SHARED MENTAL MODELS IN ACUTE CARE MEDICAL TEAMS

GETTING US ALL ON THE SAME PAGE: A SCOPING REVIEW OF SHARED MENTAL MODELS IN ACUTE CARE MEDICAL TEAMS

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TITLE: Getting us all on the same page: a scoping review of shared mental models in acute care medical teams

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Lay Abstract

Health care is a team sport and as health care systems become more complex, teamwork becomes increasingly important. However, a team of experts does not make an expert team and highly effective teams possess a particular set of characteristics that allow them to perform high quality care. One characteristic that is receiving an increasing amount of attention is the Shared Mental Model. The purpose of this study was to examine what is already known about these shared mental models in the context of acute care medical teams. This study will act as a launching point for future research exploring how teams think and how it impacts the quality of care they can provide.

Abstract

Purpose: Shared mental models (SMMs) represent commonly held understandings of task and team related knowledge within a team. Thought to facilitate implicit and adaptive coordination without the need for explicit communication, the construct has been thoroughly studied in non-health care settings. There has been increasing interest in the topic in the healthcare setting, but recent reviews have found that the construct is poorly defined and has significant heterogeneity in how it is measured (Floren et al., 2018). We conducted a scoping review examining the construct of SMMs in medical teams within the acute care setting. **Method:** Following the Arksey and O'Malley (2005) framework, five data bases were searched: Medline, CINAHL, PsychInfo, Web of Science, and Embase. Eligible studies examined SMMs in the context of medical teamwork in the acute care setting. Definitions, methods, and general study characteristics were examined. **Results**: Of the 1397 articles retrieved, 25 met eligibility criteria. The studies encompassed a variety of areas of clinical practice. There was no common definition for SMMs across the studies examined. The majority of studies (20/25) used quantitative methods with surveys, questionnaires, and observation being the most common. **Conclusions:** The construct of the SMM is poorly defined in the setting of acute care medical teams. Although many standard types of SMM measurement exist, few of the studies used these common methods. The lack of direct measurement of SMMs, especially in the case of observation, questions the validity of these studies. We propose a definition for SMMs in this context and a path forward for studying SMM in the acute care setting.

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Table of Contents

List of Figures

List of Tables

List of Abbreviations

HROs	High Reliability Organizations
ICU	Intensive Care Unit
IMOI	Inputs-Mediators-Outcomes-Inputs framework for team performance
IOM	Institute of Medicine
KSAs	Knowledge, Skills, and Attitudes
PICU	Pediatric Intensive Care Unit
PRISMA-ScR	Preferred Reporting Information for Systematic Reviews – extension for scoping reviews
SMM(s)	Shared Mental Model(s)

Declaration of Academic Achievement

C. William Johnston completed this research work independently, with scholarly guidance from his supervisor (Dr. Sandra Monteiro) and committee members (Dr. Matthew Sibbald and Dr. Sarah Wojkowski). He received research support from Grace Xu and Amy Keuhl to screen articles for the scoping review.

Introduction

When a patient enters the health care system, they expect to receive high quality and safe care. Along with this, patients expect the health care system to be efficient and error free with health professionals operating at their best and without error. Unfortunately, the health care system is far from error free (Kohn et al., 2000). The publication of the Institute of Medicine (IOM) report twenty years ago identified medical error as a cause of over 98,000 deaths in the United States annually (Kohn et al., 2000). Even in the Canadian public health care system, which functions very differently from the system in the US, harm from medical error is still significant (Chan & Cochrane, 2016). Although the IOM report brought medical error to the medical community's attention, the disease burden from medical error globally is still significant (Jha et al., 2013; Makary & Daniel, 2016)

As the modern healthcare system becomes more specialized and interconnected teamwork has become increasingly important (Baker et al., 2006; Rosen et al., 2018). Health care has become a team sport. Consider a case of an eighty-year-old gentleman who begins to experience chest pain at his home and calls 9-1-1. A team of paramedics arrives at his home to provide his initial medical care. At the hospital in the emergency department, an interprofessional team consisting of physicians, nurses, and respiratory therapists, among others, takes over his care. As he journeys from the interventional cardiology suite to the intensive care unit, he receives care from a number of different interprofessional teams including physicians of different specialties, nurses, patient care attendants, and others. Finally, as he is discharged, an interprofessional team will lead his

rehabilitation and recovery. Teamwork plays a key role all along the chain of this gentleman's care from his initial illness to his subsequent recovery.

But, teamwork is more than the sum of its parts; a team of medical experts does not make an expert medical team (Lorelei Lingard, 2016). Building the perfect medical team requires developing a specific set of knowledge, skills, and attitudes (KSAs) (Baker et al., 2006; Gregory et al., 2021b). Errors resulting from poor teamwork can take many forms and have a variety of outcomes for patients (Freund et al., 2013; L. Lingard et al., 2004).

Teamwork may not always be the number one contributing factor in error, but we know that poor teamwork leads to poorer outcomes for patients (Mazzocco et al., 2009). Effective teamwork not only leads to better patient outcomes, but also higher levels of patient satisfaction (Lyu et al., 2013). High quality teamwork is an important aspect of high quality health care and improving our understanding of how teamwork works is an important goal (Rosen et al., 2018).

The Science of Teamwork

Although there are a number of different conceptual frameworks for teamwork, one of the most commonly used is the "Big Five" of teamwork (Eduardo Salas et al., 2005). The "Big Five" consists of five key teamwork behaviours: Team Leadership, Team Orientation, Mutual Performance Monitoring, Backup Behaviours, and Adaptability. These behaviours are supported by three coordinating mechanisms, Shared Mental Models (SMM), Mutual Trust, and Closed Loop Communication. Together the coordinating mechanisms and supporting behaviours allow teams to function optimally in

a variety of settings from office boardrooms to emergency departments (Eduardo Salas et al., 2005). This framework is presented as Figure 1.

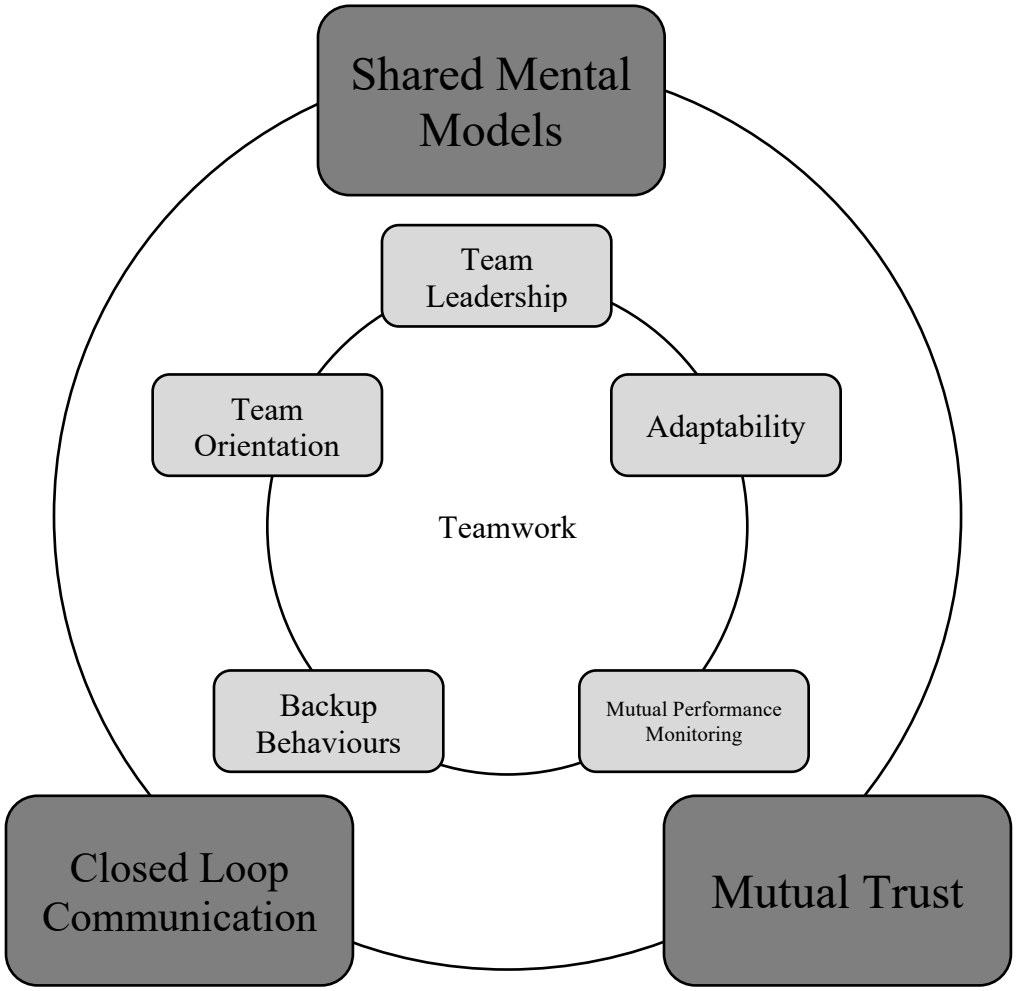

Figure 1: The "Big Five" teamwork behaviours with coordinating mechanisms (Adapted from Salas et al. ,2005)

Of the coordinating mechanisms identified by Salas et al. (2005), discussions around SMMs in the literature tend to have less clarity (McComb & Simpson, 2014). This lack of clarity in how SMMs are operationalized in the literature can lead to challenges using these findings to improve teamwork and how we provide patient care (Burtscher & Manser, 2012).

Team Cognition and Shared Mental Models

Team cognition is a broad term that refers to a number of different constructs typically divided into two categories: team knowledge outcomes and team learning (Kozlowski & Chao, 2012). SMMs are considered to be a team knowledge outcome that develops over time as teams work and interact together (Kozlowski & Chao, 2012).

Mental models can be likened to schema. They are individually held cognitive representations about how the world works, how a task is performed, or how someone fits into a team (Cannon-Bowers et al., 1993). However, they differ from schema in that they are contextual and can be tied to specific contexts or environments (Norman, 1983). Consider a rock climber who is approaching a new section of a wall. Although they have never seen this section of wall before, their experience with various sections of wall gives them a mental model of the moves required to climb. These mental models allow the climber to problem solve this new section and successfully traverse their way to the top.

SMMs are an extension of this construct from the individual level to the team level. They are overlapping cognitive representations of situational task requirements, procedures, and team role responsibilities (Cannon-Bowers et al., 1993). Although originally divided into a number of different types of mental models, SMMs are typically now considered as one of two categories: teamwork or taskwork (Mohammed et al., 2010). Contrasted with other team knowledge outcomes, SMMs are believed to emerge through a convergent processes (Cannon-Bowers et al., 1993). That is, they emerge at the team level from individual cognitive representations as teams work together and develop similar mental models for both taskwork and teamwork.

