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Systematic overview of reviews of instruments that evaluate teamwork in healthcare

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Abstract

Healthcare professionals working in teams is necessary, since good teamwork among healthcare professionals has been found to improve patient outcomes and reduce burnout. Surveys provide a quick and efficient way to capture the various constructs of teamwork to understand team functioning, areas of strength, and the potential areas for improvement. However, not all surveys are useful as majority of them remain to be validated. In this research, a systematic overview of reviews is conducted to identify robust instruments that are frequently identified in the literature. The databases searched include MEDLINE, EMBASE, CINAHL, and PsycINFO. After excluding duplicates and irrelevant articles, there were 15 articles that met the inclusion criteria for full assessment. Surveys appropriate for measuring teamwork in various healthcare settings were reported. It was determined there were seven surveys that were validated and most frequently identified in the literature. This overview provides a narrative for researchers and clinicians in deciding on instruments that is most appropriate for their goals and practice. More research is required to develop surveys that include involving patients as part of the healthcare team.

Keywords

Healthcare teams, interprofessional collaboration, surveys, instruments, systematic review

Summary for Lay Audience

Research has found that when healthcare professionals work as a team, there is increased patient outcomes and reduces burnout among healthcare professionals. In hopes to understand how effective teamwork functions, surveys have been developed. These surveys include various dimensions of teamwork and may provide insight to understanding high-performing healthcare teams. However, a problem that has risen over the years is that too many surveys have been created. Majority of these surveys lack rigorous testing to determine its usability. Therefore, this current study aims to do a systematic search and identify surveys that are used frequently and have been rigorously tested. It was determined that there were 16 different surveys that are commonly used throughout different healthcare settings. This study provides a guidance for researchers and clinicians and identify the most appropriate survey for its context. By evaluating and identifying areas for improvement, patient outcomes can also be improved.

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Chapter 1 – Introduction

1.1 Interprofessional Collaboration in Healthcare

As healthcare costs continue to rise every year, the demand for healthcare professionals to do more with fewer resources is increasing (Palumbo, 2017; Rosser, Colwill, Kasperski, & Wilson, 2011). To manage this demand, healthcare professionals must work collaboratively to provide efficient and high-quality care to patients. One such organization that has transitioned to a collaborative, patient-centered model of care is the Ontario Ministry of Health and Long-term Care by establishing Family Health Teams (FHTs) (Rosser, Colwill, Kasperski, & Wilson, 2011). This initiative began in 2005, and by 2014 there were over 200 FHTs serving approximately 22% of the provincial population (Hutchison & Glazier, 2013). Collaboration is also strongly encouraged within acute hospital settings including emergency departments, operating rooms, neonatal resuscitation teams, etc. Albeit collaboration can provide great benefits to patients, it is imperfect. International reports such as the National Health Services, Institute of Medicine, and The Joint Commission report that human factors such as communication and teamwork often play a major role in adverse events (Bosch & Mansell, 2015; Kaiser, Bartz, Neugebauer, Pietsch, & Pieper, 2018). Reviews and reports consistently find that miscommunication and lack of teamwork are among the top contributors to medical errors (Weller, Boyd, & Cumin, 2014). An analysis of closed malpractice claims determined that 31% of adverse events were attributable to communication problems (Wallace, Lowry, Smith, & Fahey, 2013). A national review, conducted by the Joint Commission, found that over two-thirds of obstetric emergencies where the infant died or had severe brain damage were attributed to human factors and miscommunication (Horbar et al., 2001). Similarly, a recent review

demonstrated that up to 40% of all pregnancy-related maternal deaths were potentially preventable (Berg et al., 2005). With costs continuing to rise with limited resources, it is more important than ever to be able to properly measure the performance of these healthcare teams and identify successful models and implement them to provide the best quality of care to patients.

1.2 Measurement of Interprofessional Collaboration

Despite the overwhelming evidence of benefits of effective teamwork, measuring teamwork performance has been difficult (Weller, Boyd, & Cumin, 2014). Understanding the reason *why* a team is not effective has been particularly challenging (O'Leary, Sehgal, Terrell, & Williams, 2012). One simple way researchers have measured teamwork performance is through measuring patient outcomes by observing medical errors, length of stay, mortality rates, and number of medications prescribed (Lemieux-Charles & McGuire, 2006). These metrics are commonly used in randomized controlled studies to understand whether a teamwork intervention had an impact to patient outcome (Reeves, Pelone, Harrison, Goldman, & Zwarenstein, 2017). This provides an overview of how well a healthcare team is doing, but it provides no explanation as to *why* it is doing well or not doing so well. Other methods have included focus groups, interviews, and case studies to comprehensively understand the functions and structure of a team to gain insight about the dimensions of teamwork that work for that particular team (Salas et al., 2008). This method, however, is time intensive and may take a significant amount of resources to conduct the research (Evanoff et al., 2005). A more efficient method of collecting data is by providing instruments such as surveys to the members of a healthcare team (O'Leary, Sehgal, Terrell, & Williams, 2012). These instruments generally ask about their communication,

cohesion, role clarity, and other dimensions related to effective teamwork to understand team performance.

1.3 Research Goals

Over recent years, many instruments have been created mostly by researchers in hopes of measuring teamwork performance in healthcare. Since many instruments have varying psychometric validity (Valentine, Nembhard, & Edmondson, 2015), this research examines systematic reviews specifically to identify instruments that measure teamwork in healthcare teams. By only reviewing systematic reviews, which are arguably the highest level evidence, robust instruments can be identified (Murad, Asi, Alsawas, & Alahdab, 2016). The goal of this research is to conduct a systematic overview of reviews to identify robust instruments and create an overview of the properties and limitations of the instruments. Given that there are many existing instruments in the literature, it is important to identify and determine their usability, limitations, and theoretical underpinnings of each instrument so that researchers and clinicians can choose the instrument that is most appropriate for their research/practice.

