

Supplemental Digital Appendix 1

An Illustration of the Distinction between the Content and Structure of a Shared Mental Model (SMM)

Consider the following clinical example focused on the task of patient falls prevention.

Mr. Smith, an 88-year-old male resident of a skilled nursing facility, has a history of multiple falls in the past month and fell again yesterday as he attempted to get out of bed and walk to the bathroom. All members of his care team (i.e., his daytime floor nurse, charge nurse, physical therapist, and geriatrician) are focused on the goal of preventing further falls and agree that Mr. Smith now needs a walker to minimize the risk of further falls. However, a disagreement in the implementation of that strategy arises. The floor nurse, who is new to the team, suggests that the walker be placed in Mr. Smith's room but out of sight behind the curtain so that it is accessible to her but does not encourage him to get out of bed. The physical therapist, geriatrician, and charge nurse recommend instead that the walker be placed at the bedside.

In this example, the content of each team member's taskwork mental model regarding a falls prevention strategy for Mr. Smith is similar (e.g., to help prevent falls, an assistive device is now needed, and a walker is preferred). However, the organization of that knowledge, specifically the association between the need for a walker and the rationale for optimal placement of the walker in Mr. Smith's room, differs between the clinicians. With further team discussion, the individual team members' organized mental representations of the proper use and placement of the walker for Mr. Smith come into alignment. The team comes to a shared understanding that the walker must be placed at bedside to prevent falls--they have developed a SMM around a falls prevention strategy.

Supplemental Digital Appendix 2

Search Strategy for a Scoping Review of the Literature on Shared Mental Models to Support Clinical Teamwork Among Health Professions Learners, 2000-2016

- **For CINAHL [n=90]**
 - shared AND (“mental model” OR “mental models”) [*n=60*]
 - (("mental model" OR "mental models" OR "team mental model" OR "team mental models" OR "shared mental model" OR "shared mental models" OR "teamwork mental model" OR "taskwork mental model" OR "teamwork mental models" OR "taskwork mental models") AND ((MH "Students, Health Occupations" OR medical student OR pharmacy student OR nursing student OR dental student OR "Students, Health Occupations"[Mesh] OR "Internship and Residency"[Mesh] OR internship* OR residenc* OR resident* OR fellow* OR fellowship* OR medical education OR pharmacy education OR nursing education OR dental education OR Interprofessional OR patient care team*)) [*n=30*]
- **For EMBASE [n=117]**
 - ('mental model' OR 'mental models' OR 'team mental model' OR 'team mental models' OR 'shared mental model' OR 'shared mental models' OR 'teamwork mental model' OR 'taskwork mental model' OR 'teamwork mental models' OR 'taskwork mental models') AND ('medical student'/exp OR 'medical student' OR 'nursing student'/exp OR 'nursing student' OR 'dental student'/exp OR 'dental student' OR 'pharmacy student'/exp OR 'pharmacy student' OR 'medical education'/exp OR 'medical education' OR 'interdisciplinary communication'/exp OR 'interdisciplinary education'/exp OR 'medical student' OR 'medical students' OR 'pharmacy student' OR 'pharmacy students' OR 'nursing student' OR 'nursing students' OR 'dental student' OR 'dental students' OR residenc* OR resident* OR fellow* OR fellowship* OR medical AND education OR 'pharmacy education' OR 'nursing education' OR 'dental education' OR 'patient care team' OR 'teamwork'/exp)
- **For ERIC [n=87]**
 - shared AND (“mental model” OR “mental models”)
- **For PsychInfo [n= 250]**
 - (shared AND ("mental model" OR "mental models")) AND ((“education” OR “clinical education” OR “medical education” OR “nursing education” OR “pharmacy education” OR “health professions education”) OR (“training” OR “clinical training” OR “medical training” OR “nursing training” OR “pharmacy training” OR “health professions training”) OR ((“health professions” AND “learners”) OR (“health professions” AND “trainees”) OR (“health professions” AND “students”)) OR (interdisciplinary OR multidisciplinary OR interprofessional)) [*n=129*]
 - (("mental model" OR "mental models" OR "team mental model" OR "team mental models" OR "shared mental model" OR "shared mental models" OR

"teamwork mental model" OR "taskwork mental model" OR "teamwork mental models" OR "taskwork mental models")

AND

(medical student OR pharmacy student OR nursing student OR dental student OR "Students, Health Occupations"[Mesh] OR "Internship and Residency"[Mesh] OR internship* OR residenc* OR resident* OR fellow* OR fellowship* OR medical education OR pharmacy education OR nursing education OR dental education OR Interprofessional OR patient care team*)) *[n=121]*

- **For PubMed [n=273]**

- shared AND ("mental model" OR "mental models") *[n=110]*

- (("mental model" OR "mental models" OR "team mental model" OR "team mental models" OR "shared mental model" OR "shared mental models" OR "teamwork mental model" OR "taskwork mental model" OR "teamwork mental models" OR "taskwork mental models")