As teams develop a SMM, the SMM is thought to allow teams to "implicitly coordinate" and anticipate other's actions without the need for explicit communication. It is hypothesized that this occurs because team members actions are guided by common understandings of the situation (Cannon-Bowers et al., 1993). This implicit coordination is particularly important when teams are in situations with significant time pressure or where their abilities to communicate are limited (Mathieu et al., 2000; Smith-Jentsch et al., 1998).

It is also important to consider how SMMs can influence a team's behaviour. A common conceptual framework for the understanding of team process and performance is that of the Inputs-Mediators-Outcomes-Inputs (IMOI) model (Ilgen et al., 2005). This framework represents a feedback loop where inputs, such as a team task, are mediated by other factors such as team knowledge, to produce outcomes, typically a team's performance. These outcomes are then fed back as inputs, through team learning, for future team performance. In the IMOI framework SMMs can act as both inputs as well as mediators. They function as inputs when teams are planning and structuring activities to reach a team goal, and as mediators to drive adaptive coordination to meet team goals and needs (Ilgen et al., 2005)

Outside of the health care setting, SMMs in teams have been shown to have significant impacts on a team's process and performance (DeChurch & Mesmer-Magnus, 2010; Mesmer-Magnus et al., 2017). Compared to other team knowledge outcomes, SMMs are more strongly predictive of team performance (Mesmer-Magnus et al., 2017).

Recent reviews have identified an increased interest in SMMs and how they impact teamwork across the health professions (Burtscher & Manser, 2012; Floren et al., 2018). SMMs are of particular interest in their potential to reduce error and patient harm, especially in situations where implicit coordination would be desired. The acute care setting is a health care area where this implicit coordination is often required.

Shared Mental Models and the Acute Care Medical Team

It is important to define what types of health care constitute the acute care setting versus other settings like chronic care. Acute care is often not well defined causing challenges with discussion and improvement initiatives in these areas (Hirshon et al., 2013). Hirshon et al. (2013) suggest that acute care "includes the health system components, or care delivery platforms, used to treat sudden, often unexpected, urgent or emergent episodes of injury and illness that can lead to death or disability without rapid intervention" (p. 386). Acute care is therefore made up of six domains: trauma and acute care surgery, emergency care, urgent care, critical care, short term stabilization, and prehospital care, represented in Figure 2 (Hirshon et al., 2013).

Perhaps more than other areas of health care, acute care services would be considered high reliability organizations (HROs). HROs operate in hazardous and complex environments while making few mistakes over long periods of time (Baker et al., 2006). Although not always hazardous, the acute care setting is surely complex. Take the emergency department as an example where interprofessional teams are can be tasked to manage multiple patients in significant crisis (E. Salas et al., 2007). There are similar

expectations of managing time sensitive complexity across all acute care domains (Hirshon et al., 2013).

Figure 2: Domains of Acute Care (Adapted from Hirshon et al., 2013)

This challenge is further compounded as teams in the acute care setting are often presented with incomplete information or situations where the primary problem is not clearly defined. These ill-defined problems require teams to rapidly adapt as new information becomes available (Zajac et al., 2014). SMMs are thought to be important mediators in the IMOI to overcome both the time pressures and ill-defined task situations that teams in the acute care setting face (Zajac et al., 2014).

Team cognition and the SMM construct are well established in areas outside of medicine (DeChurch & Mesmer-Magnus, 2010; Mesmer-Magnus et al., 2017). Within medicine there is less known about the construct and how it impacts teamwork. Recent reviews examining SMMs have broadened our understanding of the construct in the health care setting (Burtscher & Manser, 2012; Floren et al., 2018; McComb & Simpson, 2014) but there has been no specific exploration of the SMM construct in the acute care setting. These previous reviews identified a large amount of variety in how the SMM construct was operationalized and studied; specifically, methodological differences in how SMMs were being studied in health care versus other industries. Additionally, Floren et al. (2018) illustrate that in the context of health professions learners there was no consistency to the definitions used which makes operationalizing the construct and further study challenging. Although well conducted, these previous reviews were broad and did not focus on the acute care setting.

Research Objective

This scoping review aims to better understand the scope of the literature, in particular common definitions, and methodologies used for the study of SMMs of medical teams in the acute care setting. The scoping review methodology will evaluate common practices, as well as identify gaps in the current literature and opportunities for further study related to SMM in acute care settings.

Although Floren et al. (2018) identified that a large number of papers in their review were in the “high intensity setting” and reported on their characteristics, their review focused on health professions learners and likely excluded a number of papers of

interest to this review. It is therefore believed that this study will provide a unique contribution to the knowledge of SMMs in the acute care setting.

Methods

Rationale for a Scoping Review

Scoping reviews are a form of knowledge synthesis used for exploratory research questions aimed at identifying key themes, gaps, and types of evidence through systematic search, selection, and synthesis in a particular topic area (Colquhoun et al., 2014). Scoping reviews, contrasted to other types of reviews, allow for transparent, systematic and replicable searching and reporting (Grant & Booth, 2009). The broad objectives of our study were to map the existing evidence systematically and clarify key concepts around SMMs for medical teams in the acute care setting. Given these objectives, a scoping review methodology is the most appropriate method to effectively answer our questions and make future recommendations in this topic area (Munn et al., 2018).

Scoping Review Framework

The scoping review framework proposed by Arksey and O'Malley (2005) provides a rigorous method for the conduct of scoping reviews allowing for transparency and replication (Arksey & O'Malley, 2005). The framework consists of six stages:

1. Identifying the research question
2. Identifying relevant studies
3. Study selection
4. Charting the data

5. Collating, summarizing, and reporting the results
6. Consultation (optional)

Our review protocol uses the Arksey and O'Malley (2005) framework with the recommendations provided by Levac et al. (2010) and follows the PRISMA-ScR reporting guidance (Tricco et al., 2018). In line with the PRISMA-ScR guidelines our protocol was registered prior on Open Science Framework (https://osf.io/sd3ca/).

Below, each stage of the scoping review framework is presented in detail outlining the individual steps taken for this review. Additionally, a summary chart is included at the end of this chapter as Figure 3.

Stage 1: Identifying the Research Question

Levac et al. (2010) suggest that the design of research questions should consider their purpose and intended outputs of their review. Broadly, our questions were designed to provide better understanding and clarity around the definitions used in this setting as well as to examine the types of methodologies used for SMM research in the acute care setting.

Our research questions were guided by the results of previous reviews of the SMM construct in both health care and non-health care settings (Burtscher & Manser, 2012; Dechurch & Mesmer-Magnus, 2010; DeChurch & Mesmer-Magnus, 2010; Floren et al., 2018; McComb & Simpson, 2014; Mesmer-Magnus et al., 2017). We were interested in the definitions that were being used for SMMs in this setting and if there was significant variance – similar to the results from Floren et al. (2018). Burtscher and Manser (2010) identified a number of methods for SMM measurement that had potential for use in the

health care setting. We were interested in what types of methods were being used to measure SMMs in this context. Finally, we were interested in better understanding the general landscape of the SMM literature.

The research questions, framed by our title, were designed to allow for a broad investigation of the concepts of interests. Through consultation and revisions with the supervisory committee the primary questions were finalized as:

1. How are shared mental models measured and defined for teams in the acute care setting?
2. What is the general landscape of the shared mental model literature in the acute care setting?

Stage 2: Identifying Relevant Studies

A pilot search was conducted in PubMed and Google Scholar using search the search terms “Shared Mental Model” OR “Shared Mental Models” AND “Acute Care” OR “Emergency Care” to identify relevant search terms. Following the pilot search a health sciences librarian was consulted for assistance with further developing the proposed search strategy and selection of appropriate databases. Five databases were selected that would be most relevant: Medline, Embase, Web of Science, CINAHL, and PsychInfo. The research librarian also assisted in devising targeted search strategies for each database. A detailed description of each search strategy can be found in Appendix A.

The search strategy was designed to balance comprehensiveness while remaining feasible in scope and scale (Levac et al., 2010; Peters et al., 2020). The search was limited to articles published between 2000 and October 1, 2020, the date of our search. The start date of 2000 was chosen to align with the shift of focus towards teamwork in medicine with the production of the “To Err Is Human” report by the Institute of Medicine (Kohn et

al., 2000). As Floren et al., (2018) did not identify any relevant studies before 2005 we felt that limiting the search was reasonable.

A pilot search of the grey literature via Google Scholar and Google was conducted but did not return additional results which met our inclusion criteria not located in our pilot search. As one of our primary research questions was to better understand the methodologies employed in measuring SMMs, it was felt that this rigor would not be present in non-peer reviewed sources. After discussion with the health sciences research librarian, the search strategy was limited to primary research only and grey literature sources were excluded from our final search.

Stage 3: Study Selection

Study selection occurred over two phases, title/abstract screening followed by full text screening (Levac et al., 2010). Articles which had been retrieved through database searches were uploaded to the Covidence platform to allow for easier coordination of study selection and review.

Inclusion and exclusion criteria were generated iteratively as the search strategy was refined to allow for the capture of the broadest literature while remaining feasible (Arksey & O'Malley, 2005; Levac et al., 2010). The final inclusion and exclusion criteria were determined through this process and expert feedback from the research team and thesis committee. The final inclusion and exclusion criteria are included below as Table 1.

Table 1: Inclusion and Exclusion Criteria

	Include	Exclude
Study Year	Year 2000 and onwards	IF data from collected for the study is for years prior to 2000
Study Design	Original Study	Non original studies (e.g. commentaries, reviews, retractions)
Population	Practicing health care professionals (Primarily)	Students/learners
		Non-health care professionals
Setting	Acute Care (Key Terms: emergency, emergency department/room, emergent care, trauma care/team, surgery, anaesthesia, intensive care/intensive care room, urgent care)	Non-acute care settings
	Pre-hospital (Key Terms: EMS, Paramedic, Ambulance, EMT)	
Context	Teams	If the study does not explore shared mental models in the context of a team (e.g. individual mental models, decision making, mental models)

Concept	**Shared Mental Model:** *an organized understanding or mental representation of key elements of a team's relevant environment that is shared across team members (Can also be referred to as a TEAM mental model)*
	
	Categories of shared mental models:
	• Technology: knowledge of the technology involved in the work
	  ○ e.g. understanding how to use the medical charting system
	• Tasks: knowledge of the procedures or treatments as well as strategies, pitfalls, and contingency plans
	  ○ e.g. everyone on the team knows the steps to insert a chest tube including infection controls
	• Team interaction: knowledge of roles and responsibilities of each team member
	  ○ e.g. the trauma team knows that the paramedics will deliver the first information about the patient
	• Team members: knowledge of other teammates team and task-relevant knowledge, skills, and attitudes
	  ○ e.g. the team leader will be responsible for directing care during a resuscitation
	Shared Mental Model Elicitation:	

	• Cognitive Interviewing: the participants are asked to describe their mental model as it relates to the context, can be structured or open ended questioning
	  o e.g. participants are asked to describe how they respond to a cardiac arrest, the steps that they think should be done and responsibilities of other team members
	• Card Sorting: the participants are asked to organize a series of concepts according to a specific set of criteria, the concepts can be created by the participants or pre-determined
	  o e.g. participants order the steps of a laparotomy and their answers are compared – see Nakarada-Cordic et al. 2010
	• Pairwise Ratings – participants are asked to determine how related two separate concepts are
	  o e.g. quality of information and amount of information – see Gardner at al., 2016
	• Concept Mapping – participants are asked to map out a concept verbally or visually to describe the concept and the components that make up that concept
	  o e.g. participants are given the general concept of teamwork and respond that it consists of "multiple people" working towards a "common goal" with "individual responsibilities"
	
	Observed Behaviour: a) teams are observed in a natural setting (either by direct observation or by video recording) b) teams are observed during in-situ simulations c) teams are observed in the simulation lab (either by direct observation or video recording)
	
	Note: articles may not explicitly mention Shared or Team Mental Models but describe these characteristics – These articles should be included	

Titles and abstracts were screened in duplicate by two reviewers (WJ and GX) with disagreements resolved through discussion between the two reviewers. Any disagreements that could not be resolved through consensus were independently resolved through by a third reviewer (SM). Meetings were conducted at the beginning, halfway through, and at the end of screening to ensure consistency with application of review criteria (Peters et al., 2020).