1.4 Significance of Research

The outcomes of the research will provide an overview of the most robust instruments used to measure teamwork in a variety of healthcare settings. This will provide a guidance for clinicians and researchers to easily navigate the literature and identify an instrument that best fit with their healthcare setting and/or goals. This will allow healthcare teams the ability to monitor their team performance, recognize their successes, and identify areas needing improvement. Ultimately, improving teamwork will ensure patient care is also improved as a result.

1.5 Structure of the Thesis

This chapter provided an overview of the thesis including research goals and objectives. Chapter 2 will provide a literature review relevant to interprofessional collaboration and instruments that measure teamwork performance. Chapter 3 will discuss the methodology and methods used to guide the research. In chapter 4, I discuss the findings and provide an overview of the instruments that measure interprofessional collaboration. In chapter 5, the thesis ends with a discussion of interpretations of the findings, current gaps in the literature, strengths and limitations of the research, implications for practice, and recommendation for future research.

Chapter 2 – Literature Review

In this literature review, I address the current topics of interprofessional collaboration and the evaluation of teamwork in healthcare teams. I further discuss the different methods of evaluating teamwork and the existing systematic reviews that aim to summarize the existing surveys.

2.1 What is Interprofessional Collaboration?

Interprofessional collaboration can be defined as "partnership between a team of health providers and a client in a participatory collaborative and coordinated approach to shared decision making around health and social issues" (Bridges, Davidson, Odegard, Maki, & Tomkowiak, 2011). Collaborative practice promotes communication and decision making, enables synergistic influence of grouped knowledge and skills (Hall, 2005). Dimensions of collaborative practice include cooperation, assertiveness, autonomy, responsibility, accountability, coordination, communication, and mutual trust and respect (Schroder et al., 2011). The group of healthcare professionals work toward a common goal to improve patient outcome. It involves frequent interactions between healthcare professionals by sharing values and expertise from different professions and contributing to patient care (Reeves, 2010). Interprofessional collaborative practice is an enabler for improving patient care and meeting the current demands placed on the healthcare system (Lemieux Charles & McGuire, 2006). This approach to healthcare has been found to reduce errors, improve quality of care and patient outcomes, reduce healthcare workloads and cost, and increase job satisfaction and retention (Boult et al., 2001; Buist et al., 2002; Langhorne & Duncan, 2001; Morey et al., 2002).

Multi-disciplinary and collaboration is best described as a coordinated approach to overall health management where the interdisciplinary mix of professionals work together frequently but are not necessarily co-located (Lemieux Charles & McGuire, 2006). Teams and groups are seen in multitude of sectors including primary care and in hospitals. In essence, teamwork is defined as a group of healthcare providers that provide a coordinated care to patients. As such, individuals can come from different sectors within the healthcare system and different professions. Teams can also be as simple as the mix of healthcare providers within the same operating room performing a surgery on a patient. Regardless of where teams are comprised of, great coordination among healthcare teams provide improved patient outcomes (Litaker et al., 2003).

2.2 Types and Context of Healthcare Teams

There have been several classifications of teams within healthcare proposed by various researchers. Sundstrom et al. (1990) proposed four categories: (a) advice and involvement teams, (b) production and service teams, (c) project and development teams, and (d) action and negotiation teams. Advice and involvement teams are administrative staffs that are involved in policy changes to improve healthcare practice. Production and service teams include all clinical teams and it is within this category where instruments aim to measure teamwork performance. Project and development teams are those that are responsible for implementing electronic health records and other information technology developments. Action and negotiation teams are executives of the organization that brings about system level coordination or merger with other organizations. Although Babiker et al. (2014) use similar concepts when defining healthcare teams, they have revised the classification system that better reflects our current healthcare

system: (a) core teams, (b) coordinating team, (c) contingency teams, (d) ancillary teams/services, (e) support services and administration. Core teams include healthcare professionals that are directly in contact with and provide clinical care to patients. Coordinating teams include administrative staffs that provide operational management, coordination functions and resource management for the core teams. In an event where a group of healthcare professionals collaborate from an emergency (cardiac arrest, hospital action teams, etc.) is called a contingency team. In other words, contingency teams are comprised of various healthcare professionals that come to aid a patient in an emergency manner. Ancillary teams/services are support staffs that facilitate patient care by organizing the hospital's policies and procedures. Support services and administration team include executives that are responsible for the operations of the organizations.

2.2 Dimensions of Teamwork

Dimensions of strong teamwork are identified in the literature as having clear purpose, good communication, co-ordination, effective protocols and procedures, psychological safety, leadership, and even non-technical skills such as situational awareness (Schroder et al., 2011). Although there are many different dimensions proposed as to what makes a good team, there is no clear consensus (Valentine et al. 2013). For example, Edmondson (1999) proposes that psychological safety, the feeling that an individual can speak their mind and not feel judged, is one of the most important factors as to determine whether a team is performing well or not. Salas et al. (2005), on the other hand proposed five constructs that contribute to effective teamwork: leadership, mutual performance monitoring, backup behaviour, adaptability, and team orientation (See table 1). Nevertheless, great teams are adaptable to changing conditions and members of the

team have faith in their ability to solve problems and are positive about their activities (O'Leary, Sehgal, Terrell, & Williams, 2012). They can determine which areas they lack and identify areas for improvement. Since great teams are able to identify areas for improvement, resources can be carefully spent. Effective teams are evidently clear because the results are shown in patient outcomes. Effective teamwork reduces medical errors, provides greater job satisfaction and less feelings of burnout (O'Leary et al., 2010). Responsibility, coordination, cooperation, autonomy, and mutual trust and respect (Baggs, 1994; Weller, Boyd, & Cumin, 2014) are also commonly reported among effective collaborative practices. Other sources identify shared decision-making and conflict management in effective teamwork (Gibb et al., 2002; Weller, Boyd, & Cumin, 2014), which is described as a balance between the ability to be assertive and cooperative (O'Leary, Sehgal, Terrell, & Williams, 2012).

