Maastricht University Libsearch including PsycINFO, MEDLINE, Education Resources Information Center (ERIC) and Web of Science (WoS). Sources of unpublished studies/grey literature were sourced using Google search. The references of all included manuscripts were searched, and the relevant articles included. The searches were conducted between 13 March 2020 and 4 July 2021.

### Search

The text words contained in the titles and abstracts of relevant articles, and index terms were used. A full search strategy for the ERIC database is presented in table 2.

The librarians at Maastricht University were advisors to the research team and played a key role in assisting the research team to refine the search terms.

The final search string was:

“healthcare dyad\*” OR “healthcare team\*” OR “medical team\*” OR “operating room team\*”) AND (“Learn\*” OR “practic\*” OR “educat\*” OR “communic\*” OR “coordinat\*” OR “perform\*”)

**Table 1** Inclusion and exclusion criteria

Criterion	Inclusion	Exclusion
Date	2016 to 30 June 2021	Before 2016 and after 30 June 2021
Exposure of interest	Healthcare teams/dyads analysis and learning practices	Individual learning practices/non-clinical teams
Language	English	All other languages
Participants	Experienced healthcare teams/dyads of registered health professionals	Exclude all single discipline student training and interprofessional student team training
Peer review	Peer-reviewed literature and non-peer reviewed	None
Objective measures	Measuring the number and type of learning practices experienced healthcare teams use	None
Reported outcomes	Using objective measures, self-reported data	None
Setting	Acute care facilities	Ambulatory care, home care
Type of publication	Original studies, commentaries, reviews and editorials, position papers	None

### Selection of sources of evidence

In this study, we mapped the literature on learning practices to identify key concepts, gaps in practice, measurement and optimisation.

The authors acknowledge the importance of individual psychomotor skills practice and the role this plays in expertise, however, this research focused on rehearsals and practices experienced teams use to directly improve collaboration.

Following the search, all identified citations were collated and uploaded into *EndNote X9/June 2019 (Clarivate Analytics, Philadelphia, USA)* and duplicates removed. Any disagreements that arose between reviewers at each stage of the selection process were resolved through discussion with an additional reviewer. A random sample of 25 titles/abstracts were selected and reviewed by a team of four researchers. When 75% agreement was achieved on the citations/abstracts the team of four commenced screening. The final records/abstracts were determined. Two reviewers then reviewed all records/abstracts against the inclusion criteria and determined full-text articles for inclusion and exclusion, with the reasons for exclusion clearly articulated. Any discrepancies were reviewed by a third independent researcher. The same process that was used for records/abstracts was then used for the full-text manuscripts. The justifications for exclusion of any full-text articles were clearly stated. The final full-text manuscripts were determined.

The results of the search and the study inclusion process was reported in full in a PRISMA-ScR flow diagram (see [figure 3](#); Selection of sources of evidence flow chart).<sup>22</sup>

Our multidisciplinary research team included selected individuals, as researchers from interprofessional backgrounds including medical education researchers, nurses and physicians. Each person contributed to the determination on the sources to be either included or excluded, the development of the data extraction instrument and authorship of the manuscript. In selecting these individuals, it was important to consider availability and

willingness to participate, and the ability to communicate experiences and opinions in an articulate, expressive, and reflective manner.

Areas of controversy were around whether a certain practice could be classified as a learning practice which led to finding the right definition to describe learning practices in the context of this study. Resolution of these disputes was key to the results of the review.

KW is interested in healthcare reform and decreasing error and has spent the past 20 years deploying simulation to inform new policy development. JvM and MA are professors in medical education and have done research on expertise and expertise development. MM, KC-T and TY are specialist physicians and nurses who work in the simulation programme at NYC Health + Hospitals, USA, developing and delivering simulation programmes in response to, and to mitigate hospital system errors. JR is a professor in behavioural science and the Executive Director of the Center for Medical Simulation in Boston and a lifelong athlete. All authors have made substantive intellectual contributions to the development of this scoping review. We were very explicit about own individual perspectives and what they brought to the review throughout the course of the research. During this process our perspectives were both challenged and confirmed by our findings. Articles were highly variable in methods, populations studied, educational interventions, evaluative practices and results.

### Data charting process

Data was extracted from manuscripts by four independent reviewers using a data extraction tool developed by the reviewers. The extraction instrument followed the JBI data extraction tool template with customisation to answer the review objectives. The data extracted included specific details about the participants, concept, context, study methods and key findings relevant to the review question/s.