Full text screening occurred in duplicate with a team of six reviewers (AK, GX, MS, SM, SW, and WJ). A meeting occurred at the beginning of full text screening. Any concerns or needed clarification during the review process was shared by email with the entire study team. All conflicts and disagreements between two reviewers were originally resolved by consensus. If no consensus was reached WJ reviewed the conflict and made a final decision on inclusion and exclusion.

Stage 4: Charting Data

A data extraction form was designed and piloted on 10 full text studies. As scoping review data extraction is an iterative process (Peters et al., 2020), the form was modified after discussion with the study team. The data extraction form was then compiled into a Google Form to allow for electronic charting of the data.

We charted the study information charted in four categories: general information, team definitions, Shared Mental Model definitions and methods, and training interventions. Additionally, reviewers were provided with the option to include "Additional Information". This additional information was useful in the iterative process

of charting data as it allowed reviewers to highlight areas that were not currently being explored but would be useful data for answering our research questions. The data extraction form is included for reference as Appendix B.

We completed data charting in duplicate for the 10 papers that the form was initially piloted upon. There was consensus between the piloted data charting and the duplicate charting. The remaining charting was completed with one reviewer per full text study. Once the data charting was completed the results were exported to a Microsoft Excel file to complete Stage 5.

Stage 5: Collating, Summarizing, and Reporting the Results

The charted data was reviewed, collated, and summarized by one reviewer, WJ. The data was analyzed using both numerical and thematic analysis to highlight relevant findings related to the three major themes of (1) Shared mental model definitions and methods, (2) Team definitions, and (3) Training interventions. The summarized research data was shared with the research team and thesis committee for feedback and additional guidance.

The findings from this stage of the scoping review are presented in the results section of this manuscript. Implications and discussion of the research findings are further discussed in the discussion section.

Stage 6: Consultation

Key stakeholders were identified as authors who had published 3 or more articles about SMMs in health care teams. A video presentation of the results with subsequent questions was created using Google Forms and was sent by email to identified authors. Those who responded were also given the opportunity to contact WJ to provide further

information. Additionally, the thesis committee (SW and MS) and thesis supervisor (SM) are all considered experts in teamwork and interprofessional health care teams. SM, SW, and MS all provided guidance throughout this scoping review process.

Figure 3: Summary of the Scoping Review Stages

Scoping Review Stage	Purpose	Outcomes
Stage 1: Identifying the Research Questions	To define a scope for the study and align the research questions with the purpose and objective of the review	Objective: • To better understand the scope of the scientific literature, methods employed, and definitions used in relation to shared mental models and teamwork in healthcare teams working in the acute care setting Questions: • What is the scope of the literature, methods, and definitions used relating to SMMs in the acute care setting? • How are teams defined in the acute care setting? • How is simulation used in the training and measurement in shared mental models in the acute care setting?
Stage 2: Identifying Relevant Studies	To create a balance between the breadth and feasibility of the study while aligning the search strategy and selection criteria with study objectives	Databases: • Medline, CINAHL, EMBASE, Web of Science, Psych Info Timeline: • Studies Published between 2000 and 2020 Search Strategy: • Detailed Search Strategy can be found in Appendix A
Stage 3: Study Selection	To identify relevant full text studies for charting from a set of defined inclusion and exclusion criteria	• Inclusion and exclusion criteria for can be found in Table 1

Stage 4: Charting the Data	Extracting relevant numerical, thematic, and narrative data from the selected studies	• Details of data charting can be found as the data extraction form in Appendix B
Stage 5: Collating, Summarizing, and Presenting the Data	To analyze, summarize, and present the results including implications of findings as they relate to the purpose and objectives of the scoping review	• All results are found below in the results and discussion chapters
Stage 6: Consultation	For key stakeholders to provide additional references or insights that are not in the literature	• Findings were in line with stakeholders understanding

Results

Study Selection

The PRISMA flow diagram included below as Figure 4 outlines the study selection process. It includes the number of citations reviewed at each stage of the study selection process, as well as reasons for study exclusion at the stage of full text review.

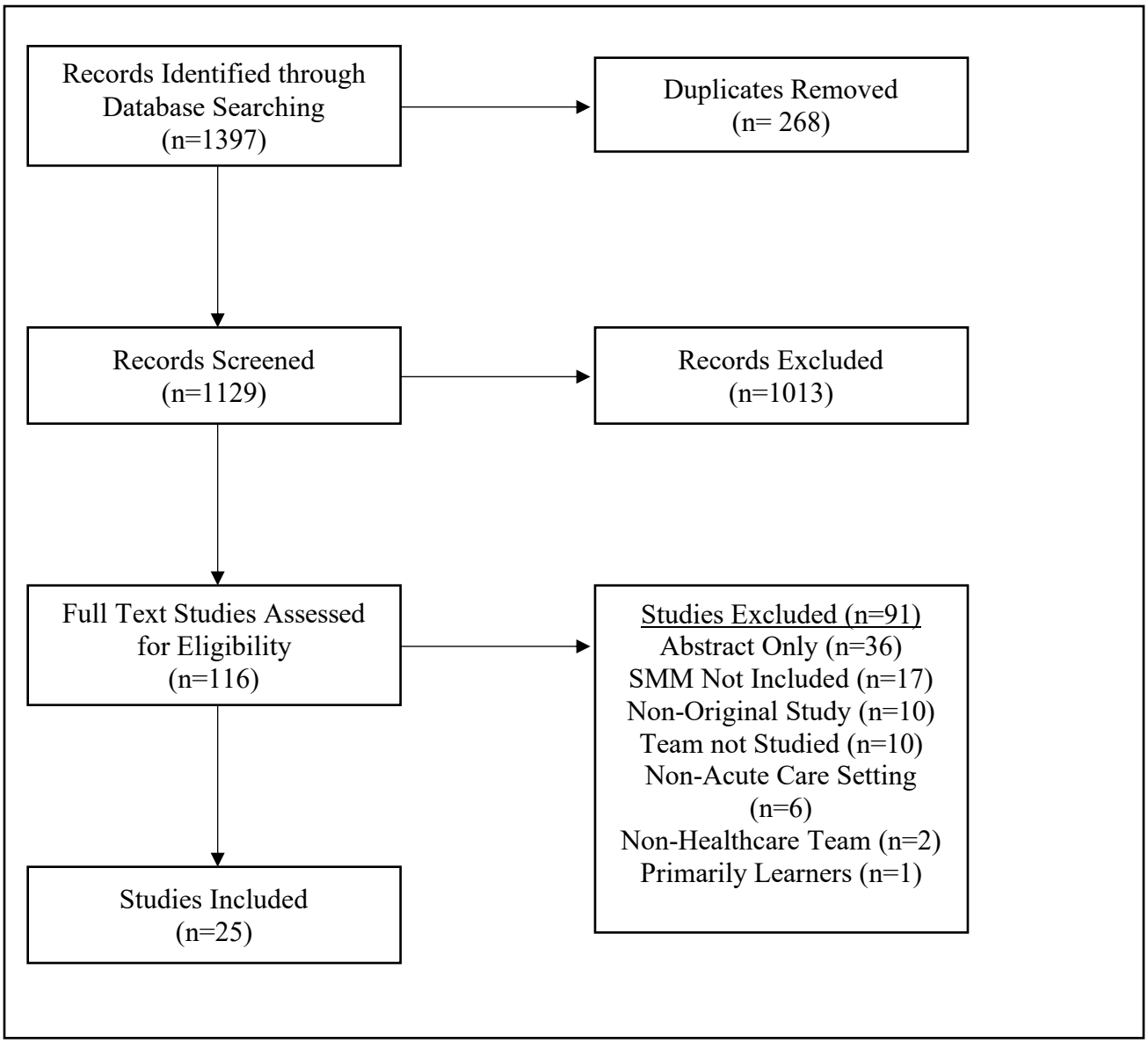

Figure 4: PRISMA Flow Diagram for Study Selection and Review

Publication Year

Figure 5 below provides the number of studies published by year. Only years when included studies were published are included, so although the search included studies published between 2000 and 2020 no studies were identified before 2005.

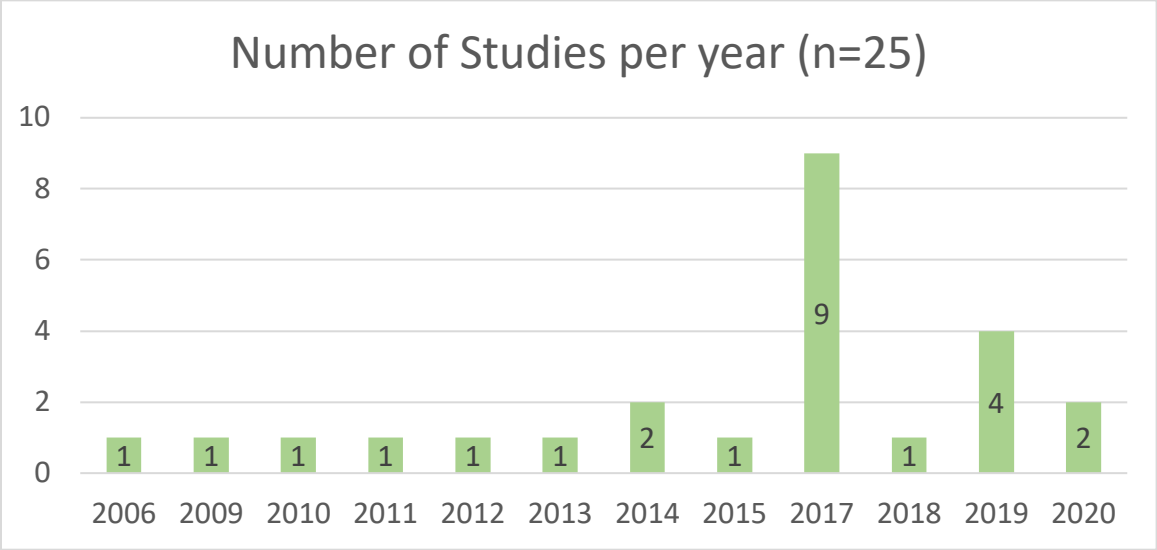

Figure 5: Number of Reviewed Studies per Year (2006-2020)

Countries

As outlined below in Table 2 and as a heat map in Figure 6, studies included in this scoping review were published in a number of different countries. The majority of the studies (40%) were published in the United States, followed by Switzerland (12%), and Norway (8%), the remainder of the studies were published in different countries. One study Kessler et al. (2017) was conducted across 10 different clinical sites in Canada, the United States, and the United Kingdom, and is reported below as "Multiple Countries".