AND

(medical student OR pharmacy student OR nursing student OR dental student OR "Students, Health Occupations"[Mesh] OR "Internship and Residency"[Mesh] OR internship* OR residenc* OR resident* OR "Pharmacy Residencies"[Mesh] OR fellow* OR fellowship* OR "Education, Medical, Undergraduate"[Mesh] OR "Education, Medical, Graduate"[Mesh] OR "Education, Professional"[mh] OR medical education OR pharmacy education OR nursing education OR dental education OR "Interprofessional relations"[mh] OR "patient care team"[mh])) *[n=163]*

- **For Scopus [n=155]**

- (((TITLE-ABS-KEY("mental models") OR TITLE-ABS-KEY("mental model")) AND (TITLE-ABS-KEY(shared))) AND (((TITLE-ABS-KEY("education") OR TITLE-ABS-KEY("clinical education") OR TITLE-ABS-KEY("medical education") OR TITLE-ABS-KEY("nursing education") OR TITLE-ABS-KEY("pharmacy education") OR TITLE-ABS-KEY("health professions education"))) OR (TITLE-ABS-KEY(("training" OR "clinical training" OR "medical training" OR "nursing training" OR "pharmacy training" OR "health professions training")))) OR ((TITLE-ABS-KEY(interdisciplinary) OR TITLE-ABS-KEY(health professions learners) OR TITLE-ABS-KEY(health professions trainees) OR TITLE-ABS-KEY(health professions students) OR TITLE-ABS-KEY(multidisciplinary) OR TITLE-ABS-KEY(interprofessional))))

- **For Web of Science [n=297]**

- (shared AND ("mental model" OR "mental models")) AND (("education" OR "clinical education" OR "medical education" OR "nursing education" OR "pharmacy education" OR "health professions education") OR ("training" OR "clinical training" OR "medical training" OR "nursing training" OR "pharmacy training" OR "health professions training") OR ("health professions" AND "learners") OR ("health professions" AND "trainees") OR ("health professions"

AND “students”)) OR (interdisciplinary OR multidisciplinary OR interprofessional)) *[n=150]*

- (“mental model” OR “mental models” OR “team mental model” OR “team mental models” OR “shared mental model” OR “shared mental models” OR “teamwork mental model” OR “taskwork mental model” OR “teamwork mental models” OR “taskwork mental models”)

AND

(medical student OR pharmacy student OR nursing student OR dental student OR “Students, Health Occupations”[Mesh] OR “Internship and Residency”[Mesh] OR internship* OR residenc* OR resident* OR fellow* OR fellowship* OR medical education OR pharmacy education OR nursing education OR dental education OR Interprofessional OR patient care team*)) *[n=147]*

Supplemental Digital Appendix 3

Methods to Measure Shared Mental Models (SMMs) to Support Clinical Teamwork Among Health Professions Learners, According to a Scoping Review of the Literature, 2000-2016

First, author (year)	Article type (design) ^a	Aims	Study population (n)	Application of the SMM construct ^b	Methods/Measurements	Key findings/outcomes related to SMMs ^c
Burtscher (2011) ¹⁶	Empirical (Mixed-methods)	To investigate how team mental model (TMM) properties interact with monitoring behaviors to predict team performance in simulated anesthesia induction, including “non-routine” events	IP anesthesia teams (n=31) ((comprised of an anesthesia resident and an anesthesia nurse) from a hospital	Focus on Taskwork: - Anesthesia induction TMM characterized as Prerequisite for Effective Teamwork	TMM Measurement: - Concept mapping technique used to measure similarity and accuracy of team members’ TMM of the task of anesthesia induction Similarity measured by comparing individual maps Accuracy measured by comparing participants’ maps with 2 subject matter experts’ maps. Individual accuracy ratings averaged to create a team level measure.	Findings related to TMMs: - TMM similarity moderated relationship between team monitoring behaviors and performance - TMM similarity and accuracy interacted to predict performance - Increased monitoring behaviors, in absence of similar TMM, negatively affected performance
Custer (2012) ²⁵	Empirical (Qualitative)	To understand expert and team cognition of complex patients in Pediatric ICU (PICU)	IP PICU team from a children’s hospital, including attending physicians (n=9); NPs (n=2); bedside nurses (n=4); pediatric critical care fellows (n=3)	Focus on Taskwork: - Care of complex PICU patients SMM characterized as Pre-requisite for Effective Teamwork and Expected Outcome of working together	SMM Measurement: - Cognitive task analysis based on thematic analysis of verbal fragments from semi-structured interviews	Findings related to SMMs: - 11 themes and 4 categories were identified: formation of patient-related MMs; and causes, results and recognition/management of inadequate MMs - Critical care teams tried to create SMMs of their patients - An “Inadequately developed or inadequately shared mental model” of patient care was a major barrier to PICU team cognition; what constituted an “inadequately shared mental model” was not explicitly defined
Garbee (2013) ³⁷	Program (Curriculum) + Empirical (Quantitative)	To evaluate efficacy and retention of teaching team-based competencies to interprofessional (IP) student teams using high-fidelity patient simulation	IP teams for Fall 2009 training (n=35 students); training was repeated in Spring 2010 (n=25 students) Teams consisted of medical (n=2), nursing (n=2), nurse anesthesia (n=2) and physical therapy (n=1-2) students	Focus on Teamwork: - SMM is characterized by authors as a team competency SMM as Design Principle: - SMMs were focus of post-	- Pre-post-test design; data collected for Fall and Spring sessions from trained observers and participants SMM Measurement: - Individual and team performance rated by participants and observers using: Teamwork Assessment Scale (TAS), a Likert-style survey to measure overall teamwork	Findings related to SMMs: - SMM subscale scores, as rated by both participants and trained observers (using paired samples t-tests) improved significantly from simulation scenario one to two in both Fall and Spring simulation sessions - Significant increases in mean participant and observer SMM