Table 1. Dimensions of teamwork proposed by Salas et al. (2005)

Teamwork	Definition	Behavioural Examples
Team Leadership	The leader directs and coordinates team members activities	Facilitate team problem solving; Provide performance expectations; Clarify team member roles; Assist in conflict resolution
Mutual performance monitoring	Team members are able to monitor one another's performance	Identify mistakes and lapses in other team member actions; Provide feedback to fellow team members to facilitate self-correction
Backup behavior	Team members anticipate and respond to one another's needs	Recognize workload distribution problem;

		Shift work responsibilities to underutilized members
Adaptability	The team adjusts strategies based on new information	Identify cues that change has occurred and develop plan to deal with changes; Remain vigilant to change in internal and external environment
Team orientation	Team members prioritize team goals above individual goals	Take into account alternate solutions by teammates; Increased task involvement, information sharing, and participatory goal setting

Some authors have proposed the importance of non-technical skills in healthcare on the assumption that these skills are important in providing good quality of care to patients (Steinemann et al., 2012). Non-technical skills can be defined as "the cognitive, social, and personal resource skills that complement technical skills, and contribute to safe and efficient task performance" (Cooke et al., 2015; Steinemann et al., 2012). In essence, they enhance workers' technical skills, and typically include situation awareness, decision-making, teamwork, leadership, and the management of stress and fatigue (O'Leary, Sehgal, Terrell, & Williams, 2012). Deficiencies in non-technical skills can increase the chance of error, which in turn can increase the chance of an adverse event. Good non-technical skills (e.g. vigilance, anticipation, clear communication, team coordination) can reduce the likelihood of error and consequently of accidents by providing a coordinated approach and thereby delivering high quality care.

2.3 Obstacles to Teamwork

Many authors agree that the greatest obstacle to teamwork is arguably the hierarchical culture of healthcare (Lemieux-Charles & McGuire, 2006). Historical power structures can sabotage the essence of what teamwork is (Thomas, Sexton, & Helmreich, 2003). Providers need to address their personal power issues, adopt common goals, break down hierarchies and then educate patients about how each team member contributes to their care (Makary et al., 2006). Edmondson found that the best teams are not a group of elites, but rather a cohesive unit that admitted to medical errors (Edmondson, 1999). Other forms of barriers to effective teamwork include the current malpractice and liability laws and funding and remuneration models (O'Leary et al., 2010). These discourage and deter the establishment of teams. For instance, current malpractice legislation places responsibility solely on individuals, namely those that carry the responsibility of potential liability, rather than teams (O'Leary et al., 2010). Regulations that support teamwork, on the other hand, would refocus this "culture of blame" to a culture of patient safety and risk management (O'Leary, Johnson, & Auerbach, 2016). Much work needs to be done to clarify the accountability for non-physician team members in performing shared tasks. As for remuneration models, traditional fee-for-service payment systems for physicians impede movement toward collaborative care. There needs to be better financial incentives that tie funding to collaboration and teamwork efforts (Blumenthal, Song, Jena, & Ferris, 2013; Ratto, Propper, & Burgess, 2002)

Barriers to teamwork can also exist in hospitals because of its structure of the organization (O'Leary, Johnson, & Auerbach, 2016). Teams are large and formed in an ad hoc fashion. A team is generally comprised of multiple different healthcare professionals. Team members in each respective discipline care for multiple patients at the same time, yet few

hospitals align team membership. Therefore, a nurse caring for four patients may interact with four different physicians. Similarly, a physician caring for numerous patients may interact with multiple nurses in a given day (Sexton, Thomas, & Helmreich, 2000). Team membership is ever changing because hospital professionals work in shifts and rotations. Finally, team members are seldom in the same place at the same time because physicians often care for patients on multiple units and floors, while nurses and other team members are often unit-based. Salas and others have noted that team size, instability, and geographic dispersion of membership serve as important barriers to improving teamwork (Salas et al., 2008). As a result of these barriers, nurses and physicians do not communicate consistently, and often disagree on the daily plan of care for their patients. When communication does occur, clinicians may overestimate how well their messages are understood by other team members, reflecting a phenomenon well known in communication psychology related to egocentric thought processes (Peters, 2016).

The key factors underpinning successful teamwork are:

- Leadership, and having champions who can drive change management processes (O'Leary et al., 2010)
- Clarity regarding roles on the part of all team members (Valentine, Nembhard, & Edmondson, 2015)
- Trust, respect, value, and being valued within the teamwork setting (Schroder et al., 2011)
- Cultural readiness within the workplace, or significant efforts to try to create a culture of acceptance (Edmondson, 1999)

Conversely, the factors that would signal likely failure in implementing collaborative practice include:

- A lack of time to bring people together to reflect and to change (O'Leary et al., 2010)
- Insufficient inter-professional education, including continuing education (Reeves et al., 2010)
- Systems of payment that do not reward collaboration (Blumenthal, Song, Jena, & Ferris, 2013)
- Few links between collaborative practice and individual goals (Ratto, Propper, & Burgess, 2002)

2.4 Evaluating the Functioning of Healthcare Teams

Although there is no strict consensus on how to measure a healthcare team, the most commonly used method is by employing instruments in the form of surveys (Valentine, Nembhard, & Edmondson, 2015). This provides an efficient method of collecting data and the additional benefit is that the data can be easily interpreted (Brinkman et al., 2006). The reason for this is because usually, there are dimensions such as communication, cohesion, and role clarity in the survey, which can provide a score on each of the dimension. This survey is usually used in conjunction with an interprofessional collaboration intervention to measure pre and post evaluation. These scores then can be analyzed using a statistical software to detect any significant changes (Gellis et al., 2019). Other methods have included measuring patient outcome to directly and indirectly interpret how well the team is doing (Lockyer, 2003; Reeves, Pelone, Harrison, Goldman, & Zwarenstein, 2017). For example, length of stay, medical errors, mortality rate, number of prescriptions prescribed, are patient measures that could be used to

assess the performance of healthcare teams (Fletcher et al., 2003; Reeves et al., 2010). The disadvantage is that they provide no explanation as to which areas of teamwork the team is doing well.