Table 2: Study distribution by Country

Locations	Citation	Number
Australia	Polis et al., 2017	1
Canada	Calder et al., 2017 (Calder et al., 2017)	1

Denmark	Gjeraa et al., 2019	1
Germany	Neugaus et al., 2019	1
Israel	Drach-Zahavy et al., 2017	1
Netherlands	Coolen et al., 2019	1
New Zealand	Weller et al., 2014	1
Norway	Johnsen et al., 2017; Westli et al., 2010	2
Sweden	Goras et al., 2020	1
Switzerland	Blondon et al., 2017; Burtscher et al., 2011; Kolbe et al., 2014	3
United Kingdom	Undre et al., 2006	1
United States	Bates et al., 2014; Colman et al., 2019; Custer et al., 2012; Gardner et al., 2017; Jiang et al., 2017; McComb et al., 2017; Miller et al., 2009; Sochet et al., 2018a, Sochet et al., 2018b, Stey et al., 2020	10
Multiple Sites	Kessler et al., 2017	1
Total		25

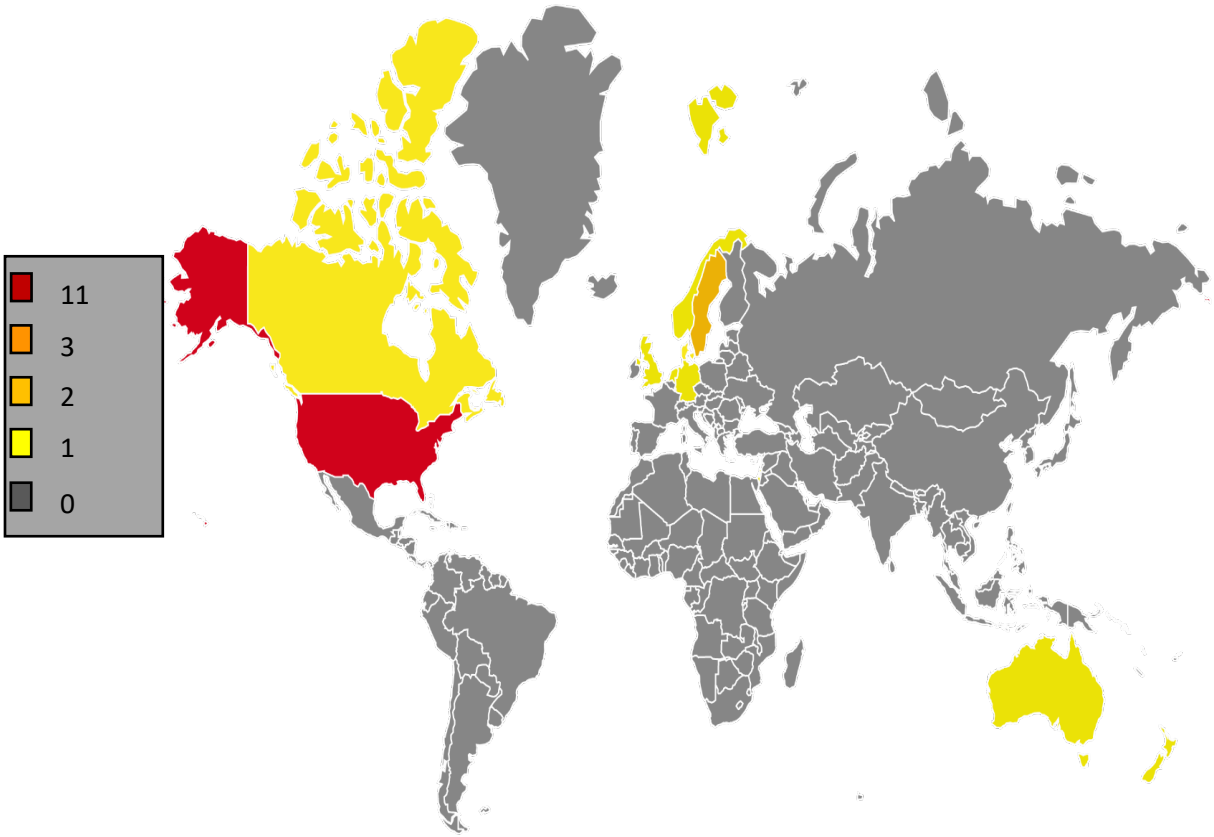

Figure 6: Heat Map of Study Locations

Area of Clinical Practice

Table 3 below describes the areas of clinical practice that were identified in the included studies. The studies were published in 10 unique clinical contexts. The pediatric intensive care unit (PICU) (20%) produced the most studies, followed by anesthesia (16%), surgery (16%), and general pediatrics (16%). One study Polis et al. (2017) was conducted with clinicians from a variety of clinical practice areas, it is reported below as "Multiple Areas of Practice".

Table 3: Areas of Clinical Practice

Area of Practice	Citation	Number
Anaesthesia	Burtscher et al., 2011; Kolbe et al., 2014; Neuhaus et al., 2019; Weller et al., 2014	4

Emergency Medicine	Calder et al., 2017; Johnsen et al., 2017; Westli et al., 2010	3
Intensive Care Unit (Adult)	Drach-Zahavy et al., 2017; Stey et al., 2020	2
Intensive Care Unit (Pediatric)	Bates et al., 2014; Colman et al., 2019; Custer et al., 2012; Jiang et al., 2017; Sochet et al., 2018[a]; Sochet et al., 2018[b]	5
Internal Medicine	Blondon et al., 2017; McComb et al., 2017	2
Labour and Delivery	Miller et al., 2009	1
Pediatrics	Coolen et al., 2019; Kessler et al., 2017	4
Surgery	Gardner et al., 2017; Gjeraa et al., 2019; Goras et al., 2020; Undre et al., 2006(Gardner et al., 2017; Gjeraa et al., 2019; Göras et al., 2020; Undre et al., 2006)	4
Multiple Areas of Practice	Polis et al., 2017	1

Study Interventions

Table 4 below outlines the types of interventions evaluated. The majority of the studies (68%) did not evaluate any intervention. The remaining studies primarily studied clinical handover interventions (16%), followed by simulation based training (8%).

Table 4: Study Intervention Types

Intervention Type	Citation	Number
Handover		
Clinical handover assessment tool	(Bates et al., 2014)	4
Electronic shift handoff tool	(Jiang et al., 2017)	
Structured handover process	(Sochet et al., 2018a)	
Structured handover process	(Sochet et al., 2018b)	
Team Training	(Colman et al., 2019)	1
Semi-structured briefing tool	(Neuhaus et al., 2019)	1
Video based training	(Weller et al., 2014)	1
No Intervention	(Blondon et al., 2017; Burtscher et al., 2011; Calder et al., 2017; Coolen et al., 2019; Custer et al., 2012; Drach-Zahavy et al., 2017; Gardner et al., 2017; Gjeraa et al., 2019; Johnsen et al., 2017; Kessler et al., 2017; Kolbe et al., 2014; Mccomb et al., 2017; Miller et al., 2009; Polis et	17

	al., 2017; Stey et al., 2020; Undre et al., 2006; Westli et al., 2010)	

Handover Interventions

Of the studies that investigated handover interventions, Sochet et al. (2018a) was a follow-up study of the structured handover tool developed by Sochet et al. (2018b). The structured handover tool was implemented for all transfers from the PICU. The tool was found to improve a number of important handover characteristic, such as team members present at the bedside, attention, summarization, and presence of a shared mental model in the study population at implementation (Sochet et al., 2018a) and at one-year follow-up (Sochet et al. 2018b).

Bates et al. (2014) designed and validated a novel tool to assess clinician shared understanding following a clinical handover in the cardiac intensive care unit. The tool had high inter-rater reliability (0.71 – 1.00) with simulation based testing and moderate inter-rater reliability (0.41 – 0.87) with in-situ testing.

Jiang et al. (2017) examined the impact on clinician SMMs following the implementation of an electronic medical record (EMR) based shift handoff tool. The implementation of the EMR based tool was not found to improve similarity of SMMs.

Other Interventions

Coleman et al. (2019) examined the improvement of teamwork skills and perception of teamwork following the implementation of simulation-based team training. They found improvements in all areas, specifically in perceptions of team SMM and situational awareness.

A semi-structured pre-anaesthesia induction briefing tool was studied by Neuhaus et al. (2019). During a difficult airway simulation, teams using the briefing tool advanced through the difficult airway algorithm faster than teams in a control group.

Weller et al. (2014) tested the impact on video-based training for a structured anesthesia "call out" on information sharing, structured call out use, and medical management during a simulated anesthesia emergency. They found that there was an improvement in use of the "call out" tool but that this did not increase the information shared.

Use of Simulation

Simulation was used in 11 of the included studies, split almost evenly between in-situ simulation (45%) and lab-based simulation (55%). For this review, studies were coded as using in-situ simulation if the simulation took place in the real clinical environment, and studies that took place outside of the normal clinical environment were coded as lab-based simulation (Motola et al., 2013). The remaining 14 studies did not use simulation. Table 5 below outlines the use of simulation across the included studies.

Table 5: Simulation Use

Simulation Type	Citation	Number
In-Situ Simulation	(Burtscher et al., 2011; Calder et al., 2017; Johnsen et al., 2017; Miller et al., 2009; Westli et al., 2010)	5
Lab-Based Simulation	(Colman et al., 2019; Coolen et al., 2019; Gardner et al., 2017; Kessler et al., 2017; Neuhaus et al., 2019; Weller et al., 2014)	6
No Simulation Used	(Bates et al., 2014; Blondon et al., 2017; Custer et al., 2012; Drach-Zahavy et al., 2017; Gjeraa et al., 2019; Göras et al., 2020; Jiang et al., 2017; Kolbe et al., 2014; Mccomb et al., 2017; Polis et al., 2017; Sochet, Ryan, Bartlett, et al., 2018; Sochet, Ryan, Miller, et al., 2018; Stey et al., 2020; Undre et al., 2006)	14

Findings related to Shared Mental Models

Results related to SMMs are divided into two categories: (1) SMM Definitions and (2) SMM Methodologies. Detailed coding of the definitions, methods, and SMM related outcomes can be found included as in Appendix C and D respectively.

i) Shared Mental Model Definitions

SMM definitions were coded using a modified version of the framework from Floren et al. (2018). The following codes were used for SMM definitions: "Individual Representation", "Organized Knowledge", SMM Properties: "Similarity" and "Accuracy", Content Domains: "Taskwork" and "Teamwork", and "Performance". Detailed coding of individual study SMM definitions are included as Appendix C.