			from a health sciences training center	case, structured debriefing	(includes team based behaviors scale and overall teamwork scale (with subscales for SMM (3-items) and communication (3 items))	scores between Fall simulation one and Spring simulation two showed an overall training gain
				SMM as Expected Outcome: - SMM is characterized as one of nine “key team-based competencies”		
Mamykina (2014) ¹⁸	Summary (Book chapter with literature review) + Empirical (Mixed-methods)	To investigate and measure development of SMMs in critical care setting	IP, critical care ICU teams at a medical center were observed and in-depth interviews were conducted w/ a nurse, medical residents (n=2), and a medical fellow	Focus on Taskwork: - SMM construct applied to ICU handoffs SMM as Expected Outcome: - Rounds expected to align team members’ MM around taskwork	SMM Measurement: - Qualitative analysis of transcripts from interviews, observations, audio recordings of handoffs - SMM Index (numeric value between 0-1 signifying extent of overlap across team members) was assigned to segments of conversation - SMMs during handoffs measured by focusing on handoffs related to a single patient over 3 days	Findings related to SMMs: - Rounds support alignment of team member MM around taskwork (i.e., patient care in ICU) and handoffs facilitate information integration, supporting coherent SMM development with respect to patient care - Disruptions in SMM continuity can be attributed to transitions of care
Mamykina (2016) ²²	Empirical (Mixed-methods)	To examine a novel mixed-methods approach for analyzing handoff from the perspective of patient care teams	IP, CTICU teams at a large urban medical center were observed and recorded during handoffs; teams included: an attending, a fellow, a resident, a PA or NP and a bedside nurse	Focus on Taskwork: - SMM construct applied to CTICU handoffs in an overlap analysis	SMM Measurement: - Qualitative analysis of transcripts from recorded observations of verbal handoffs - Patterns related to temporal frame and clinical content were identified using categorical cluster analysis - SMM Index (numeric value between 0-1 signifying extent of overlap across team members’ statements) was assigned to segments of conversation	Findings related to SMMs: - SMM Index calculations showed higher degree of overlap for statements concerned with patient presentation and statements referring to the past - Team coherence was positively associated with SMM Index

McComb (2015) ¹⁹	Empirical (Quantitative)	To develop and administer a survey to examine SMMs and mutual trust among nurses and physicians working in GM units	IP, GM clinical team members from an urban teaching medical center; participants included: Nurses (n=37) and doctors (most were residents),(n=42)	Focus on Teamwork: - SMMs, mutual trust viewed as coordinating mechanisms facilitating teamwork and impacting patient safety SMM as Pre-requisite for Effective Teamwork	SMM Measurement: -SMM/Mutual Trust questionnaire, a 7 point Likert scale survey to analyze SMMs of nurses and physicians related to professional roles and responsibilities, was developed and administered - Respondents indicated which professional they felt was responsible for each role, rated perceptions of cross- discipline interactions - Statistical comparison of ratings followed	Findings related to SMMs: - In 14 out of 22 mental models regarding role responsibilities, nurses and physicians report significant differences in perception; no significant differences were noted for the remaining 8 mental models
Nakarada-Kordic (2016) ²³	Empirical (Quantitative)	To explore the similarity of MMs of task sequence and responsibility for task within multidisciplinary OR teams using surgical simulations	IP, OR clinical team members from two teaching hospitals; (n=20, 6-person teams) where each team included: a consultant and junior surgeon (surgical subteam); a consultant anesthetist or senior anesthetic fellow (anesthetic subteam); two nurses (nursing subteam) {Note: team members had worked together previously in their ORs}	Focus on Taskwork: - SMM construct applied to OR task sequence Focus on Teamwork: - SMM construct applied to task responsibilities of OR subteams	SMM Measurement: - Using a computer-based card-sorting tool (“Momento”), individuals sorted 20 key tasks by sequence and by subteam responsibility for task prior to commencing each simulation (card sorts and simulations were completed for two laparotomy-related scenarios) - Similarity of SMMs measured by pairwise comparisons of scores within each OR teams and subteam; mean similarity scores were calculated for each task - Accuracy not measured	Findings related to SMMs: - For laparotomy simulations, OR team members’ MMs were similar with respect to task sequence - Poor agreement b/w OR team members’ MMs related to subteam responsibility was observed for half of the tasks