Focus groups, interviews, and case studies have also been used to measure teamwork. The benefit of these methods is that it provides a better explanation as to why a certain team is doing well. This, however, is time intensive and may not be practical. As a result, majority employ instruments to measure teamwork. While self-report tools are easy to administer and can capture affective components influencing team performance, they may not reflect actual skills on the part of individuals or teams (O'Leary, Johnson, & Auerbach, 2016). Peer assessment includes the use of 360-degree evaluations or multisource feedback and provides an evaluation of individual performance. Direct observation provides a more accurate assessment of team related behaviors using trained observers. Observers use checklists and/or behaviorally anchored rating scales (BARS) to evaluate individual and team performance (Massagli & Carline, 2007). A number of BARS have been developed and validated for the evaluation of team performance. Of note, direct observation may be difficult in settings in which team members are not co-located at the same time. An alternative method, which may be better suited for general medical units, is the use of survey instruments designed to assess attitudes and teamwork climate (Beaulieu et al., 2014). Importantly, higher survey ratings of collaboration and teamwork have been associated with better patient outcomes in observational studies (Bookey-Bassett, Markle-Reid, Mckey, & Akhtar-Danesh, 2017).

2.5 Can IPC Intervention Improve Patient Outcome?

A systematic review conducted by Reeves et al. (2017) searched various databases and found nine studies in total. All studies were done in high-income countries and had a minimum follow-up period of 12 months. It was noted that patient outcomes can be slightly improved in interprofessional checklists and rounds and in stroke patients when facilitated by interprofessional activities. However, for the majority of the interventions, it was concluded that there was not sufficient evidence to suggest that IPC intervention improve patient outcomes. A similar systematic review was conducted to comprehend patient outcomes in interdisciplinary rounds in hospitals (Bhamidipati et al., 2016). Upon searching various databases, 22 studies were found eligible for full review. It was determined that interdisciplinary rounds can shorten patients' length of stay but could not conclude it had any impact on patient clinical outcomes. However, other studies have shown some positive results to IPC interventions by implementing Structured Interdiscplinary Rounds (SIDRs) (O'Leary et al., 2015). When the medical unit was assessed pre- and post- intervention, it was found that teamwork among the unit improved and reduced adverse events (O'Leary et al., 2015). It is suggested that IPC interventions alone are not enough to improve patient outcomes, but rather, IPC interventions improve teamwork in medical units and thereby indirectly improve patient outcomes (O'Leary, Johnson, & Auerbach, 2016). Furthermore, acclimatisation to teamwork takes time and may require longer periods for the effect of patient outcomes to be revealed (Reeves, Pelone, Harrison, Goldman, & Zwarenstein, 2017). It is recommended a sufficient intervention period and a use of mixed-methods to evaluate teamwork in conjunction with measuring patient clinical outcomes to determine the effect of the interventions.

2.6 Using Surveys to Measure Teamwork

Surveys are commonly used to collect information about a population of interest. There are many different types of surveys, ways to administer them, and methods of sampling (O'Leary, Johnson, & Auerbach, 2016). The survey may include closed-ended questions or open-ended questions. Closed-ended questions include predetermined responses and these responses are usually a Likert scale. A Likert scale usually ranges from "do you strongly disagree" to "do you strongly agree" (Lance, Butts, & Michels, 2006). Closed-ended questions are easier to interpret, manage, and organize and thus are more preferred. Open-ended questions on the other hand ask the respondents to answer each question in their own words. Open-ended responses require more inferencing and interpretation to comprehend the data. The type of surveys primarily used in measuring teamwork in healthcare include closed-ended questions or a mix of closed-ended questions and open-ended questions with the majority of questions being the former (Litwin & Sage Publications, 2003).

2.7 Reliability of Surveys

Before surveys are deemed usable in the scientific community, there are several psychometric properties that should be evaluated. Once these psychometric properties have met the minimum standards, these instruments are then considered validated (Strating & Nieboer, 2009). One of the psychometric properties is called reliability. Reliability refers to the ability of reproducing a consistent result over time and from different users. It is one of the main quality criteria of an instrument. An instrument that has a good reliability is stable, consistent, and accurate (Lance, Butts, & Michels, 2006). A specific kind of reliability is called test-retest reliability, where it measures the consistency of a construct over time. A second class of

reliability is the internal consistency (LeBreton & Senter, 2008). Internal consistency shows whether the questions within the domain of the instrument are actually measuring the domain in question and not something else. This is an important measure of property for surveys that assess single construct. Low internal consistency may indicate that the items in the survey are measuring multiple different constructs and that the survey is inconsistent (LeBreton & Senter, 2008). Most researchers assess internal consistency through Cronbach's alpha coefficient, which demonstrates the covariance level between the items of a scale (Cronbach, 1951). Although there is no exact consensus as to what level of Cronbach's alpha is appropriate, most agree that surveys should not have a value lower than 0.7 (LeBreton & Senter, 2008). Inter-rater reliability is the extent to which different observers are consistent in their judgments (James, Demaree, & Wolf, 1984). Ratings or scores from multiple researchers or observers should be highly correlated with each other (Cronbach, 1951).

2.8 Validity of Surveys

Validity refers to the fact that an instrument measures exactly what it proposes to measure and there are different types of validity measures (DeVellis, 1991; Kelly, O'Malley, Kallen, & Ford, 2005). Face validity is the extent to which a measurement method appears "on its face" to measure the construct of interest. Although face validity can be assessed quantitatively—for example, by having a large sample of people rate a measure in terms of whether it appears to measure what it is intended to—it is usually assessed informally. Face validity is at best a very weak kind of evidence that a measurement method is measuring what it is supposed to (Keszei, Novak, & Streiner, 2010). Content validity refers to how well the instrument reflects the construct that is being measured (Keszei, Novak, & Streiner, 2010).