**Table 2** Search strategy—Education Resources Information Center (ERIC)

#	Searches	Results
S1	("Operating room teams") AND ("performance")	0
S2	("Operating room teams") AND ("practice")	0
S3	("distributed cognition") AND ("team performance")	0
S4	("Operating room teams") AND ("learning")	0
S5	("Cognitive Load") AND ("dyad performance")	0
S6	"Health dyads" AND "Learning" or "Behavior"	0
S7	("dyad" OR "surg* dyads" OR "health dyads" OR "surgery") AND ("communicat*" OR "perform*" OR "coordinat*" OR "expect*" OR "practice*" OR "cognit*" OR "lead*")	109
S8	("surg* dyads") AND ("communicat*" OR "perform*" OR "coordinat*" OR "expect*" OR "practice*" OR "cognit*" OR "lead*")	4
S9	("surgeon dyads" OR "health dyads" OR "medical dyads") AND ("communicat*" OR "perform*" OR "coordinat*" OR "expect*" OR "practice*" OR "cognit*" OR "lead*")	6
S10	("expert healthcare dyad*" OR "expert healthcare team*" OR "expert medical team*" OR "expert operating room team*") AND (Learn* OR practic* OR educat* OR "deliberate practice" OR communic* OR coordinat*) AND (performance)	1
S11	("healthcare dyad*" OR "healthcare team*" OR "medical team*" OR "operating room team*") AND ("Learn*" OR "practic*" OR "educat*" OR "communic*" OR "coordinat*" OR "perform*")	11

The reviewers independently charted the data, discussed the results and continuously updated the data charting form in an iterative process. Data from eligible studies were extracted using the data abstraction tool designed for this study. The tool captured the relevant information on key study characteristics and detailed information on learning practices in acute care settings. Four reviewers independently charted the data from each eligible article using the SurveyMonkey tool. Any disagreements were resolved through a virtual call discussion between two reviewers and further determination by a third reviewer.

### Data items

We abstracted data on article characteristics (eg, country of origin, year of publication), and contextual factors (eg,

acute care setting, number of participants, learning practices identified, research design), and how the learning practices were deployed. The draft data extraction tool was modified and revised as necessary during the process of extracting data from each included evidence source (online supplemental appendix file 1 Data Extraction Tool).

As the study synthesis progressed several elements were discarded, and new areas explored.

### Synthesis of results

We grouped the studies by charting the learning practices deployed in each acute care setting. We summarised the empirical studies by type of settings, populations and study designs for each research study, including the number of healthcare professionals participating. We identified 24 reviews, including systematic, narrative and scoping reviews, that met our inclusion criteria. We also included 10 commentaries in the review.

### Patient and public involvement

We did not involve patients or the public in this scoping review, but rather plan to use the results to inform patients and the public with the view to designing new projects in which they will be involved.

## RESULTS

### Selection of sources of evidence

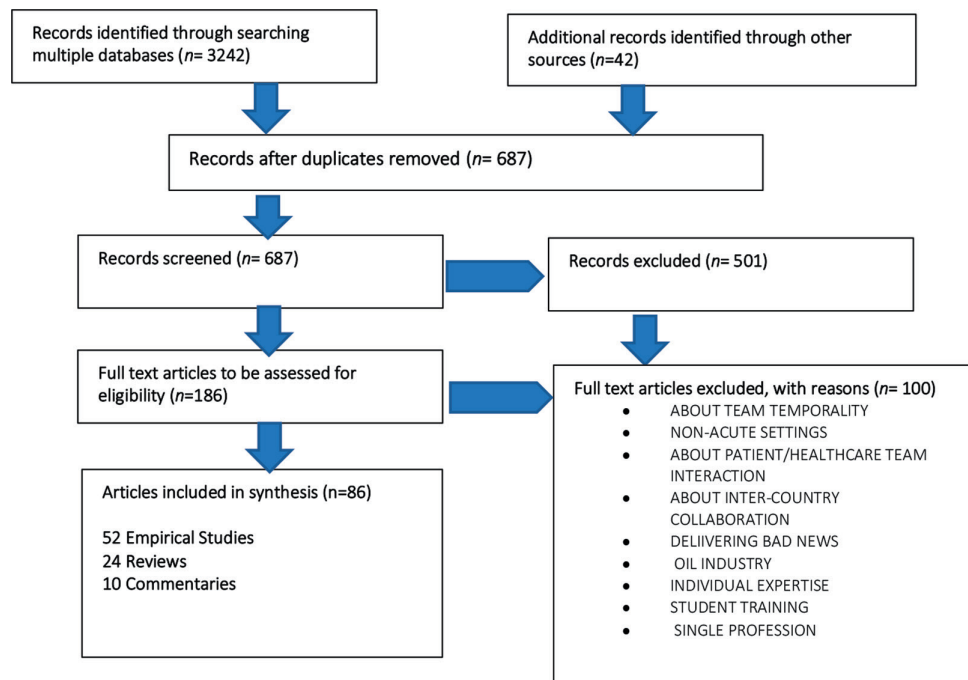
After duplicates were removed, a total of 687 citations were identified from searches of electronic databases and references from the review articles. Based on the title and the abstract, 501 were excluded, with 186 full-text articles to be retrieved and assessed for eligibility. Of these, 100 articles were excluded for the following reasons: they were focused on team temporality, patient/healthcare team interaction, intercountry collaboration and delivering bad news which were all concepts not considered part of this review. Several were not set in acute care settings, and one was based on the oil industry. Some studies were on gaining individual expertise, student training and only included single discipline which did not meet inclusion criteria.