^a Article categories included: (1) Program: An educational program, curriculum, or tool is described. No data or analysis is included. (2) Empirical: A quantitative, qualitative, or mixed-methods research study is described. Data and analysis are included. (3) Conceptual: A framework or model related to the concept of a SMM is provided. (4) Opinion/Position: Thoughts about SMMs in the context of clinical learning are shared. No research or program development is presented. (5) Summary: A review of existing literature or research is described. (6) Other: Abstracts or poster presentations are described.^{22,23}

^b Though the term team mental model is specific to shared/overlapping mental models amongst team members, the term shared mental models is the most frequently used in the health professions literature. Therefore, the terminology used in each article is reflected in the table.

^c For key findings related to SMMs as well as other key findings from the included articles, see Supplemental Digital Appendix 4.

Supplemental Digital Appendix 4

Overview of All 23 Included Articles in a Scoping Review of the Literature on Shared Mental Models (SMMs) to Support Clinical Teamwork Among Health Professions Learners, 2000-2016

First, author (year)	Article type (design) ^a	Aims	Study population (n)	Intervention type/description	Application of the SMM construct ^b	Methods/Measurements	Key findings/outcomes related to SMMs
Burtscher (2011) ¹⁶	Empirical (Mixed-methods)	To investigate how team mental model (TMM) properties interact with monitoring behaviors to predict team performance in simulated anesthesia induction, including “non-routine” events	IP anesthesia teams (n=31) (comprised of an anesthesia resident and an anesthesia nurse) from a hospital	N/A	Focus on Taskwork: - Anesthesia induction TMM characterized as Prerequisite for Effective Teamwork	TMM Measurement: - Concept mapping technique used to measure similarity and accuracy of team members’ TMM of the task of anesthesia induction Similarity measured by comparing individual maps Accuracy measured by comparing participants’ maps with 2 subject matter experts’ maps. Individual accuracy ratings averaged to create a team level measure. Other Measurements: - Monitoring behaviors (i.e., observing activities/performance of other team members) assessed based on observations - Team performance assessed via checklist	Findings related to TMMs: - TMM similarity moderated relationship between team monitoring behaviors and performance - TMM similarity and accuracy interacted to predict performance - Increased monitoring behaviors, in absence of similar TMM, negatively affected performance

Carbo (2011) ³⁵	Program (Curriculum) + Empirical (Quantitative)	To develop and investigate the effect of a team training curriculum on attitudes and knowledge related to patient safety	IM residents from 2 urban teaching hospitals (n=50); respondents completing both pre- and post-intervention survey (n=33)	Teamwork Curricula/ Training - Hour-long, case-based, interactive team training curriculum focused on 4 key teamwork skills and patient safety. Curriculum based on Crew Resource Management (CRM) principles which include: assertiveness, effective briefings, callback/verification, situational awareness and SMMs; in aggregate, called the "ABC'S" of teamwork	SMM as Design Principle: - SMMs used as an organizing principle guiding the team training curriculum SMM Awareness as Expected Outcome: - During interactive discussion, faculty emphasized importance of briefings as means of producing a SMM	- Pre-post-test design Measurements: - Pre-post intervention, multiple choice question-based knowledge and attitudes survey - Quantitative analysis method not specified	Findings related to SMMs: - Findings do not make a clear connection to SMMs, instead focus on the aggregated "ABC'S" of teamwork - After training, resident's knowledge of aggregated teamwork skills nearly doubled, but SMMs were not directly measured
Custer (2012) ²⁵	Empirical (Qualitative)	To understand expert and team cognition of complex patients in Pediatric ICU (PICU)	IP PICU team from a children's hospital, including attending physicians (n=9); NPs (n=2); bedside nurses (n=4); pediatric critical care fellows (n=3)	N/A	Focus on Taskwork: - Care of complex PICU patients SMM characterized as Pre-requisite for Effective Teamwork and Expected Outcome of working together	SMM Measurement: - Cognitive task analysis based on thematic analysis of verbal fragments from semi-structured interviews	Findings related to SMMs: - 11 themes and 4 categories were identified: formation of patient-related MMs; and causes, results and recognition/management of inadequate MMs - Critical care teams tried to create SMMs of their patients - An "Inadequately developed or inadequately shared mental model" of patient care was a major barrier to team cognition in PICU; what constituted an "inadequately shared mental model" was not explicitly defined
Dickerson (2016) ²⁹	Empirical	To determine if direct, in-person	IP clinical teams from a large	N/A	Focus on Teamwork:	- Comprehensive imaging review was performed for	Findings related to SMMs:

(Mixed-methods)	communication between radiologists and acute care surgeons alters surgical decision making	academic medical center included: attending physician(s) from acute care surgery (n=1) and abdominal radiology (n=1-3); chief surgical resident (n=1); abdominal radiology fellows (n=1-2); acute care surgery residents (n=2-4); radiology residents (n=1-2); acute care surgery PAs (n=1-2); medical students (n=1-3) Patients were reviewed (n=100) during multidisciplinary meetings (n=21)		- Team communications and collaboration	cases selected by surgeons - Semi-weekly, ~60 minute-long, rounds between radiologists and acute care surgeons focused on promoting targeted, in person collaboration - RADPEER interradiologist concordance scores were assigned to all reviewed examinations. - Impression and plan of the attending surgeon were recorded before and after each in-person review	- Promotion of a SMM between acute care surgical team and abdominal radiologists cited as primary mechanism driving substantial and frequent changes in patient management - SMM facilitates exchange of complex information related to patient management within the multidisciplinary team	
Duthie (2014) ²⁶	Empirical (Qualitative)	To present a case analysis of cognitive under-specification (CU) in 2 instances of unintended communication outcomes	IP, inpatient clinical teams from 2 large academic medical centers, included medical residents	N/A	Focus on Teamwork: - Team communications SMM as Expected Outcome: - Prevention of SMM development may result from incomplete communications between providers where a knowledge gap is bridged with mismatching information	- Applied Reason's human error theory and Dekker's theory of human incident investigation to case analyses of CU errors	Findings related to SMMs: - Contributing factors to CU include: workload, interruptions, inexperience, and lack of a SMM

Garbee (2013) ³⁷	Program (Curriculum) + Empirical (Quantitative)	To evaluate efficacy and retention of teaching team-based competencies to interprofessional (IP) student teams using high-fidelity patient simulation	IP teams for Fall 2009 training (n=35 students); training was repeated in Spring 2010 (n=25 students) Teams consisted of medical (n=2), nursing (n=2), nurse anesthesia (n=2) and physical therapy (n=1-2) students from a health sciences training center	Teamwork Curricula/ Training During each training session, student teams participated in two simulated inpatient cases (ICU-based) and debrief post-case	Focus on Teamwork: - SMM is characterized by authors as a team competency SMM as Design Principle: - SMMs were focus of post-case, structured debriefing SMM as Expected Outcome: - SMM is characterized as one of nine "key team-based competencies"	- Pre-post-test design; data collected for Fall and Spring sessions from trained observers and participants SMM Measurement: - Individual and team performance rated by participants and observers using: Teamwork Assessment Scale (TAS), a Likert-style survey to measure overall teamwork (includes team based behaviors scale and overall teamwork scale (with subscales for SMM (3-items) and communication (3 items)) - Separate Communication and Teamwork Skills (CATS) assessment tool was also used	Findings related to SMMs: - SMM subscale scores, as rated by both participants and trained observers (using paired samples t-tests) improved significantly from simulation scenario one to two in both Fall and Spring simulation sessions - Significant increases in mean participant and observer SMM scores between Fall simulation one and Spring simulation two showed an overall training gain
Gonzalo (2014) ²⁷	Empirical (Mixed-methods)	To measure provider differences in perception of quality and safety issues during "off hours" in medicine units	IP, "off hours care team" in an Inpatient medicine unit in an academic medical center including: attending physicians (n=25), housestaff (residents, medical interns) (n=71 completed survey; n= 5 for debriefings), nurses (n=64)	N/A	Focus on Taskwork: - Off-hours care delivery SMM as Pre-requisite for Effective Teamwork and Expected Outcome: - Development of a SMM related to quality and safety issues in off-hours care delivery may facilitate quality improvement	- Thematic analysis of housestaff debriefs enabled development of Likert survey to measure provider perceptions of quality and safety issues during "off hours" Measurement: - Survey measured average ratings compared, significant differences between groups reported	Findings related to SMMs: - Team members lacked a SMM of off-hours care delivery - ED transfers and timeliness of consults contributed to poorly developed SMM
Hicks (2008) ²⁸	Empirical (Mixed-methods)	To develop and administer a	IP, EM clinicians from two	Teamwork Curricula/ Training			Findings related to SMMs:

		needs assessment survey to measure attitudes towards CRM-based training amongst Emergency Medicine (EM) clinicians	academic teaching hospitals including: EM staff physicians (n= 35), nurses (n=19), and EM residents (n=30)	- Propose CRM-based EM training with interdisciplinary focus to improve EM resuscitation team performance	SMM as Expected Outcome: - Propose CRM-based EM training with interdisciplinary focus; recommended team training to improve communication, collaboration and increase SMM of resuscitation processes across team	- Web-based, 22-item survey developed and administered to measure the attitudes importance of CRM behaviors in team resuscitation; descriptive statistics were calculated and a two-tailed Fischer's exact test was used to examine associations - Survey data to be used to develop an interdisciplinary, CRM curriculum	- Findings do not make a clear connection to SMMs, but survey results demonstrated clinicians' consensus regarding importance of core CRM principles in emergency department resuscitation (i.e., effective communication, team leadership, resource utilization, problem solving and situational awareness, but not specifically SMMs)
Janss (2012) ¹⁷	Summary + Conceptual (Framework for medical action team dynamics)	To review social psychology and organizational behavior literature to develop framework for understanding team dynamics in ad hoc medical action teams	IP, ad hoc Medical action teams (e.g., trauma, OR, etc.) including Junior medical residents	N/A	SMM as Expected Outcome: - Checklists (one for preop briefing focused on task/procedures; one focused on team member characteristics) could support SMM development	N/A	Findings related to SMMs: - Findings do not make a clear connection to SMMs Other key findings: - Power and conflict strongly influence team behaviors and dynamics
Leykum (2014) ³⁰	Program (Communication tool)	To describe the development and pilot test plans for a structured communication tool to improve inpatient rounds	Inpatient physician teams including medical attendings and medical residents	Teamwork Supportive Tool: - Introduced PRISm (Physician Relationships, Improvement and Sensemaking) structured communication tool (pre- and post- round	SMM as Expected Outcome: - PRISm tool may support development of SMM of treatment plans - SMM may extend beyond physician team to	Measurement (planned): - Proposed assessment of PRISm usage and physician team outcomes will occur via observations, field notes, surveys, and attending feedback	- No research findings were presented