This study found similar results to that of Floren et al. (2018) with significant variation in definitions across studies. Nine studies did not define SMM (Bates et al., 2014; Colman et al., 2019; Coolen et al., 2019; Custer et al., 2012; Göras et al., 2020; Kessler et al., 2017; Kolbe et al., 2014; Undre et al., 2006; Weller et al., 2014).

Whereas similarity, or "shared" was the most frequently described property, occurring in 13 of the studies, none of the studies described the content domain of accuracy alone. Two of the studies (Kolbe et al., 2014; Mccomb et al., 2017) described SMM as containing both properties of similarity and accuracy.

Five of the studies described SMMs containing content domains of both taskwork and teamwork (Gjeraa et al., 2019; Jiang et al., 2017; Johnsen et al., 2017; Kolbe et al., 2014; Westli et al., 2010). Four studies described only the SMM content domain of taskwork (Blondon et al., 2017; Drach-Zahavy et al., 2017; Miller et al., 2009; Stey et al., 2020). Three studies described only the SMM content domain of teamwork (Calder et al.,

2017; Gardner et al., 2017; Polis et al., 2017). Four studies described SMMs as containing neither the domains of teamwork nor taskwork (Burtscher et al., 2011; Mccomb et al., 2017; Neuhaus et al., 2019; Sochet, Ryan, Bartlett, et al., 2018)

ii) SMM Methodologies

SMM measurement methods were grouped into two broad categories, quantitative methods and qualitative methods. The majority of the studies used quantitative methods with only five studies using qualitative methods (Custer et al., 2012; Göras et al., 2020; Jiang et al., 2017; Stey et al., 2020; Undre et al., 2006). One study, Calder et al. (2017) used a mixed methods approach.

The methods were then further coded based on method used, content domains (taskwork or teamwork), content or structure, measurement properties (similarity and accuracy), and results related to SMMs. These results are presented in Appendix D.

SMM Property Measurement

The SMM content domains of similarity and accuracy both contribute to team process and performance (Burtscher & Manser, 2012). The majority of the studies (68%) examined the similarity of SMM among team members. Six of the studies did not examine the similarity or accuracy of the SMM. None of the studies addressed SMM accuracy only; however, two of the studies addressed both (Burtscher & Manser, 2012; Drach-Zahavy et al., 2017)

SMM Content Domains

Although there were originally a number of different categories of mental models previously identified in the literature, current standard practice involves organizing mental models as either “Taskwork” or “Teamwork” (Dechurch & Mesmer-Magnus,

2010). The majority of the included studies (15) examined taskwork. A smaller number of studies (7) examined teamwork and three of the studies examined both taskwork and teamwork.

SMM Content and Structure

An individual's mental model contains both the individual representations of the knowledge (content) and the organization of that knowledge (structure) (Burtscher & Manser, 2012; DeChurch & Mesmer-Magnus, 2010; Mesmer-Magnus et al., 2017). Both properties can be measured and compared within a team.

Most of the studies (52%) examined only the mental model content. Four of the studies measured both structure and content. A small number of studies (32%) did not measure content or structure, and no studies measured structure of a mental model alone.

In addition, structure and content can be either researcher or participant generated depending on the method used to elicit the mental model. The majority (60%) of the studies that examined content measured content that was participant generated, the remaining studies (35%) measured content that was researcher generated.

Discussion

This review intended to address a number of questions related to how the construct of SMMs are operationalized within the healthcare literature. This chapter will address our major findings and their implications. We also provide recommendations and a path forward for the study of team cognition in acute care medical teamwork.

There has been an increasing interest in SMM over time. The majority of the papers included in this scoping review (n=16) were published between 2017 and the end of our search date in 2020. There were also a large number of abstracts which met our initial inclusion criteria but were excluded during the full text review phase.

Interestingly, conference abstracts accounted for (n= 36 of 116, 31%) citations excluded. This suggests that there are projects investigating SMM with the potential for a significant amount of work to be published in the future. Future knowledge syntheses should continue to examine the methods being used as this area of practice continues to mature.

Clinical Practice Areas and Teamwork

Although the included studies were from a variety of practice areas within the acute care setting, there were still clinical practice areas with no representation in the literature in the studies identified with our search strategy. For example, none of the studies represented the paramedic/pre-hospital/emergency medical services areas of practice. Paramedics perform work in unique environments and contexts requiring a profession specific set of skills (Tavares et al., 2016). Although there are commonalities with other areas of practice, the identified literature may not apply to the paramedic

clinical environment. This suggests a substantial research gap that requires further investigation. Future research should examine SMMs in the paramedic clinical context.

Although all the included studies investigated the acute care environment, the composition and characteristics of teams across these settings are variable (Hollenbeck et al., 2012). Even within a single acute care setting you may have a combination of ad hoc teams, immediate action teams, and intact teams, among others (Hollenbeck et al., 2012). In this review, only three of the articles defined the types of teams being studied. Without definitions or a common language, generalizability of results to other acute care areas becomes a challenge as it is possible a team in the ICU is investigating an entirely different type of team than one from the emergency department (Andreatta, 2010).

Andreatta's (2010) analysis of teams across different health care areas found teams within the same area of practice may also be categorized differently. Thus, measuring SMMs in these contexts and subsequent improvement may vary significantly between areas. Future research should aim to provide some clarity and provide explicit definitions of the types of teams being studied. To guide this future work, Andreatta's four type matrix (Figure 6) could be used as a framework. Andreatta's (2010) model is built around the characteristics, stability and variability of personnel and roles within a team. This framework would be useful for comparing teams in the acute care setting as it defines teams without reference to their tasks. Using a framework such as this would be useful to provide a simple and common language for the study of teamwork in the acute care setting.

		Team Role	
		Stable	Variable
Team Personnel	Stable	$S_R S_P$	$V_R S_P$
	Variable	$S_R V_P$	$V_R V_P$

Figure 7: Health care team typologies (Andreatta, 2010)

SMM Definitions

Consistent with the lack of definitions of the types of teams, the lack of common definitions, or any definitions, for SMMs presents a significant gap in the SMM literature. These findings are not unique to this scoping review but have also been noted in other reviews of the SMM concept applied to the health care setting (Floren et al., 2018; McComb & Simpson, 2014). McComb & Simpson (2014) noted that the SMM construct can be superficially described, creating challenges when applying the construct in research or operationalizing the definition for measurement. The consistency of our findings with the findings from these previous reviews suggests that the lack of clarity in definitions remains an issue.

In their review, Floren et al. (2018) define the SMM construct in the health care setting. Even with this operationalized definition, many of the studies published after Floren et al. (2018) still do not use a standard definition. In this scoping review, many of the papers reviewed seemed to tailor the SMM definition to the aspects of the constructs that were being examined. For example, papers which examined the SMM construct of teamwork, but not taskwork, tended to exclude taskwork from their definition. This lack

of consistency in definitions creates challenges as authors attempt to join and continue the conversation that exists in this space. Future studies should be mindful of how they define the construct and ensure that the inclusion or exclusion of certain aspects of the SMM construct are justified.

Proposed Definition

The operationalized definition from Floren et al. (2018) includes three major concepts. First, the inclusion of content and the structure relationships (among content) to help differentiate SMM from other constructs in team cognition science (Floren et al., 2018). Second, an emphasis on the sharedness of these representations between individuals as a unique characteristic of SMM (Floren et al., 2018). Finally, the individually held nature of the content and structure representations and need for aggregation and comparison at the team level for measurement (Floren et al., 2018). Using this definition as a starting point, we believe it could be further operationalized in the acute care setting with the inclusion of two additional constructs, performance and accuracy.

A key component of the SMM construct is that accurate and similar mental models allow teams to adapt and coordinate implicitly improving performance (Baker et al., 2006; Bedwell et al., 2012; DeChurch & Mesmer-Magnus, 2010; Mesmer-Magnus et al., 2017). However, this increase in performance and adaptability is not included in many of the definitions used in the health care SMM literature. Adding a component of adaptability and performance is an important part of an operational SMM definition as it

conveys the impact of having an accurate and similar SMM for effective team performance.

A team can be entirely 'on the same page' with a similar mental model, but be reading from the wrong book, an inaccurate mental model. In these instances the team's performance is abysmal (Mathieu et al., 2005). This inaccuracy is especially important in the health care context where teams, operating often with incomplete information, are performing highly technical procedures that have significant impacts on patient outcomes. An accurate mental model is therefore an important component of an effective SMM. We propose that this importance should be solidified in the operational definition.

With the addition of performance and accuracy to Floren et al.'s (2018) definition, the following is proposed as an operational definition of SMM for medical teams in the acute care setting:

> *Shared mental models represent commonly held individual cognitive representations of task and team related knowledge. Similarity and accuracy of team level mental models allow health care teams to adapt and coordinate behaviours to produce high quality patient care.*

Our definition differs from Floren et al. (2018) definition in two key characteristics. First, we include the concept of accuracy in addition to similarity. Floren et al. (2018) did not include accuracy as they argued that a shared mental model does not have to be accurate. However, Burthscher et al. (2011) found both accuracy and similarity interacted to produce team performance; thus we believe that this is evidence that accuracy is an important part of the SMM construct. Although accuracy may be

challenging to measure, especially without an expert mental model, (Floren et al., 2018) that does not mean that it is not an important aspect of the SMM construct.

Second, our definition includes performance as an outcome resulting from accurate and similar SMMs. This references how SMMs fit into the IMOI conceptualization of modifier to produce the team performance outcome (Ilgen et al., 2005). The inclusion of performance through adaptation and coordination is also important as it provides tangible outputs that can be measured at the team level. As there are gaps in the measurement of SMM in the literature, linking the definition to some form of measurement is important for its operationalization in future research.

Our analysis of SMM definitions identified gaps in how the SMM construct was being defined and further operationalized in the literature; thus, a new definition was proposed to provide further clarification and ease of use for further research into SMM in the health professions.

SMM Methods

Outside of the health care literature there are established methods used to measure SMMs (Dechurch & Mesmer-Magnus, 2010). Although there have been attempts to define key methodologies (Gisick et al., 2018), the same cannot be said for the SMM construct in the health care literature. Our results again align with Floren et al. (2018), who identified significant variation in how SMM were measured. Specifically, this scoping review identifies three main research gaps: the lack of measurement of accuracy; the lack of measurement of structure; and reliance on quantitative methods of measurement. Addressing each of these gaps is necessary so that future research will be

able to more robustly study SMMs and draw more significant conclusions related to their application in the acute care settings.