The remaining 86 studies were considered eligible for this review, acknowledging that 84 studies included teams that were larger than dyads. This was a major challenge for the hypothesis of this manuscript and shows that further research is needed on dyads. As most of the data comes from teams that were larger than two people, we are hoping that this review will set the stage for additional studies in this area.

Figure 3 is the selection of sources of evidence flow chart.

### Characteristics of sources of evidence

Of the 86 manuscripts included in the synthesis, 52 were empirical studies from data base searches or reference reviews, 24 were various types of reviews and 10 were



**Figure 3** Selection of sources of evidence flow chart.

commentaries. For the empirical studies, each citation was characterised by year of publication, location of study by continent, type of setting, acute care or simulation, the number of participants or cases in the study, the profession of participants, research design and learning practices identified (online supplemental appendix file 2A: Characteristics of Sources of Evidence - Empirical Studies). Review articles were characterised by the type of review, the population studied and the main ideas and recommendations from the study (online supplemental appendix file 2B: Characteristics of Sources of Evidence-Reviews). The recommendations or main ideas were the characteristics captured for commentaries (online supplemental appendix file 2C: Characteristics of Sources of Evidence - Commentaries).

### Results of individual sources of evidence

Table 3 illustrates 15 different learning practices deployed by acute care setting or simulation centre. Structured observation, case scenarios and surveys were the most used, while coaching, cognitive aides (other than checklists), serious games and online learning were least popular.

### Synthesis of results

Eighty-six studies discussed learning practices of experienced healthcare teams in acute care settings and simulation centres. The majority were from North America (29), with 17 from Europe, 5 from Australasia and 1 from Asia (see figure 4; Manuscripts by location of study).

Most empirical studies were qualitative studies (46%), 31% were mixed methods and 23% were quantitative studies (see figure 5; Manuscripts by research design). There were also 24 reviews which included systematic,

narrative, realist and scoping reviews and 10 commentaries. The most frequent team-based learning practices were structured observation and case scenarios (21%) followed by audio/video analysis and surveys of unit clinical teams (17%). Next was unit staff reflective interviews and didactic presentations (12%) followed by prebriefing/debriefing and checklists (11%). Rating scales accounted for 7%, peer review and discussion 5%, focus groups of unit clinical team participants 2% and finally online learning, serious games, cognitive aides and coaching 1%. Overall, 84 of the 86 publications selected, examined the learning practices of teams that were larger than two participants. While most manuscripts reported improved team behaviours from implementing suggested learning practices, none incorporated direct measures of dyad performance.

Of the quantitative studies, 50% were observational (non-experimental), 10% were surveys, 8% were prospective cohort studies and observational (experimental) studies, 4% were descriptive, cross-sectional, questionnaires, pretests/posttests and randomised clinical trials (see figure 6; Manuscripts by research design - quantitative).

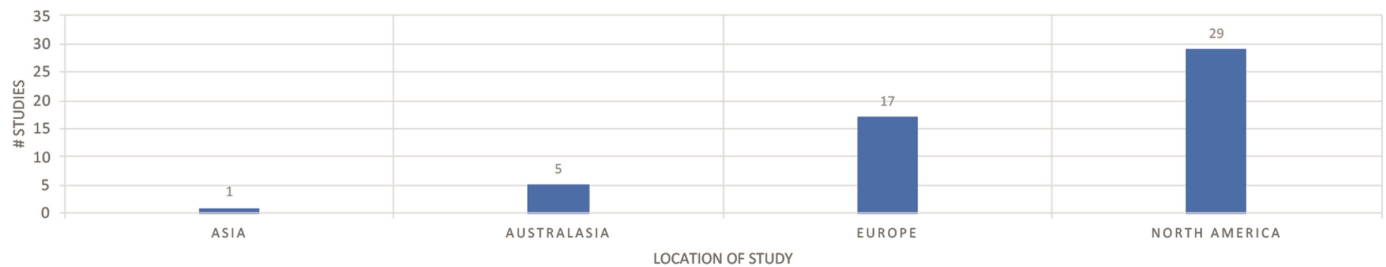
Of the qualitative studies, 30% were interviews, 25% were observational and grounded theory studies and 20% were ethnography (see figure 7; Manuscripts by research design - qualitative).

Of the mixed methods studies, 75% were before and after studies, 13% were interviews and structured observation and 6% were observational and sequential studies (see figure 8; Manuscripts by research design - mixed methods).