briefings, structured discussions)
 - Authors propose use of “PRISm” tool and outline plans to implement the PRISm intervention on 8 inpatient medical and surgical teams

other providers, patients, caregivers

Mamykina (2014) ¹⁸	Summary (Book chapter with literature review) + Empirical (Mixed-methods)	To investigate and measure development of SMMs in critical care setting	IP, critical care ICU teams at a large urban medical center were observed and in-depth interviews were conducted w/ a nurse, medical residents (n=2), and a medical fellow	N/A	Focus on Taskwork: - SMM construct applied to ICU handoffs SMM as Expected Outcome: - Rounds expected to align team members' MM around taskwork	SMM Measurement: - Qualitative analysis of transcripts from interviews, observations, audio recordings of handoffs - SMM Index (numeric value between 0-1 signifying extent of overlap across team members) was assigned to segments of conversation - SMMs during handoffs measured by focusing on handoffs related to a single patient over 3 days	Findings related to SMMs: - Rounds support alignment of team member MMs around taskwork (i.e., patient care in ICU) and handoffs facilitate information integration, supporting coherent SMM development with respect to patient care - Disruptions in SMM continuity can be attributed to transitions of care
Mamykina (2016) ²²	Empirical (Mixed-methods)	To examine a mixed-methods approach for analyzing handoff from the perspective of patient care teams	IP, CTICU teams at a large urban medical center were observed and recorded during handoffs; teams included: an attending, a fellow, a resident,	N/A	Focus on Taskwork: - SMM construct applied to CTICU handoffs in an overlap analysis		Findings related to SMMs: - SMM Index calculations showed higher degree of overlap for statements concerned with patient presentation and statements referring to the past

a PA or NP and a bedside nurse

SMM Measurement:
 - Qualitative analysis of transcripts from recorded observations of verbal handoffs
 - Patterns related to temporal frame and clinical content were identified using categorical cluster analysis
 - SMM Index (numeric value between 0-1 signifying extent of overlap across team members' statements) was assigned to segments of conversation

- Team coherence was positively associated with SMM Index

 Other key findings:
 -Temporal focus of handoff often determined by role of clinician handing off

McComb (2015) ¹⁹	Empirical (Quantitative)	To develop and administer a survey to examine SMMs and mutual trust among nurses and physicians working in GM units	IP, GM clinical team members from an urban teaching medical center; participants included: nurses (n=37) and doctors (n=42) {Note: medical residents were "majority of respondents"}	N/A	Focus on Teamwork: - SMMs, mutual trust viewed as coordinating mechanisms facilitating teamwork and impacting patient safety - Focus of survey is to analyze SMMs of nurses and physicians related to professional roles and responsibilities SMM as Pre-requisite for Effective Teamwork	SMM Measurement: -SMM/Mutual Trust questionnaire, a 7 point Likert scale survey, was developed and administered - Respondents indicated which professional they felt was responsible for each role, rated perceptions of cross-discipline interactions - Statistical comparison of ratings followed	Findings related to SMMs: - In 14 out of 22 mental models regarding role responsibilities, nurses and physicians report significant differences in perception; no significant differences were noted for the remaining 8 mental models
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Nakarada-Kordic (2016) ²³	Empirical (Quantitative)	To explore the similarity of MMs of task sequence and responsibility for task within multidisciplinary OR teams using surgical simulations	IP, OR clinical team members from two teaching hospitals; (n=20, 6-person teams) where each team included: a consultant and junior surgeon (surgical subteam); a consultant anesthetist or senior anesthetic fellow (anesthetic subteam); two nurses (nursing subteam) {Note: team members had worked together previously in their ORs}	N/A	Focus on Taskwork: - SMM construct applied to OR task sequence Focus on Teamwork: - SMM construct applied to task responsibilities of OR subteams	SMM Measurement: - Using a computer-based card-sorting tool (“Momento”), individuals sorted 20 key tasks by sequence and by subteam responsibility for task prior to commencing each simulation (card sorts and simulations were completed for two laparotomy-related scenarios) - Similarity of SMMs measured by pairwise comparisons of scores within each OR teams and subteam; mean similarity scores were calculated for each task - Accuracy not measured	Findings related to SMMs: - For laparotomy simulations, OR team members’ MMs were similar with respect to task sequence - Poor agreement b/w OR team members’ MMs related to subteam responsibility was observed for half of the tasks
O’Connor (2016) ²⁴	Empirical (Mixed-methods)	To collect and analyze examples of poor teamwork between junior doctors (interns) and nurses working in GM units; identify the failures in teamwork that contributed to poor teamwork; ascertain if specific types of teamwork failures are associated with higher levels of risk to patients	First year interns (n=28) and nurses (n=8) working in the inpatient setting from two teaching hospitals; (n=33) scenarios were coded	N/A	Focus on Teamwork: - Lack of SMM associated with high-risk Teamwork failures SMM as Pre-requisite for Effective Teamwork	- Critical Incident Technique interviews were conducted, focusing on a recent challenging incident where interns and nurses had failed to work effectively as a team - Interview transcripts coded by aspects of poor teamwork (poor quality of collaboration; lack of coordination; lack of SMMs; poor communication; poor leadership) as well as potential risk to patients	Findings related to SMMs: - Lack of SMM and poor communication between interns and nurses were significantly associated with high-levels of potential risk to patients, relative to medium risk scenarios <hr/> Other key findings: - The majority of teamwork failures were related to “poor quality of collaboration” (63.6%); and “lack of coordination” and “poor leadership” were also common causes of teamwork failure (48.5% and 42.4%, respectively)