Measurement of Accuracy

Similarity of the mental models is likely insufficient as accuracy and similarity of a mental model interact to produce team performance (Burtscher et al., 2011; Lim & Klein, 2006). Although it could be argued that if a task is accomplished successfully, the mental model is correct, this assumes that no other factors interact to produce a successful team performance, which is not true (DeChurch & Mesmer-Magnus, 2010; Mesmer-Magnus et al., 2017). Mathieu et al (2005) found teams required both similar and accurate mental models to be successful, whereas possessing only very similar or only very accurate mental models lead to poor performance. This is particularly relevant for interdisciplinary medical teams. Imagine a patient who is very ill but the cause of their emergency is unclear – which would establish an ill-defined task situation (Zajac et al., 2014). A team's mental model in this case could be very similar, but incorrect. This accuracy similarity gap that could lead to poor teamwork and harm to the patient.

The accuracy of a SMM in the acute care medical team is highly context specific to the task that being performed - which may make the measurement of accuracy challenging outside of a gold-standard (Floren et al., 2018). Due to absent established guidelines for team roles and team knowledge, researchers should consult local experts to develop their "gold standard" model. Qualitative approaches may help to bridge this gap. Preliminary evaluation of team related mental models through established practices such as cognitive interviewing may help establish the "gold standard" for team roles within a context and team.

There have been recent suggestions highlighting the importance of "sharing and updating mental models" to teams during crisis care situations (Hicks & Petrosoniak, 2018; Reid et al., 2018), ultimately creating a SMM. The team leader sharing their intended next steps aligns the mental models for all of the team members ensuring that the team has both a similar and accurate mental model. Future research in this area should look at how the accuracy and similarity of mental models interact to produce effective team performances. Closing this gap in the literature would help us better understand where to direct team training as well as how to provide strategies for error mitigation.

Measurement of Structure

Similar to the construction of a new house which requires both the raw building materials and the blueprints, a SMM is constructed of the content and the structure. As with the concept of accuracy, very few of the studies examined the structure of the mental models. Although the methods of structure measurement can be more challenging to prepare and time consuming to complete in the health care setting (Gisick et al., 2018), they can provide important insights particularly when trying to understand teamwork process (Dechurch & Mesmer-Magnus, 2010). This approach would be useful when attempting to implement new procedures or practices, or when trying to better understand how errors occurred in certain practice settings.

Of the papers reviewed for this scoping review, Burtscher et al. (2011) provides an excellent example of how both content and structure of a SMM can be evaluated using methods that are not overly cumbersome or time consuming. Using the concept mapping

approach, they are able to compare how anesthetists' and nurses' mental models of an anesthesia induction are structured (Burtscher et al., 2011). Future research, with a focus on taskwork, could use a similar method to evaluate the structure of a mental model as well.

Reliance on Quantitative Measurement Methods

The majority of the studies that were examined for this review used quantitative methods for SMM measurement (n = 20) and only a small number of studies used qualitative methods (n = 4). Although not only focused on SMMs, one study (Calder et al., 2014) used a mixed methods approach. Quantitative methods such as surveys and questionnaires may be less time consuming to conduct, but they are not without their disadvantages (Dechurch & Mesmer-Magnus, 2010). Similarly, qualitative methods involving large scale interviews with members across various teams can be time consuming and challenging to complete. Merging quantitative and qualitative methods would provide the most robust and thorough examination of SMMs (Gisick et al., 2018)

Drawing implications about the impact SMMs have on team process and performance requires the direct measurement of SMM (Burtscher & Manser, 2012). Many of the studies included in this review used only observations of team performance or behavioural markers thought to be indicative of SMMs. Without direct measurement of the SMM, drawing conclusions on their impact is challenging. Merging qualitative and quantitative methods would allow for robust measurement of both the SMMs and the subsequent behaviours leading to better and more useful conclusions.

Calder et al. (2017) provides an example of how a combination of mixed methods approaches can be used for the measurement of SMMs in this setting. Using a

combination of cognitive interviews and observations of simulated and real resuscitations in the emergency department, they were able to better understand how the team related SMM coincided behaviours observed in real and simulated clinical performance (Calder et al., 2017). Merging both quantitative and qualitative methods in this fashion allows for a deeper direct measurement of the SMM construct while the observation allows for a more objective measure of performance.

Recommendations for SMM Measurement in Acute Care Teams

In our review we were able to identify gaps that exist in the measurement of SMM in medical teams in the acute care setting. The three major gaps that we identified are: (1) A lack of measurement of accuracy (2) A lack of a measurement of structure and (3) A reliance on quantitative methods. These gaps lead us to make the following recommendations for future SMM research in acute care medical teams:

1. Measurement of SMMs should include all the relevant characteristics including the content and structure of the measured mental model as well as the similarity and accuracy of the team level construct of the SMM.
2. Researchers should collaborate to develop and validate SMM measurement tools that are context specific to their area of practice.
3. Future research should utilize both quantitative and qualitative research methods to allow for a robust and thorough assessment of SMMs

4. Future observational research should ensure to also include direct measurement of SMMs to draw stronger conclusions about the impact of SMMs on team process and performance

As the SMM literature in health care continues to evolve, we anticipate the methods will also continue to evolve. As the methods and definitions become more established, more meaningful conclusions about the impact that the SMM construct has on acute care medical team performance will be possible.

The Way Forward for Research in Team Cognition

Although SMMs are a prominent construct in the team cognition literature, there are other team cognition constructs, such a transactive memory systems, situational awareness, and macrocognition which also act as mediators for team process and performance (DeChurch & Mesmer-Magnus, 2010; Fiore et al., 2010; Mesmer-Magnus et al., 2017). Although not addressed in this review, a more holistic understanding of how all of these concepts interact through the IMOI model to create high quality medical teamwork is warranted. The interaction of these various factors is important for understanding how teams interact in task situations that are ill-defined (Zajac et al., 2014), as is often the case in the acute care setting. Future research should develop a more holistic understanding of how these various aspects of team cognition contribute to team performance in order to develop targeted interventions to build better medical teams that can avoid error and provide high quality and safe patient care (Gregory et al., 2021).

Finally, patient care does not happen in a vacuum. As a patient journeys through the medical system their care will be provided by several different teams of health care

providers. Each of these teams, and their transitions of care, represent opportunities for medical error and patient harm. Across the health care system, and even within a single medical team, the care being provided takes place in phases that require responsive and adaptive teams (Anderson et al., 2021). Team cognition and teamwork behaviours are typically thought of as occurring in a linear fashion, measured by surveys and performance ratings at one time point (Anderson et al., 2021). Although more feasible for study, it is not reflective of how normal patient care is provided. Future research should examine how cognition and IMOI mediators like SMMs changes and adapts over time (Fernandez et al., 2008; Marks et al., 2001). Through well designed study, these changes in cognition can be linked to changes in behaviours over time to provide opportunity to improve the care that we provide to our patients (Lavelle et al., 2020).

Limitations

No study is without its limitations. Our limitations primarily resolve around the nature of the scoping review methodology. Our search criteria identified 25 articles evaluating the concept of SMMs in non-learner medical care teams working in the acute care setting. Our articles included only primary research articles therefore excluding reviews and commentaries. It is possible that information exists in these sources which may inform the SMM conversation and as such, the results from this review need to be interpreted within context.

Due to constraints, we did not include non-English articles. Thus, it is possible that additional literature which would provide other important contributions to this review

has been excluded if it was published in a language other than English. However, only one full text article that was excluded based on language, but our initial search may have eliminated additional useful articles. Future reviews conducted in this topic area should attempt to include non-English articles.

While allowing for more breadth in exploration of a particular research question, scoping reviews do not traditionally include evaluation of the quality and risk of bias during data extraction (Munn et al., 2018). In the future a systematic review could be conducted including examining of study quality and risk of bias to provide additional clarity and guidance for this topic.

Finally, SMMs are not the only construct from the team cognition literature that may be useful to understand in the health care setting (Fernandez et al., 2017). We have chosen to limit our review to SMM to allow for a more thorough analysis of the construct. Future work could compare and contrast the various constructs that are outside of the scope of this current review.

Conclusion

This study examined the construct of SMMs in the context of medical teams in the acute care setting using a scoping review methodology. We identified 25 studies from the peer reviewed literature exploring the construct of SMMs in acute care medical teams. A thematic and narrative analysis identified three major gaps which aligned with previous reviews examining this construct (Floren et al., 2018; McComb & Simpson, 2014). Specifically, the gaps identified include a lack of a common definition for SMMs;.

significant variety in the methods being used; and a lack of definition for the types of teams being studied.

This thesis provides recommendations for future methodological considerations in future research design, as well a novel definition for the SMM construct in this setting, with an ultimate goal of providing further clarification for future studies whose results can lead to tangible improvements to teamwork in the acute care setting.

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Appendix A

Table 6. Shared Mental Model Search Strategies

Search Date: 1 October 2020

Databases Searched
OVID Medline Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE® Daily and Ovid MEDLINE® 1946 to Present: (N = 570)
Embase (1974-2020): (N = 450)
APA PsychInfo 1987 to October Week 1 2020: (N = 386)
CINAHL: (N = 229)
Web Of Science: (N = 592)

Database: OVID Medline

Line #	Search
1	mental model.mp /
2	Models, Psychological/
3	1 or 2
4	Patient Care Team/
5	Hospital Rapid Response Team/
6	team* .mp
7	4 or 5 or 6
8	3 and 7

Database: Embase

Line #	Search
1	Cognitive model/
2	mental model.mp
3	1 or 2
4	Emergency health service/ or rapid response team
5	multidisciplinary team/
6	team* .mp
7	4 or 5 or 6
8	3 and 7

Database: APA PsychInfo

Line #	Search
1	Mental model.mp or exp Mental Models/
2	exp Teams/
3	exp Health Care Services/
4	team* .mp
5	2 or 3 or 4
6	1 and 5

Database: CINAHL

Line #	Search
1	mental model
2	MH “Models, Psychological”
3	MH “multidisciplinary care team”
4	MH “rapid response team”
5	MH “rapid response team”(emergency care
6	1 or 2
7	3 or 4 or 5
8	6 and 7

Database: Web of Science

Line #	Search
1	Topic: (mental model)
2	KP = (mental AND model*)
3	KP = (mental model)
4	KP = (multidisciplinary care team*)
5	KP = (team*)
6	#4 OR #3 OR #2 OR #1
7	#6 OR #5
8	#9 AND #8

Appendix B

Table 7. Data Extraction Form

Reviewers Initials:	Date:
Article Identifiers	
Title:	
First Author's Last Name:	Year:
Study Location (Country):	
Author Contact Information:	
Eligibility	
☐ Practicing health care professionals ☐ Health care teams ☐ Acute care setting	☐ Shared Mental Model ☐ English Language
Article Details	
Study Design	
Research Objective/Questions	
Study Population	
Sample Size:	
Study Setting	
☐ Pre-Hospital (Paramedics, EMS, Ambulance, etc.) ☐ Emergency Department ☐ Trauma ☐ Urgent Care	☐ Surgery (Type:_____) ☐ Anaesthesia ☐ Intensive Care Unit ☐ Other: _____
Study Context	
☐ Real performance observation ☐ In-Situ Simulation (simulation in the teams normal setting) ☐ Sim Lab ☐ Other:	
Team Demographics (Who is included in the team)	
☐ Physicians ☐ Residents ☐ Nurses ☐ Respiratory Therapists	☐ Paramedics/EMTs/EMS ☐ Other:_____ ☐ Other:_____
Was there an explicit definition of the type of team?	
☐ Yes	☐ No
If yes, include the definition – If no, how do they refer to the team?	