**Table 3** Results of individual sources of evidence

Setting	Setting										Total
	Simulation center	Operating room	Emergency room	Intensive care unit	Labour and delivery	General medical unit	Paediatric emergency room	Neonatal intensive care unit			
Learning practices											
Structured observation	1	10	2	3	0	0	1	1	1	18	21.24
Case scenarios	3	10	4	1	0	0	0	0	0	18	21.24
Audio/video analysis	2	7	2	2	0	0	0	1	1	14	16.52
Prebriefing/ debriefing	2	3	3	1	0	0	0	0	0	9	10.62
1:1 Reflexive conversations	0	0	0	0	0	0	0	0	0	0	
Coaching	0	0	0	1	0	0	0	0	0	1	1.18
Interviews	0	8	0	1	0	0	0	1	1	10	11.8
Peer review and discussion	0	4	0	0	0	0	0	0	0	4	4.72
Focus groups	2	0	0	0	0	0	0	0	0	2	2.36
Checklists	1	6	0	1	1	0	0	0	0	9	10.62
Cognitive aids	0	1	0	0	0	0	0	0	0	1	1.18
Rating scales	0	4	1	0	0	0	1	0	0	6	7.08
Learning by doing	0	0	0	0	0	0	0	0	0	0	
Experimentation/trial and Error	0	0	0	0	0	0	0	0	0	0	
Surveys	2	10	1	0	0	1	0	0	0	14	16.52
Serious games	0	1	0	0	0	0	0	0	0	1	1.18
Didactic presentations	1	4	3	1	0	0	1	0	0	10	11.8
Web-based information and social media	0	0	0	0	0	0	0	0	0	0	
Online learning	0	0	1	0	0	0	0	0	0	1	1.18
Journal clubs	0	0	0	0	0	0	0	0	0	0	





**Figure 4** Manuscripts by location of study.

There were also 24 reviews which included systematic, narrative, realist and scoping reviews and 10 commentaries.

A large majority of the research was conducted in the operating room (29), followed by 7 in the emergency room and 6 studies in simulation centres. Four studies were based in intensive care units, three in paediatric units, two in neonatal intensive care units and one each in labour and delivery and general medical units (see figure 9; Manuscripts by setting).

## DISCUSSION

### Summary of evidence

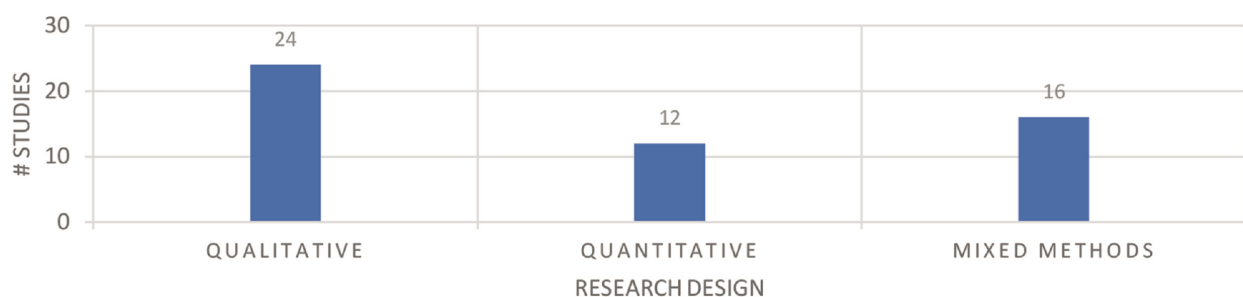
We found that most manuscripts on teamwork in acute care settings were empirical studies that included structured observations, case studies and surveys. While the number of empirical articles was increasing year-by-year prior to the pandemic, the 52 studies do not yet rate the efficacy of one learning practice over another, demonstrate any consistency on when or how the practice is applied or objectively measure the effect. This finding is concerning as apart from healthcare systems and hospitals spending thousands of dollars each year on teamwork training, we are unclear on the efficacy of that training. Many studies report on the use of simulation to deliver learning practices, but there is no determined best practice on how often or who should participate in the training. Some studies focused on training clinical leaders in units. More empirical research is needed, particularly research where collaboration is measured and its effect on team performance.

Fifteen learning practices were identified from the manuscripts we examined. More work is needed to map the identified learning practices to improvement in teamwork collaboration. Specifically, research to