Criterion validity refers to the extent the measure is related to the outcome (LeBreton & Senter, 2008). This can be further broken down to concurrent and predictive validity. Concurrent validity refers to the measure compared with the outcome at the same time (Kelly, O'Malley, Kallen, & Ford, 2005). Predictive validity, on the other hand, refers to the measure compared with the outcome assessed at a later time (Lance, Butts, & Michels, 2006).

2.9 Purpose

Over the past two decades, given the rising trends of collaborative initiatives within healthcare, there have been many instruments developed to measure teamwork in healthcare. There have been hundreds of different instruments with all varying measures of psychometric properties (Valentine, Nembhard, & Edmondson, 2015). This means that some instruments have been validated, but the majority have not been (Strating & Nieboer, 2009). A pilot search of the literature revealed that there have been many systematic reviews published to organize the existing validated instruments that measure teamwork in healthcare. These systematic reviews searched various bibliographic databases using key words to identify existing instruments that match its specific criteria whether it be for the purpose of identifying specific instruments for their target of healthcare setting or a general all-encompassing healthcare setting (Valentine, Nembhard, & Edmondson, 2015). The systematic reviews that have been recently published, focus on a particular healthcare setting and narrow down validated instruments that could be used to measure teamwork within the appropriate context (Walters, Stern, & Robertson-Malt, 2016). Despite recommendations from different researchers to modify existing surveys instead of creating a new instrument, many researchers still choose to create their own surveys "de novo". Given the overwhelming number of surveys that currently exists coupled with the increasing

pressure to demonstrate value in healthcare, it is now more important than ever to identify surveys that are robust. The goal of this research is to conduct a systematic overview of reviews to identify robust instruments and create an overview of the properties and limitations of the instruments. This will allow healthcare professionals and researchers to easily choose an instrument appropriate for their own practice and context. One way to do this is by searching various databases and conducting a systematic search of the literature.

Chapter 3 – Methods

This chapter describes the methodology and methods used to search the different databases for relevant articles and the data extraction process. This chapter begins by describing the methodology of systematic reviews and systematic overviews and the databases searched. It then describes how articles were extracted and how the study quality was assessed.

3.1 Systematic Reviews of Surveys and Systematic Overviews

A systematic review is a methodological approach to identifying relevant articles in the literature and typically involves a detailed and comprehensive plan and search strategy derived a priori, with the goal of reducing bias by identifying, appraising, and synthesizing all relevant studies on a particular topic (Moher et al. 2009). Often, systematic reviews include a meta-analysis component which involves using statistical techniques to synthesize the data from several studies into a single quantitative estimate or summary effect size (Petticrew & Roberts, 2006). There are generally eight stages to a systematic review (See Appendix E) (Liberati et al., 2009). The first stage is formulating the review question. The second stage is determining the inclusion and exclusion criteria to systematically exclude irrelevant articles. It is also important to operationally define terms and the types of studies to include and determine if there are any language restrictions (Remes Olivia, Brayne Carol, Linde Rianne, & Lafortune Louise, 2016). The third stage is to develop a search strategy using key words and Medical Subject Headings (MeSH) terms to optimize the search. It is highly recommended to use a reference librarian as they are extremely skilled in searching various electronic databases. The next stages include reviewing title and abstracts and reviewing the full article that appear to be relevant (Liberati et al., 2009). This is usually done by at least two reviewers to establish inter-rater reliability

(Liberati et al., 2009). The next stage includes assessing relevant articles using a checklist for study quality and risk of bias. Studies that use meta-analyses then may use various software to run statistical analyses. Qualitative systematic reviews may categorize and organize the findings to interpret the results. The last stage is to disseminate the findings at the Chrocane Collaboration or other relevant journals.

When there are many systematic reviews on one particular topic, the logical next step is to conduct a systematic overview of reviews (Hunt, Pollock, Campbell, Estcourt, & Brunton, 2018). Different names of overview of reviews include, systematic review of systematic reviews, umbrella review, review of reviews, summary of systematic reviews, synthesis of reviews, reviews of systematic reviews, and review of reviews (Hunt, Pollock, Campbell, Estcourt, & Brunton, 2018). All these different names are considered synonyms and employ the same methods. For the purpose of this thesis, the term systematic overview of reviews is used. The intent of this type of research is to include reviews and examine only the highest level of evidence. Systematic reviews are deemed to be at the top of the hierarchy of evidence whereas expert opinions and case reports are deemed to have the lowest level of evidence. Arguably, systematic reviews are least likely to suffer from systematic bias and thereby inform evidence-based practices (Burns, Rohrich, & Chung, 2011). The aim systematic overview of reviews is not to repeat the searches, assess study eligibility, or assess risk of bias from included studies, but rather to provide an overall picture of findings and the current literature of that topic.

3.2 PRISMA

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist was used to guide this systematic overview (Moher et al. 2009). PRISMA is an

evidence-based minimum set of items for reporting in systematic reviews and meta-analyses. PRISMA focuses on the reporting of reviews evaluating randomized trials but can also be used as a basis for reporting systematic reviews of other types of research, particularly evaluations of interventions. It consists of a 27-item checklist (See appendix F) and a four-phase flow diagram. The checklist includes items deemed essential for transparent reporting of a systematic review.