Reader (2009) ³¹	Summary + Conceptual (Framework for ICU team performance)	To review the literature on relationship between teamwork and patient outcomes in ICU settings and to develop ICU team performance framework	IP ICU teams; Residents and Fellows mentioned as part of the ICU team	N/A	SMM as Pre-requisite for Effective Teamwork: - SMMs discussed as an integral part of team coordination processes, where plans are “cross-checked” to ensure SMM development around task	- Literature search followed by extraction of data related to teamwork behaviors associated with patient or staff-related outcomes	Findings related to SMMs: - Findings do not make a clear connection to SMMs <hr/> Other key findings: - Authors propose model of ICU performance focusing on inputs (team, task, leader), processes (team communication, leadership, coordination, decision making) and outcomes (patient, team outcomes)
Senette (2013) ³⁸	Empirical (Mixed methods)	To investigate use of simulation as a teaching and learning strategy to support handoff communication and teamwork	IP teams (n=4-5 students/ team) of nursing students (n=13) and paramedic students (n=13) from two community campuses	N/A	Focus on Taskwork and Teamwork: -Simulations to support handoffs and team communications	- Quasi-experimental, 2-group, post-test design Measurements: - Attitude Toward Collaboration Survey measured collaborative learning attitudes, intent to collaborate, preferred teamwork and communication strategies - Qualitative content analysis of open-ended questions used to assess perceived benefits, challenges of this IP simulation	Findings related to SMMs: - Divergent MMs related to patient status were identified as a theme in qualitative analysis <hr/> Other key findings: - High degree of satisfaction regarding simulation, strong intention to use collaborative strategies in practice; striking differences in some preferences for teamwork and collaboration were revealed (e.g., nursing students preferred SBAR >10:1 over paramedic students)
Thomas (2006) ³²	Empirical (Quantitative)	To measure frequency of team behaviors during delivery room care and explore relationship between behaviors and care quality	IP, neonatal resuscitation teams in a large, urban teaching hospital; teams included at least 2 providers (generally, Pediatric medical residents and neonatal nurses);	N/A		Measurements: - Using videos of neonatal resuscitations, raters assessed frequency of 10 teamwork behaviors, compliance with neonatal resuscitation guidelines and quality of care	Findings related to SMMs: - Findings do not make a clear connection to SMMs <hr/> Other key findings: - Teamwork behaviors generally related to neonatal resuscitation guidelines and quality of care

			in high risk resuscitations, faculty, pediatric fellows, respiratory therapists joined (n=132 videos, 118 unique teams)				- Leadership was observed < 20% of the time
Tourgeman-Bashkin (2010) ²¹	Empirical (Qualitative)	To examine how ICU clinicians evaluate potential severity of Almost Adverse Events (AAEs)	IP, critical care teams from both a Neonatal ICU (NICU) and PICU in a large medical center; NICU teams included nurses, senior physicians; PICU teams included nurses, senior physicians; a pediatric critical care fellow and pediatric resident	N/A	SMM as Pre-requisite for Effective Teamwork and Expected Outcome: - Sharing of relevant information amongst clinicians can help promote SMM development and lead to more efficient team communications, improved performance	- Both ICUs were observed for 500 hrs. Measurements: - AAEs (n=114) rated independently and anonymously by 5 staff (senior nurses and physicians) using 3 point severity scale	- Low levels of rater agreement observed between clinicians in both ICUs - Agreement significantly greater among nurses than physicians
Weller (2014) ³³	Summary + Program (7-point plan for effective teams)	To describe features of effective teams, discuss evidence of information sharing amongst team members, categorize IP teamwork and communication challenges and to propose a plan for effective health care team communication	IP, hospital-based teams; Medical students, medical residents and junior doctors; learners from other health professions were referred to in general terms	N/A	SMM as Pre-requisite for Effective Teamwork and Expected Outcome: - SMMs posited to be critical for effective teamwork - Sharing information is a “fundamental requirement” for developing SMM - Structured briefings and verbalizations	N/A	- Team information sharing can be promoted by: teaching effective communication strategies, training teams together, using simulations in training, defining an inclusive team, creating a democratic team ethos, using protocols to support teamwork and developing a supportive culture