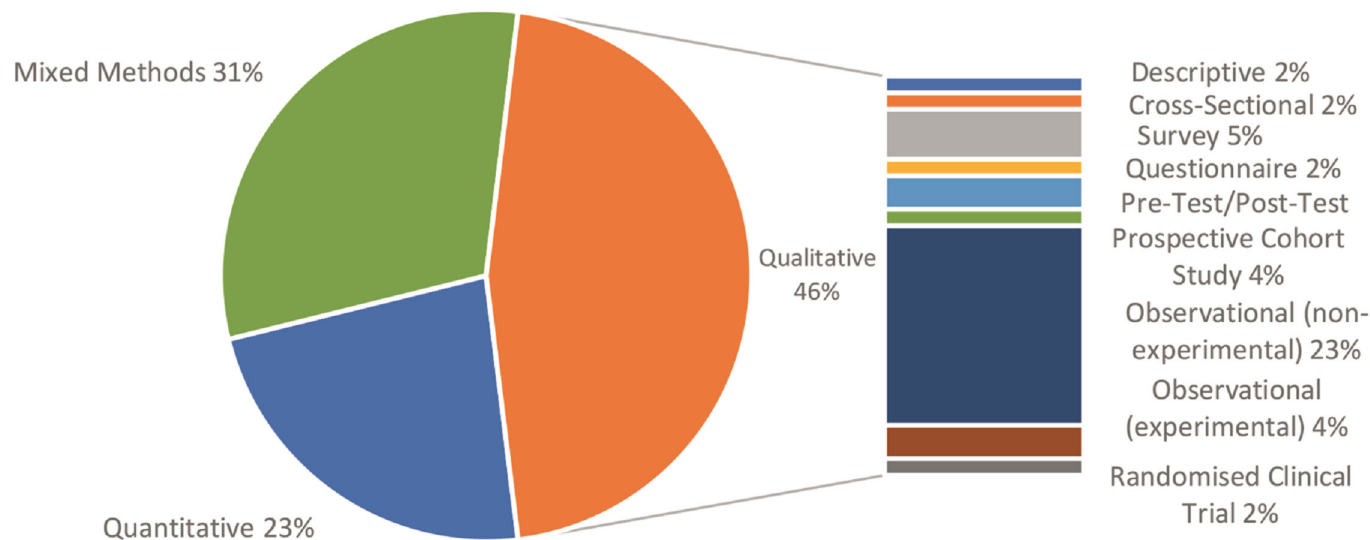
determine how to improve team and dyad collaborative expertise is needed, as the limited empirical work in this area indicates that reproducibility may be a weakness of current team training. While many of the publications we reviewed provided potential solutions (eg, debriefing of structured observation and case scenarios) the lack of reproducibility might be solved with improved clarity of the measurement of team collaboration and in turn the measurement of team performance. One of the most important tasks in any field of study is to develop a shared nomenclature. It is only through a shared understanding of words that shared concepts can evolve into more focused ideas. When words are used imprecisely, generalising results is more difficult. Many of the publications we reviewed were not specific about the learning practices deployed and did not unearth a shared understanding of teamwork collaborative measurement and measurement of team performance. We can think of collaboration as the mediating variable and teamwork excellence as the dependent variable. More exploration is required to identify the constellation of learning practices that focus on collaboration.

Efforts were taken to ensure that the results of this scoping review would benefit the field. The methodology we used in this scoping review was rigorous, following evidence-based guidelines on how to effectively scope a field of literature. We solicited input from a wide range of stakeholders and sought input on early drafts.

We were interested in how identified learning practices can help develop excellent team and dyad performance, and if and how this can be explained by the three theoretical perspectives of distributed cognition, relational coordination and cognitive load theory. We surmise that checklists and other types of cognitive aids can possibly help to decrease workload and so free up processing



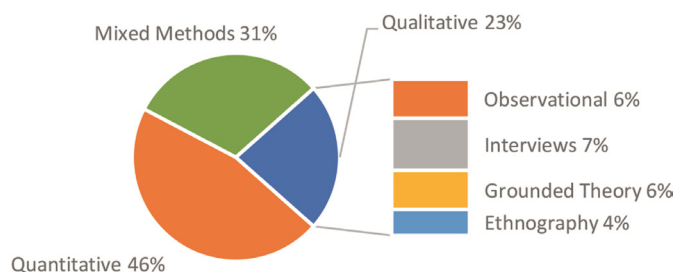
**Figure 5** Manuscripts by research design.



**Figure 6** Manuscripts by research design - quantitative.

resources that can be used for improved relational coordination. Reviewed studies also show that prebriefings and debriefings might help dyads to develop a common understanding of the task through distributed cognition enabling a shared mental model and so improve coordination. There have also been learning practices identified that seem to be unrelated to the underpinning theories. These include practices such as the use of rating scales. We find this particularly interesting as it suggests that additional theoretical perspectives are necessary in future research, for example, rating scales might suggest that theories of (self-)assessment may also be important to understand how dyads develop into excellent teams.