Shared Mental Models	
Was there an explicit definition of Shared/Team Mental Models included?	
☐ Yes	☐ No
If yes, include the definition – If no, how do they refer to team cognition?	
How are shared/team mental models being measured?	
☐ Cognitive Interviewing ☐ Card Sorting ☐ Concept Mapping	☐ Pairwise Comparisons ☐ Observation: ☐ Other: _____
Please describe:	
What other variables are being measured in addition to the shared mental models?	
Please describe:	
Training	
Is the study evaluating a training intervention?	
☐ Yes	☐ No
If yes, please describe	
Conclusions	
Key Messages	
Additional Information	

Appendix C

Table 8. Shared Mental Model Definitions

Author	Shared Mental Model Definition	Dimensions						
		Individual Representation	Organized Knowledge	Properties		Content Domains		Performance
				Similarity (Shared)	Accuracy	Taskwork	Teamwork	
Blondon (2017)	Organized mental representations of the key elements within a team's relevant environment that are shared across team members	-	+	+	-	+	-	-
Burtscher (2011)	The organized understanding of relevant knowledge that is shared across team members	-	+	+	-	-	-	-
Calder (2017)	Organizing knowledge structure of the relationships among the team	-	+	-	-	-	+	-
Drach-Zahavy (2017)	Shared mental models are the parties' shared and organized understanding of key elements of their common work	-	+	+	-	+	-	-

Garner (2016)	SMMs reflect the extent to which team members similarly categorize information that impacts execution of interdependent team processes	-	-	+	-	-	+	-
Gjeera (2018)	The shared understanding of the team's task and situation, as well as available resources, which enable team members to coordinate their behaviour based on the demands of the current situation and their team members	-	-	+	-	+	+	-
Jiang (2017)	A team members' ability to develop and maintain a shared understanding of task requirements, procedures, and role responsibilities as well as the context of their work	-	-	+	-	+	+	-

Johnson (2017)	Team members' ability to apply a shared understanding of the task, the structure of the team, and each team member's role within it	-	-	+	-	+	+	-
Kolbe (2014)	A shared and correct understanding of the task requirements and the situation and relies on the correct anticipation of one another's' actions and needs and on the respective behaviour adjustment	-	-	+	+	+	+	-
McComb (2017)	Individually held knowledge structures that help team members function collaboratively in their environments and are comprised of ... content, similarity, accuracy and dynamics	+	-	+	+	-	-	-

Miller (2009)	A team trait characterized by an articulated common understanding of the problem and/or the plan.	-	-	+	-	+	-	-
Neuhaus (2019)	Internal representations that allow an individual to interact with the system and understand its behaviour, dynamics, and performance	+	-	-	-	-	-	+
Polis (2017)	A team's ability to mutually understand how the team functions and have clear expectations of each team members role	-	-	+	-	-	+	-

Sochet (2018)[1]	A shared mental model is a structured knowledge framework permitting individuals to recognize and prioritize relationships from their environment, explain or infer the importance of observations, and generate expectations for performance and predicted behavior	+	+	-	-	-	-	+
Stey (2020)	Communal understanding of an underlying problem	-	-	+	-	+	-	-
Westli (2010)	A shared understanding of the task, the structure of the team, and the team members' roles within it	-	-	+	-	+	+	-

Appendix D

Table 9. Shared Mental Model Methods

Quantitative Methods

First Author	Type of Methodology	Type of SMM	Type of Emergence	Measurement	SMM Outcomes
Bates (2014)	Questionnaire	Taskwork Shared clinical understanding after handover of the patient, condition, and management in a Pediatric ICU	Content Participant Generated Structure N/A	Similarity -Agreement on the questionnaire between sender-receiver pairs was coded numerically -Agreement was calculated between sender-receiver pairs of the same profession Accuracy -N/A	Increased length of stay was correlated with increased agreement on a number of patient information categories More complex patients (measured by number of medications) had lower agreement levels
Blondon (2017)	Survey	Teamwork Perceptions of role responsibilities between nurses and physicians Taskwork Management of an internal medicine patient	Content Researcher Generated Structure N/A	Similarity Agreement on one or two top actions for either the physician or nurse during each hypothetical scenario Agreement was calculated between all hypothetical pairs of physicians and nurses Accuracy -N/A	Higher agreement for cases where more than one "top action" was permitted and "acute" versus "non-acute" Agreement more likely in pairs with more females and with previous internal medicine experience

Burthsher (2011)	Concept Mapping	Taskwork Steps in performing an anesthesia induction	Content Researcher Generated Structure Assessed	Similarity Measured as agreement in step order between team members prior to induction Accuracy Accuracy determined by comparing participant concept maps to subject matter expert completed concept maps	Interaction effect of similarity and accuracy to predict performance Similarity moderated relationship between monitoring behaviours and performance
Colman (2019)	Mixed Methods Observation Survey	Teamwork Teamwork behaviours during simulated pediatric emergencies	Content N/A Structure N/A	Observation of team performance during simulated emergencies using the CTS tool. 15 teamwork behaviours are rated on an 11 point Likert scale. Similarity Staff perception of unit teamwork behaviours was compared on a 28 question survey before and after simulation based training. Accuracy N/A	Following simulation based training there were improvements in three categories of team work perception

Coolen (2019)	Questionnaire	Taskwork Patient information and management priorities during simulated pediatric emergencies	Content Participant Generated Structure Assessed	Similarity Participant answers to 5 questions about the current patient at three time points were compared between team members Percentage agreement was calculated for all team members Accuracy N/A	Strong relationship between team agreement on patient diagnosis and task prioritization No association between team agreement and time to simulation goal completion
Drach-Zachary (2017)	Concept Mapping	Taskwork Management, patient information, and priorities for ICU patients	Content Researcher Generated Structure Assessed	Similarity Similarity of incoming/outgoing nurse's concept maps for both content and structure/associations Accuracy Accuracy of concept maps was calculated by comparing to "expert" nurse concept maps	Almost half of the incoming nurse concept maps lacked patient management information and information about physiological systems Incoming nurse maps contained ~1/3 of the information that experts included

Garner (2016)	Pairwise Comparisons	Teamwork Perceptions of how teamwork concepts interact to produce effective teamwork	Content Researcher Generated Structure N/A	Similarity Calculated as the absolute difference between each team members answers on the comparisons matrix (Expressed as a score 0-100) Accuracy N/A	Similarity increased significantly over the course of the 5 day bootcamp Mental model similarity was predictive of performance on days 2-5
Gjeera (2018)	Survey	Teamwork Perceptions of other team member's technical and non technical skills Taskwork Understanding of patient risks and future needs during a Video-Assisted Thoracoscopic Surgery (VATS)	Content Researcher Generated Structure N/A	Similarity Team scores were averaged and collective professional group scores were compared to the total group mean Accuracy N/A	Low agreement between team members on the patient information and patient risks Teams that perceived themselves as more familiar demonstrated a greater degree of similiarity for mental models of team resources

Johnson (2017)	Observation	<u>Taskwork</u> Leader performance in managing an acutely ill patient in the emergency department	<u>Content</u> N/A <u>Structure</u> N/A	Frequency and duration of behavioural markers of SMM in team leaders were coded from video recorded observations of simulated team performance <u>Similarity</u> N/A <u>Accuracy</u> N/A	Positive correlation between team performance and leaders sharing information, supporting team mates, and updating situational awareness Leaders of better performing teams had more instances of sharing information and updating situational awareness
Kessler (2017)	Observation	<u>Taskwork</u> Description of the reason for the pause in resuscitation	<u>Content</u> N/A <u>Structure</u> N/A	Trained raters determined the level of agreement with the phrase "During the Pause the Team had a good shared mental model" of a scale of 1 - 4 <u>Similarity</u> N/A <u>Accuracy</u> N/A	When the rationale for the pause in CPR was clear pauses were shorter than when the rationale was unclear Team leaders were more likely than team members to provide the rationale for the pauses in CPR

Kolbe (2014)	Observation	Taskwork Management of anesthesia patients during typical inductions	Content N/A Structure N/A	Frequency, timing, and duration of verbal and non-verbal behaviours were coded from video recordings using Co-ACT framework Similarity N/A Accuracy N/A	Higher performing teams were more likely to engage in backup behaviours after team monitoring than lower performing teams Following team monitoring behaviours high performing teams were more likely to "speak up" than lower performing teams
McComb (2017)	Survey	Teamwork Perception of team member roles during typical patient care	Content Researcher Generated Structure N/A	Similarity Perception of primary responsibility for a task was compared on a Likert scale from 1 (Physician Only) to 7 (Nurse Only) Each groups responses was aggregated and compared to other group to determine similarity Accuracy N/A	Physicians reported primary responsibility for a number of roles Nurses perceived as shared tasks There were significant differences in role perception for a number of tasks, suggesting a lack of SMM for team roles

Miller (2009)	Observation	<u>Taskwork</u> Patient information related to management of patients in obstetrical emergencies	<u>Content</u> N/A <u>Structure</u> N/A	Sharing of information with various team members as a proxy for a SMM was scored as "done", "partially done", or "not done" during various timepoints in a simulated obstetrical emergency <u>Similarity</u> N/A <u>Accuracy</u> N/A	Identified 7 distinct communication behaviours thought to be relevant to shared mental models Nurses frequently shared information with the physicians but infrequently shared information with the patient and patient's family, and other health care providers
Neuhaus (2019)	Observation	<u>Taskwork</u> Management of a can't intubate can't ventilate anesthesia emergency	<u>Content</u> N/A <u>Structure</u> N/A	Observed the time to switch airway management strategies during a simulated anesthesia emergency <u>Similarity</u> N/A <u>Accuracy</u> N/A	Structured briefing groups spent less time with the alternative airway before moving to the "Plan C" airway than groups with no structured briefing No difference in time to call for help, time to switch to alternative airway, or time to cricothyrotomy

Polis (2017)	Survey	Teamwork Perception of nursing teamwork across nursing disciplines in a hospital	Content Researcher Generated Structure N/A	Similarity Frequency of teamwork behaviour was assessed using a 5 point Likert scale with questions from the Nursing Teamwork Survey Nurses from each area of practice scores were summed and compared to groups from other areas of practice Accuracy N/A	Experienced staff reported overall higher teamwork scores than less experienced staff New nurses had significantly lower SMM subscale scores than experienced nurses SMM subscale was consistently the highest rated across areas of practice
Ryan (2018)	Questionnaire	Taskwork Patient related information during pediatric critical care transfer	Content Participant Generated Structure N/A	Similarity Congruence of patient information between all participants in a handover on a five question patient questionnaire (SMMi) Accuracy N/A	A structured handover process lead to more similar SMM post intervention Prior to the intervention teams with > 3 members had low SMMi scores, this did not occur after introduction of a structured handover