3.3 Literature Search and Data Extraction

A systematic literature search was performed in consultation with a health sciences research librarian to identify relevant reviews of instruments to measure teamwork within a healthcare setting. Literature search strategy used key words that described teamwork such as "team", "interprofessional collaboration", "interprofessional relations [MESH Terms]" with "surveys", "questionnaires", "measurement" and "assess" to search MEDLINE, EMBASE, CINAHL, and PsycINFO databases. The search strategy was adapted to meet the specific requirements of the databases and was limited to only review articles and English-language publications from January 2000 to September 2017 as the majority of systematic reviews have been published since after 2010. When possible, articles published in "review" type format were searched as opposed to the entire directory to increase fidelity and to limit identification of irrelevant articles. Forward and backward searches, which meant searching for articles that have cited a particular article or examining the references to identify what articles it has cited, were done with a review article by Valentine and her colleagues which is one of the first review article in identify instruments related to healthcare teams (Valentine, Nembhard, & Edmondson, 2013). Articles must have contained a review of surveys or instruments used in assessing teamwork in any healthcare setting to be included. All review articles that summarized theories or concepts of

teamwork, or articles that were published within interprofessional education context, were excluded. Once relevant articles were identified, three independent reviewers (HK, CF, RM) read titles and abstracts to narrow down the search. By having multiple iterations of meetings, irrelevant articles were further excluded.

3.4 Assessment of Study Quality

Risk of Bias in Systematic Reviews (ROBIS), which is a new checklist for assessing the risk of bias in systematic reviews, was used in this study. Although ROBIS has three distinct phases in assessing the review, phase 1 was optional and was deemed unnecessary for the purpose of this study. The reason for exclusion was because the purpose of this step was to assess relevance by identifying participants, interventions, comparisons, and outcomes (PICO). Given that this study is a qualitative systematic overview, there are no participants or interventions. Instead, phase 2 and 3 were completed to assess risk of bias. Phase 2 aims to identify areas where bias may be introduced into the systematic review. It involves the assessment of four domains to cover key review processes: study eligibility criteria; identification and selection of studies; data collection and study appraisal; and synthesis and findings. This phase of ROBIS identifies areas of potential concern to help judge overall risk of bias in the final phase. Each domain comprises three sections: information used to support the judgment, signalling questions, and judgment of concern about risk of bias. Each question is answered as “yes”, “probably yes”, “probably no”, “no”, and “no information”. Phase 3 considers whether the systematic review as a whole is at risk of bias. This assessment uses the same structure as the phase 2 domains, including signalling questions and information used to support the judgement, but the judgement regarding concerns about bias is replaced with an

overall judgement of risk of bias. Two independent reviewers (HK and CF) used the checklist for each article. Any discrepancy was discussed and came to a consensus. Furthermore, multiple research team meetings were held to discuss the current state of the study and its next steps and multiple progress reports were given to the research supervisor throughout the study.

3.5 Data Synthesis

After all relevant systematic reviews were identified, following information was extracted into an excel sheet and reported: the purpose of the review, applicable healthcare setting, dimensions of teamwork, search strategy, theoretical framework that guided the search, risk of bias assessment, list of instruments (validated and invalidated). The instruments identified from the reviews were aggregated to create a master list, which detailed the frequency count. Out of pragmatism, most frequently identified surveys were determined by counting the frequency in which the survey has been mentioned in the reviews. Counting the frequency of its references yields good but imperfect measure of robustness (Aksnes, Langfeldt, & Wouters, 2019). It can be argued that citations relate to scientific impact and relevance. Instruments that have been identified four times within the reviews were deemed “robust” for the purpose of this study. Instruments’ psychometric properties, dimensions of teamwork, theoretical underpinnings, number of questions, and its applicability in various healthcare settings were reported. Furthermore, psychometric properties such as, internal consistency, interrater agreement and reliability, and validity, were reported for the selected instruments if the information was available.

Chapter 4 – Results

This chapter describes the findings from included systematic reviews, including the objectives, dimensions of teamwork, the framework or methods of synthesis used to report the findings, and most frequently identified instruments. The most frequently identified instruments are then summarized describing its dimensions of teamwork, number of questions, and its psychometric properties.

4.1 Literature Search Extraction

The database search generated 4209 potentially relevant articles from multiple disciplines including nursing, medicine, and social sciences (See Figure 1). After duplicates were removed, 3177 articles remained. Three independent reviewers read through the title and abstract. After several iterations of meetings, relevant articles were read in its entirety. By having three independent reviewers, inter-rater reliability was established. Vast majority of the articles were excluded because they were not a review article or because they described theories of teamwork without mentioning any list of surveys or instruments. There were 31 potential articles remaining. From the 31 articles, 16 were excluded because the dimensions that guided the review were not relevant to teamwork, failed to expand on details other than conceptual framework of instruments, or instruments were mentioned in interprofessional education context. The remaining 15 review articles reported a list of instruments to a specific context or a healthcare setting within their own purpose of research.