In [figure 2](#) we introduced the frameworks of distributed cognition, relational coordination and cognitive load. We have interpreted our findings on learning practices in relation to the three theoretical frameworks in the following way. When considering the 15 learning practices identified, we found that elements of both distributed cognition and relational coordination could be addressed through clustering the learning practices into the five broader topic areas or constellations. These are (1) evaluate performance, (2) practice, (3) feedback, (4) use just-in-time aids and (5) study ideal examples. Evaluating performance would be achieved through structured observation, audio/video analysis and rating scales. Practice would employ case scenarios, with an emphasis on prebriefing and debriefing. Feedback would



**Figure 7** Manuscripts by research design - qualitative.

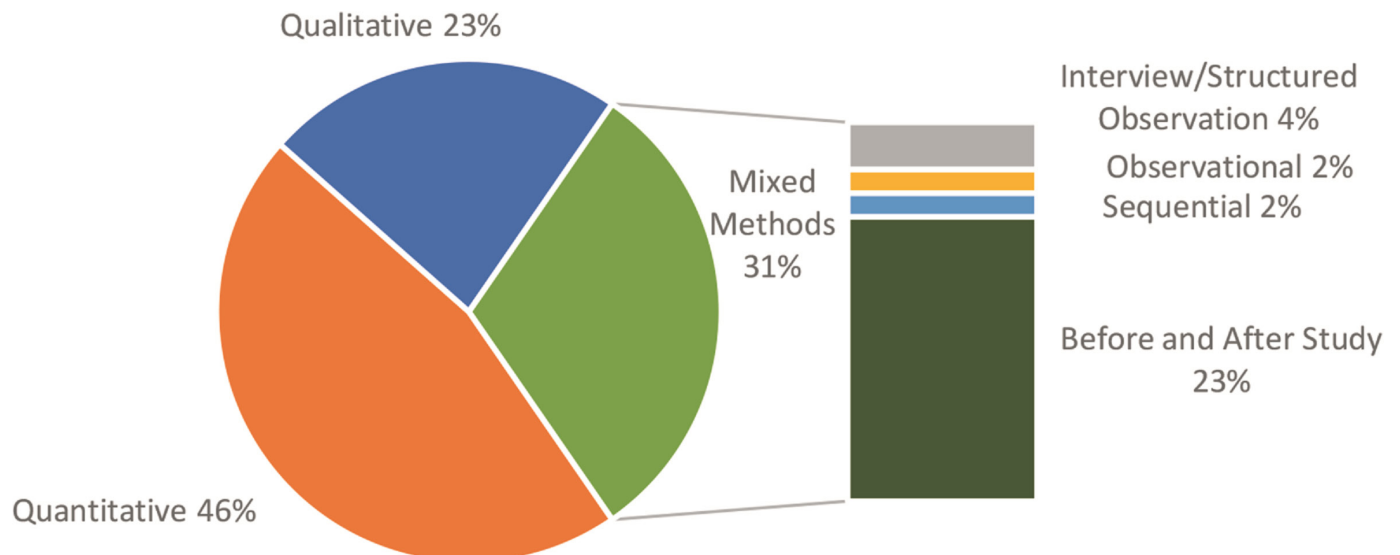
entail coaching, interviews, peer review, focus groups and surveys. Just-in-time aids refers to checklists and cognitive aids and finally, studying ideal examples could be demonstrated through serious games, online learning and didactic presentations. [Figure 10](#) demonstrates learning practice constellations in relation to collaborative frameworks.

Literature has supported that the application of cognitive load theory improves efficiency of learning.<sup>12</sup> Creative learning practices that consider cognitive load will optimise skill acquisition in dyadic collaboration. By shaping learning practices that break down the complexity of collaborative frameworks through the study of ideal examples and feedback (the intrinsic load, see learning practices 6–10 and 13–15 in [figure 10](#)), while managing to minimise the irrelevant information through just-in-time aids (the extraneous load, learning practices 11–12 in [figure 10](#)) and optimising germane processing through practice and evaluating performance (learning practices 1–3 and 4–5), dyads may train more efficiently to achieve expert performance.

### Limitations

There are limitations in our scoping review. To make our review more feasible, we extended the scope of the review to include larger teams as there were so few manuscripts on dyadic learning. Another limitation stemmed from using the dyad or duo as the unit of analysis, rather than the individual. There has been so little research conducted on what constitutes learning practices when the individual is not the unit of analysis. Further adding to this issue is how do we measure these learning practices and determine their suitability for developing and maintaining dyadic and team expertise rather than individual expertise.

Another potential limitation is how we created the search for our review. We did not search on terms that may have provided a broader net such as ‘duos’ or ‘pairs’ and so we may have missed some relevant work in the