Sochet (2018)	Questionnaire	Taskwork Patient related information during pediatric critical care transfer	Content Participant Generated Structure N/A	Similarity Congruence of patient information between all participants in a handover on a five question patient questionnaire (SMMi) Accuracy N/A	Sustained improvements in SMMi from the post intervention phase at the 1 year mark Sustained improvements in SMMi scores regardless of team size at 1 year
Weller (2014)	Questionnaire	Taskwork Patient management information during a difficult airway situation	Content N/A Structure N/A	Similarity Unique information was pre-planted in different team members to share during the simulation Similarity measured as percentage of total planted information learned by team members at end of the simulation Accuracy N/A	Only a small amount of unique information was completely shared across all team members During the post-scenario debrief teams reported that it was common to have unshared information

Westli (2010)	Observation	<u>Teamwork</u> SMM behaviours during simulated management of trauma patients	<u>Content</u> N/A <u>Structure</u> N/A	The behavioural marker systems ANTS and ATOM were modified to fit trauma simulations Behaviours thought to be indicative of SMMs were coded for frequency and duration during trauma simulations <u>Similarity</u> N/A <u>Accuracy</u> N/A	Higher performing teams demonstrated more SMM behaviours than lower performing teams Positive SMM markers correlated with high performing teams SMM markers could predict 23% of team performance in a regression model

Qualitative Methods

First Author	Type of Methodology	Type of SMM	Type of Emergence	Measurement	SMM Outcomes
Calder (2017)	Mixed Methods Semi-Structured Interviews Simulation Observation Live Observation	Teamwork Team member roles and responsibilities in an emergency department (ED) resuscitation (Interviews) Taskwork Management of a critically ill patient in the ED (Observations)	Content Participant Generated Structure Researcher Generated	Observations of communication patterns during simulated and live resuscitation to generate a map of resuscitation communication (observations) Similarity Themes were generated around team member roles across disciplines during semi-structured interviews Accuracy N/A	There were consistent categories of information exchanged during simulated and live resuscitations (Time, Patient Status, History, Interventions, Team members present) Interviews identified the need to generate a shared mental model for successful resucitations

Custer (2012)	Semi-Structured Interviews	Taskwork Management of complex patients in the pediatric ICU	Content Participant Generated Structure N/A	Similarity Themes were generated around similarities related to care for complex patients Accuracy N/A	Identified 4 mental model categories: (1) Patient-related (2) Causes (3) Results, and (4) Recognition/Management of inadequate MMs Critical care teams reported trying to create a SMM for each patient Inadequately developed SMM was perceived to be a barrier to team cognition
Goras (2020)	Semi-Structured Group Interviews (Focus Group)	Teamwork Understanding roles and expectations of different team members to create safe and adaptive care	Content Participant Generated Structure N/A	Similarity Themes were assessed around similarities between OR professionals around adapting to care Accuracy N/A	Identified three main categories around team adaptation to unexpected circumstances: (1) Preconditions and resources (2) Planning and preparing for the expected and unexpected (3) Adapting to the unexpected Communication was seen as increasingly important in teams that were less familiar

Jiang (2017)	Audio transcript analysis	Taskwork Management of a complex patient in the pediatric intensive care unit during handover	Content Participant generated Structure N/A	Similarity Audio transcripts of patient handovers were qualitatively coded for overlap between clinicians. An overlap index was created to measure the amount of similarity between clinicians Accuracy N/A	Average overlap indexes during handovers were very low After implantation of a handover tool there were no significant improvements in overlap indexes
Stey (2020)	Semi-Structured Interviews	Taskwork Patient care priorities and management of an intensive care unit patient	Content Participant Generated Structure N/A	Similarity Thematic analysis of interviews for management priorities between professionals working in the surgical ICU Accuracy N/A	There were central theme of "distribution of shared responsibility" identified with sub-themes of: (1) The tension of time and (2) Distinct yet interchangeable roles Time was identified as important for the development of a shared mental model, the more time the better the mental model Communication was important to develop a shared mental model between subspecialities

Undre (2006)	Semi-structured interviews	Teamwork Perception of roles, teamwork behaviours, and performance in the OR	Content Participant Generated Structure N/A	Similarity Themes were generated for various professionals around (1) Team Structure (2) Role Perception (3) Teamwork (4) Communication between professionals working in the OR Accuracy N/A	There was disagreement whether the team worked as one team or multiple small teams Team members believed that they understood other team members roles than those team members understood their roles There was no agreement on what an ideal surgical team would look like or what type of team the surgical team was

Appendix E

Table 10. Study Characteristic Overviews

First Author (Year)	Type of Study	Study Objective	Intervention	Type of Simulation	Area of Practice	Team Composition
Bates (2014)	Quantitative	To study the reliability, feasibility, and validity of a novel assessment of shared clinical understanding (PKAT)	Clinical handover assessment tool	N/A	Pediatric Intensive Care Unit	Two Separate Groups: Attendings Clinicians: included nurse practitioners, clinical fellows, and hospitalists 29 Individuals completed 90 unique handoffs
Blondon (2017)	Quantitative	To assess factors associated with a concordant team mental model, based on doctor and nurse teams in an Internal Medicine ward, using a clinical case-based questionnaire	N/A	N/A	Acute Care Internal Medicine Ward	Nurses and Physicians 196 Hypothetical Nurse-Physician pairs based on 28 participants (14 Physicians/14 Nurses)
Burtscher (2011)	Quantitative	Investigated how team mental model properties interacted with monitoring behaviours to predict team performance in anesthesia.	N/A	In-Situ	Anaesthesia	Nurses and Anaesthesia Residents 31 Nurse/Resident pairs

Calder (2017)	Mixed Methods	To understand how teams communicate during resuscitation, whether they endorsed a SMM and team information needs	N/A	In-Situ	Emergency Department	Interviews -physicians, trauma team leaders, emergency medicine residents, registered nurses, respiratory therapists, advanced care paramedics, patient care assistants, registration clerks, and social workers
Colman (2019)	Quantitative	To evaluate Pediatric ICU team performance and staff perceptions of teamwork following Simulation based team training	Simulation based team training	Simulation Lab	Pediatric Intensive Care Unit	Physicians, Nurses, Respiratory Therapists
Coolen (2019)	Quantitative	To evaluate the use of a situational awareness global assessment in multi-disciplinary pediatric team training	Simulation based training evaluation	Simulation Lab	Pediatric Acute Care	Physicians Nurses Residents
Custer (2012)	Qualitative	To understand expert and team cognition in the Pediatric ICU	N/A	N/A	Pediatric Intensive Care Unit	Physicians Fellows Nurses Nurse Practitioners

Drach-Zahavy (2017)	Quantitative	To examine similarities and accuracies among mental models of incoming and outgoing nurses	N/A	N/A	ICU	Nurses
Gardner (2017)	Quantitative	To examine how similarity of SMM changes over time and how similarity of SMM relates to team performance	N/A	Simulation Lab	Surgery	Physicians Nurses
Gjeera (2018)	Quantitative	To measure the degree of similarity of shared mental model (SMM) within surgical teams when performing video-assisted thorascopic surgery	N/A	N/A	Surgery	Surgeon, Anaesthesiologist, Nurses Certified Nurse Anaesthesia Assistant
Goras (2020)	Qualitative	To understand complexity in the operating room (OR) and how OR teams adapt to create safe patient care	N/A	N/A	Surgery	Nurses Nurse Anaesthetist Surgeons
Jiang (2017)	Quantitative	To measure the impact of an electronic handoff tool on SMM development in pediatric ICU	Electronic shift handoff tool	N/A	Pediatric Intensive Care Unit	Nurses Residents Fellows

Johnsen (2017)	Quantitative	To investigate whether behavioural markers of SMM in team leaders were associated with team performance in simulated trauma teams	N/A	In-Situ	Emergency Department	Surgeons Anaesthetists Nurses Radiographers
Kessler (2017)	Quantitative	To determine the frequency, duration, and causes for pauses during simulated pediatric cardiac arrest	Just in time cardiac arrest training	Simulation Lab	Pediatrics	Nurses Physician Other Medical Student Resident
Kolbe (2014)	Quantitative	To examine the teamwork processes that enable high-risk teams to be adaptable and flexible during	N/A	N/A	Anaesthesia	Nurses Residents Physicians
McComb (2017)	Quantitative	Examine shared mental models and mutual trust between physicians and nurses working on a general medical unit	N/A	N/A	General Medical Unit	Nurses Physicians
Miller (2009)	Quantitative	To measure markers of key nursing behaviours in interdisciplinary teams during critical events to assess the extent of high reliability	N/A	In-Situ	Labour and Delivery	Obstetricians Nurses Nurse Practitioners Certified Nurse Anaesthetists Anaesthetists

Neuhaus (2019)	Quantitative	To assess the influence of a semi-structured briefing on the management of a simulated airway emergency	Semi-structured briefing tool	Simulation Lab	Anaesthesia	Anaesthetist Nurse
Polis (2017)	Quantitative	To investigate which factors are associated with nursing team work in a large Australian hospital setting	N/A	N/A	Multiple Areas -Inpatient -Outpatient -Acute Care	Nurses Midwives
Sochet et al., (2018a)	Quantitative	To evaluate the congruence of SMM for patient data, handover quality, and other teaming metrics before and after the standardization of interfacility transport in pediatric critical care	Structured handover process	N/A	Pediatric Intensive Care, Pediatric Emergency Medicine, Neonatal Intensive Care	Nurses Respiratory Therapists Physicians Advanced Practice Providers
Sochet et al., (2018b)	Quantitative	To identify lasting improvements in SMMi development, teaming, handover process, and participant face validity by matching a previously published pre/post assessment with 1-year follow-up data	Structured handover process	N/A	Pediatric Intensive Care, Pediatric Emergency Medicine, Neonatal Intensive Care	Nurses Respiratory Therapists Physicians Advanced Practice Providers

Stey (2020)	Qualitative	To generate hypotheses about how care decisions are made among interdisciplinary providers caring for critically injured patients	N/A	N/A	Intensive Care Units	Nurses Respiratory Therapists Pharmacists Nurse Practitioners Anaesthetists Neurosurgeon Trauma Surgeon Neurocritical Care Physician
Undre (2006)	Qualitative	To investigate how surgical team members perceive their teamwork, the structure and processes of their teams and their teams' performance	N/A	N/A	Surgery	Nurses Anaesthetists Surgeons OR Technicians
Weller (2014)	Quantitative	Evaluate if a video based intervention modelling a structured call out would improve call out in subsequent simulated cases and if improved simulated call out affected information sharing and medical management during simulated crises	Video Based training	Simulation Lab	Anaesthesia	Nurses OR Technicians Anaesthetists

Westli (2010)	Quantitative	The first objective of this study was to field test and to validate the teamwork skills system by observing and assessing trauma team simulations The second objective was to assess whether shared mental models would help to explain differences in team performance	N/A	In-Situ	Emergency Department	Surgeons Anaesthetists Nurses Radiographers