					(observations and decision-making processes) promote SMM development amongst team members		
Weller (2011) ³⁶	Empirical (Qualitative)	To understand the nature of interactions, activities and issues facing new graduates from medicine and nursing in order to inform and improve IP collaboration interventions	Junior doctors (n= 13) and junior nurses (n=12)(both recent graduates) who had hospital-based work experience	N/A	SMM as Expected Outcome: -Sharing patient information is a way to build SMMs and shared priorities are viewed as evidence of SMMs regarding the clinical situation - SMMs between clinicians may be supported through formal processes of information sharing and IP education focused on experience, capabilities and knowledge of multiple health professionals	- Interviews were conducted focused on exploration of IP work experiences Measurements: - Data were coded thematically using a framework of healthcare team function including: collaboration quality, SMMs, team coordination and communication environment	Findings related to SMMs: -Findings do not make a clear connection to SMMs <hr/> Other key findings: - Mutual respect was evident, but organizational structures were seen to limit establishment of professional relationships - Information sharing and agreement regarding goals were keys to good decision-making; could be hindered by environment, differing professional perspectives - Participants saw themselves as having complementary, non-competitive roles
Wu (2011) ³⁴	Conceptual (Design process)	To describe the early design process of an interactive cognitive aid for anesthesia crisis care teams	IP, anesthesia crisis care team in a simulation center in a large urban teaching hospital; teams included simulation staff (n=3-4), anesthesia residents (n=2)	Teamwork Supportive Tool: Authors propose design of a coordinated, interactive system comprised of large screen display (projecting checklist, vitals) with tablet for data input	SMM as Design Principle: - Authors use SMM construct as a design principle for their proposed cognitive aid - Highlight utility of display to prompt team dialogue and	Measurement: - Gaze analysis of separate training videos allowed quantification of demands on attention, time	Findings related to SMMs: - Findings do not make a clear connection to SMMs <hr/> Other key findings: - Delays/failures of information transfer, patterns of attention and checklist use were noted

-Six crisis care scenarios were conducted with simulation center staff; resident anesthesiologists observed

promote development of a SMM

SMM as Expected Outcome:
- SMM of the crisis across team members

Xie (2015) ²⁰	Empirical (Mixed-methods)	To promote Human Factors Engineering principles, including Participatory ergonomics in redesign of family centered rounds (FCR) and implement FCR checklist to promote	IP, inpatient care teams, including a heme/onc and hospitalist service, at a large children's hospital; intervention implementation team included: Researcher (n=5), a parent representative, nurse managers (n=2), nurses (n=2), attending physicians (n=2), senior medical residents (n=2)	Teamwork Supportive Tool: FCR process was redesigned and a checklist was developed to support rounds; FCR checklist use was implemented	SMM as Design Principle: - Authors used SMM as a design principle for development of the content of FCR checklist	- Participatory ergonomics approach (where workers are encouraged to engage in design of workplace interventions) included gathering of multiple stakeholder groups to form intervention team (IIT) - IIT designed intervention to improve family engagement in FCR - Observational, interview and survey data used to design an intervention including a FCR checklist that was piloted and evaluated via observations	Findings related to SMMs: - Findings do not make a clear connection to SMMs
					SMM as Expected Outcome: - Intent of FCR checklist is to develop SMM of rounds process among team members, patients and families		Other key findings: - Survey data demonstrated consistently high satisfaction with IIT process and FCR checklist trainings were well-received - Observations of FCR checklist usage demonstrated very high, but inconsistent usage of some items, prompting addition of a "tips" section

^a Article categories included: (1) Program: An educational program, curriculum, or tool is described. No data or analysis is included. (2) Empirical: A quantitative, qualitative, or mixed-methods research study is described. Data and analysis are included. (3) Conceptual: A framework or model related to the concept of a SMM is provided. (4) Opinion/Position: Thoughts about SMMs in the context of clinical learning are shared. No research or program development is presented. (5) Summary: A review of existing literature or research is described. (6) Other: Abstracts or poster presentations are described.^{22,23}

^b Though the term team mental model is specific to shared/overlapping mental models amongst team members, the term shared mental models is the most frequently used in the health professions literature. Therefore, the terminology used in each article is reflected in the table.