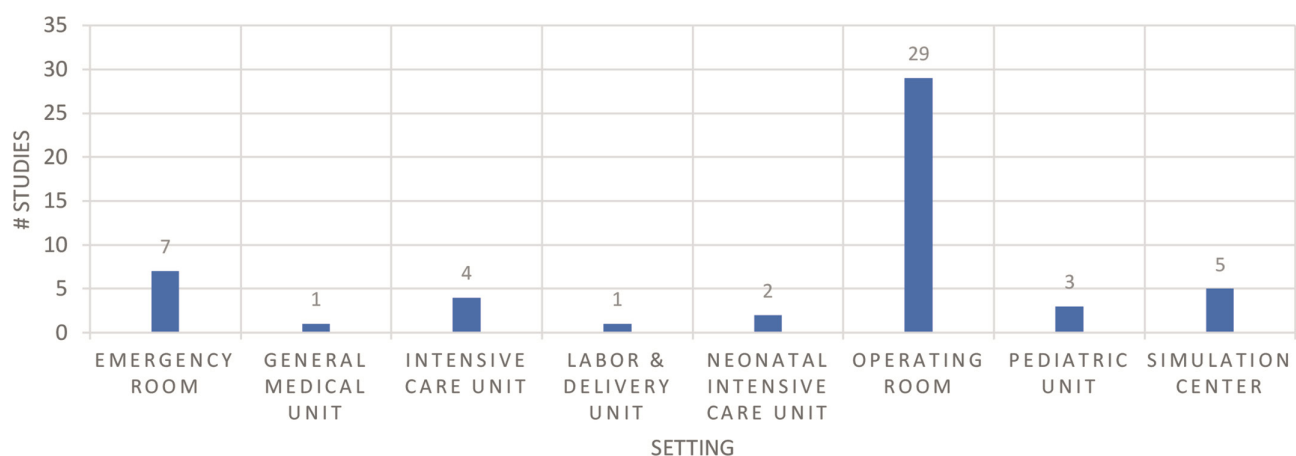
**Figure 8** Manuscripts by research design - mixed methods.

initial searches. We did do a comprehensive snowball search on the references of all included manuscripts and this process unearthed more relevant studies. Regardless of these limitations, we think that the review demonstrates a clear progression in the domain of team learning practices and casts a light on areas of weakness and areas needing further study. Furthermore, some may consider a scoping review as lacking in rigour as the results are simply mapped, not synthesised. In summary, this review clearly demonstrated the dearth of research on healthcare pairs or dyads and areas for further research.

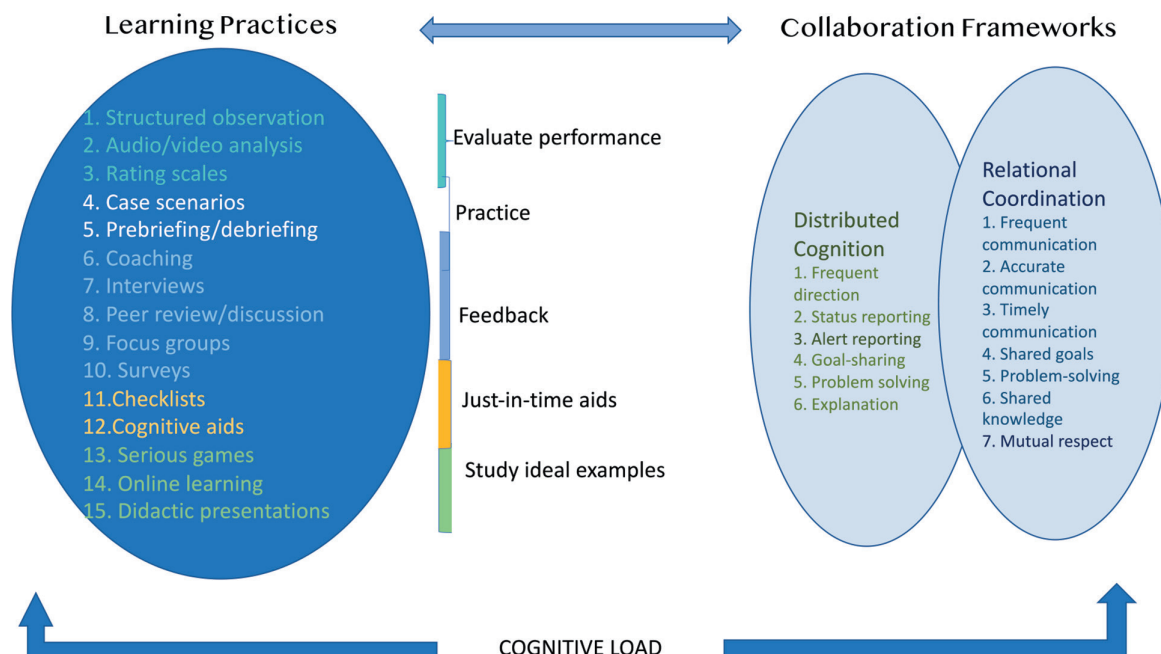
## CONCLUSIONS

The lack of evidence to support learning practices that promote expert performance of experienced teams and healthcare dyads in acute care settings poses a challenge to excellence in healthcare delivery and reduction of error. How do we develop expert teams and healthcare dyads when we do not understand the learning practices that should be undertaken to achieve excellence? The aim of this scoping review was to identify gaps in the

literature which may guide further research on excellent performance in teams and healthcare dyads. However, the lack of evidence found on dyadic learning practices means that we will need to turn to our expert dyadic teams and question them to understand how they became experts and the learning practices they participate in to guide future performance. Currently, evidence is insufficient to guide the nature of best learning practice interventions. There is also limited evidence to describe how learning practices should be evaluated and rated to determine their efficacy. Examination of the underpinning frameworks of workload theories, distributed cognition and relational coordination may guide teams and dyadic units to increased collaboration and therefore guide best learning practices teams and dyads should undertake to achieve excellence. This advocates the need for high quality research to determine the learning practices teams and dyads should undertake, how these learning practices should be deployed and how performance can be measured. Further research questions may include what are the learning practices used by healthcare teams