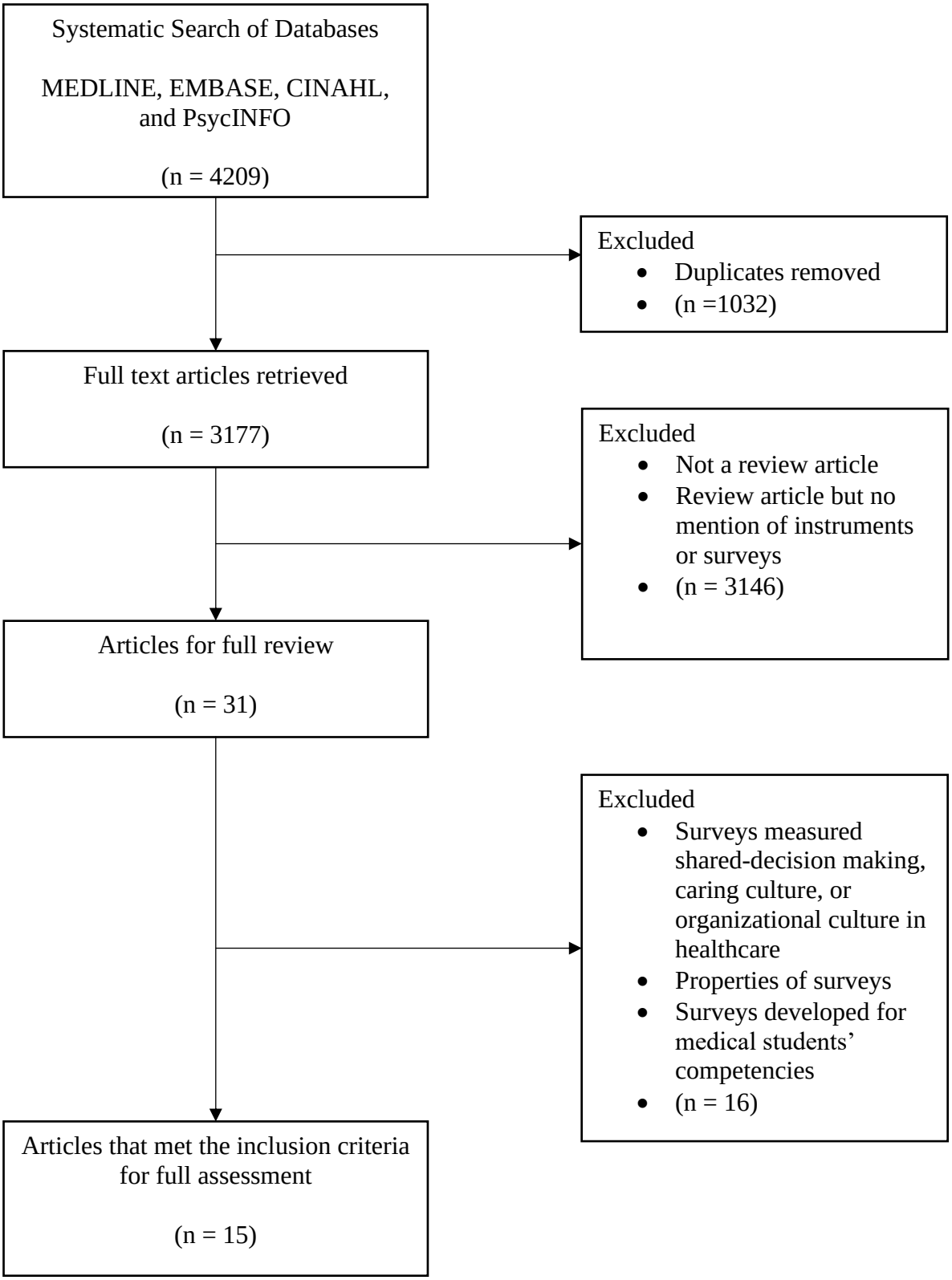

Figure 1. Literature search results.

4.2 Objectives, setting and context of the included review

The objectives of the included articles varied widely. Some articles aimed to identify instruments for a specific healthcare setting whereas other reviews aimed to find all relevant instruments applicable in general healthcare setting. For example, Bookey-Basset et al. (2016) aimed to identify instruments that measure interprofessional collaboration in the context of chronic disease management in community dwelling older adults and determine its strengths and limitations of the instruments that were most appropriate to that specific context. Ultimately, it was noted that no instrument was perfect for that particular setting but identified Collaborative Practice Assessment Tool (CPAT) to be the most appropriate. Other examples included three review articles that aimed to identify instruments that assess team effectiveness in obstetric emergencies (Clary-Muronda & Pope, 2016; Fransen et al., 2017; Onwochei, Halpern, & Balki, 2017). Among the three articles identified, one article primarily looked at instruments appropriate to the measurement of teamwork in neonatal resuscitation teams (Fransen et al., 2017). One article aimed to identify instruments measuring teamwork in surgery (Whittaker, Abboudi, Khan, Dasgupta, & Ahmed, 2015) and another aimed to identify instruments measuring teamwork in internal medicine (Havyer et al., 2014). Two articles by Cooper et al. (2013; 2014) aimed to identify instruments that measure non-technical skills to assess teamwork in medical emergencies. One article aimed to summarize characteristics and validity of evidence of tools that assess teamwork in undergraduate medical education (Havyer et al. 2016). One review article aimed to identify teamwork in healthcare action teams (Rosenman, Ilgen, Shandro, Harper, & Fernandez, 2015). There were five articles that looked at instruments that measure interprofessional collaboration without any specific healthcare setting (Dougherty & Larson,

2005; Jacob, Boshoff, Stanley, Stewart, & Wiles, 2017; Shoemaker et al., 2016; Valentine, Nembhard, & Edmondson, 2015; Walters, Stern, & Robertson-Malt, 2016).

4.3 Dimensions of teamwork identified in the review

Not surprisingly, dimensions of teamwork overlapped across many different reviews. Dimensions that were frequently mentioned were communication, cooperation, coordination, leadership, and situational awareness. Less frequently identified dimensions include use of expertise, conflict management, newly created professional activities, social support, psychological safety, and organization culture. Out of 15 articles, only two articles included "Patient Involvement" as one of the dimensions identified in the review. This reflects a gap in the literature that needs to be addressed because patients were aware of healthcare teamwork, and that patient satisfaction has been recognized as a valuable measure of team performance (Ladonna, et al., 2016).

The dimensions identified in the article is primarily determined by the type of theoretical underpinnings of collaborative practices. For example, the Partnership Self-Assessment tool is based on the partnership synergy framework. The partnership synergy framework measures key indicators for successful collaboration (Weiss, Anderson, & Lasker, 2001). Conversely, the Modified Index of Interdisciplinary Collaboration (MIIC) is based on Bronstein's model of interdisciplinary collaboration (2003). The theoretical perspectives of the model consist of four influences on collaboration: professional role, structural characteristics, personal characteristics and a history of collaboration. Conversely, another well-known instrument called Team Climate Inventory (TCI) is based on four-factor theory of climate for innovation (Anderson & West, 1998). Anderson and West (1998) stated that for individuals to function effectively in a group,

they must interact, share common goals and have sufficient task interdependence to develop shared understandings. Edmondson, on the other hand, puts heavy emphasis on psychological safety as the dimension to measure in understanding teamwork performance (Edmondson, 1999).