**Figure 9** Manuscripts by setting.



**Figure 10** Learning practice constellations in relation to collaborative frameworks.

and dyads, which are most beneficial? How are these practices best deployed? Our review has identified five constellations of learning practices and maybe positive effects will mainly be realised by the integration of these constellations into medical education. For example, teams need to receive information on what is excellent performance (study ideal examples), practice in particular ways (also using simulation, role play) and receive feedback on their own performance (rating scales, video feedback, etc). If we want to reach positive effects, a combination of learning practices will probably be necessary.

**Twitter** Katie Walker @ubiquitouslinks

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#### ORCID iDs

Katie Walker <http://orcid.org/0000-0003-2107-8061>

Maryam Asoodar <http://orcid.org/0000-0001-6044-6790>

#### REFERENCES

- 1 Organization WH. WHO calls for urgent action to reduce patient harm in healthcare, 2019. Available: <https://www.who.int/news/item/13-09-2019-who-calls-for-urgent-action-to-reduce-patient-harm-in-healthcare> [Accessed 08 Nov 2020].
- 2 Cooper JB. Critical role of the Surgeon-Anesthesiologist relationship for patient safety. *J Am Coll Surg* 2018;227:382–6.
- 3 Avgerinos E, Gokpinar B. Team Familiarity and productivity in cardiac surgery operations: the effect of dispersion, bottlenecks, and task complexity. *M&SOM* 2017;19:19–35.
- 4 Hutchins E, Hutchins E. How a Cockpit Remembers its speeds. *Cogn Sci* 1995;19:265–88.
- 5 Hazlehurst B, McMullen CK, Gorman PN. Distributed cognition in the heart room: how situation awareness arises from coordinated communications during cardiac surgery. *J Biomed Inform* 2007;40:539–51.
- 6 Gittell JH, Godfrey M, Thistlethwaite J. Interprofessional collaborative practice and relational coordination: improving healthcare through relationships. *J Interprof Care* 2013;27:210–3.
- 7 Gittell JH, Hoffer Gittell J. Supervisory span, relational coordination and flight departure performance: a reassessment of Postbureaucracy theory. *Organization Science* 2001;12:468–83.
- 8 Hoffer Gittell J. Coordinating mechanisms in care provider groups: relational coordination as a mediator and input uncertainty as a Moderator of performance effects. *Manage Sci* 2002;48:1408–26.
- 9 Havens DS, Vasey J, Gittell JH, et al. Relational coordination among nurses and other providers: impact on the quality of patient care. *J Nurs Manag* 2010;18:926–37.
- 10 Ericsson KA, Nandagopal K, Roring RW. Toward a science of exceptional achievement: attaining superior performance through deliberate practice. *Ann N Y Acad Sci* 2009;1172:199–217.

- 11 Sweller J, van Merriënboer JJG, Paas FGWC. Cognitive architecture and instructional design. *Educ Psychol Rev* 1998;10:251–96.
- 12 Sweller J, van Merriënboer JJG. And instructional design: 20 years later. *Educ Psychol Rev* 2019;31:261–92.
- 13 Kirschner F, Paas F, Kirschner PA. A cognitive load approach to collaborative learning: United brains for complex tasks. *Educ Psychol Rev* 2009;21:31–42.
- 14 Salas E, Rosen MA, King H. Managing teams managing crises: principles of teamwork to improve patient safety in the emergency room and beyond. *Theoretical Issues in Ergonomics Science* 2007;8:381–94.
- 15 Aromataris E MZ, ed. *JB I manual for evidence synthesis*, 2020.
- 16 Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005;8:19–32.
- 17 Tricco AC, Soobiah C, Antony J, et al. A scoping review identifies multiple emerging knowledge synthesis methods, but few studies operationalize the method. *J Clin Epidemiol* 2016;73:19–28.
- 18 Bingham T, Conner ML. *The new social learning : a guide to transforming organizations through social media*. Alexandria, Va. San Francisco: ASTD Press ;Berrett-Koehler Publishers, 2010.
- 19 Ericsson KA. Deliberate practice and acquisition of expert performance: a general overview. *Acad Emerg Med* 2008;15:988–94.
- 20 Benner P. From novice to expert. *Am J Nurs* 1982;82:402–7.
- 21 Manser T. Teamwork and patient safety in dynamic domains of healthcare: a review of the literature. *Acta Anaesthesiol Scand* 2009;53:143–51.
- 22 Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med* 2018;169:467–73.