4.4 Method of Synthesis/Analysis Employed in the Systematic Reviews

Most of the systematic reviews used the standard PRISMA guidelines to synthesize the data. Others have included using the COSMIN checklist (Consensus-based standards for the selection of health measurement instruments) (Mokkink et al., 2010). COSMIN checklist is a validated tool to assess methodological quality of studies used to construct and validate healthcare measurement instruments. There are different sets of checklists: COSMIN Study Design checklist and COMINS Risk of Bias checklist. Both of these checklists were used. Shoemaker et al. (2016), on the other hand, used the input-process-output framework of team-based primary care (Rydenfält, Odenrick, & Larsson, 2017) to guide the identification and assessment of available measurement instruments. The conceptual framework presents inputs, mediators, and outputs of effective teamwork in primary care. “Inputs” refer to “precursors” or “pre-conditions” that make it possible for teams to exist. “Mediators” are processes that occur within the team. “Outputs” are the results of effective teamwork. Mediators include cognitive (sense-making, continuous learning, shared explicit goals and accountability, and evolving mental models of roles), affective/relational (trust, respectful interactions, heedful inter-relating, and commitment), behavioral (communication, adaptable to context and needs, and conflict resolution), and leadership domains that contribute to effective teamwork. Other guideline used was Oxford Center for Evidence Based Medicine (OCEBM), which is a tool to make the process of finding appropriate evidence feasible and its results explicit and to assess levels of evidence

(Durieux, Vandenput, & Pasleau, 2013). The Social Ecological Model (SEM) was also used to guide the integrative review (Clary-Muronda et al. 2016).

4.5 Assessment of the Study Quality

The systematic reviews included in this review had very low risk of bias assessed by the ROBIS checklist (See Table 2). Each review had clearly defined inclusion/exclusion criteria, the searches were appropriate given that a wide range of databases were searched, and clearly defined what guidelines or models they used to guide the research. Some employed forward and backward searches of leading articles to further search the literature and thereby increase credibility. This allowed optimal level to retrieve as many eligible studies as possible. Most adhered to PRISMA guidelines and other guidelines and risk of bias was reduced by including multiple reviewers to assess the inclusion and exclusion of articles. Emphasizing the results were avoided and critically extracted relevant details as to the validation of the instruments to make proper, non-biased assessments. The synthesis and findings were deemed unclear in Cooper et al. (2010; 2013) because of its low number of articles identified in its initial data search. Because there was a low number of articles identified, it was unclear whether they found all relevant articles.

Table 2. ROBIS Checklist

ARTICLES	DOMAIN 1 STUDY ELIGIBILITY CRITERIA	DOMAIN 2 IDENTIFICATION AND SELECTION OF STUDIES	DOMAIN 3 DATA COLLECTION AND STUDY APPRAISAL	DOMAIN 4 SYNTHESIS AND FINDINGS	RISK OF BIAS
Bookey-Bassett 2016	LOW	LOW	LOW	LOW	LOW
Clary-Muronda 2016	LOW	LOW	LOW	LOW	LOW

Cooper 2010	LOW	LOW	LOW	UNCLEAR	LOW
Cooper 2013	LOW	LOW	LOW	UNCLEAR	LOW
Fransen 2017	LOW	LOW	LOW	LOW	LOW
Havyer 2014	LOW	LOW	LOW	LOW	LOW
Havyer 2015	LOW	LOW	LOW	LOW	LOW
Rosenman 2015	LOW	LOW	LOW	LOW	LOW
Valentine 2015	LOW	LOW	LOW	LOW	LOW
Whitetaker 2015	LOW	LOW	LOW	LOW	LOW
Onwochei 2017	LOW	LOW	LOW	LOW	LOW
Jacob 2017	LOW	LOW	LOW	LOW	LOW
Walter 2016	LOW	LOW	LOW	LOW	LOW
Shoemaker 2016	LOW	LOW	LOW	LOW	LOW
Doughterty 2005	LOW	LOW	LOW	LOW	LOW

4.6 Robust Instruments Identified

Upon counting frequency of each instrument mentioned within the systematic reviews, there were 16 instruments identified to be the most frequently identified. These include Anaesthetists' nontechnical skills (ANTS), Attitudes Toward Health Care Teams, Clinical Teamwork Skills (CTS), Collaborative Practice Assessment instrument (CPAT), Global Rating Scale (GRS), Human Factors Rating Scale (HFRS), Jefferson Scale of Attitudes Toward Physician–Nurse Collaboration, Mayo High Performance Teamwork Scale (MHPTS), Modified index for interdisciplinary collaboration (MIIC), Nontechnical Skills for Surgeons (NOTSS), Nurse Physician Collaboration (ICU), Observational Teamwork Assessment for Surgery (OTAS), Obstetric Team Performance (AOTP), Safety Attitudes Questionnaire (SAQ), Team Climate Inventory (TCI), Team emergency assessment measure (TEAM), and The Assessment

of Interprofessional Team Collaboration Scale (AITCS). Among the 16 instruments, there were seven instruments that were more frequently identified than others (See table 3). These seven instruments were all validated. These instruments include Collaborative Practice Assessment instrument (CPAT), Mayo High Performance Teamwork Scale (MHPTS), Modified index for interdisciplinary collaboration (MIIC), Nurse Physician Collaboration (ICU), Observational Teamwork Assessment for Surgery (OTAS), Team Climate Inventory (TCI), and Team emergency assessment measure (TEAM).

4.7 Collaborative Practice Assessment instrument (CPAT)

The CPAT was first developed at Queen's University, which funded by Health Canada (Paterson et al., 2007). CPAT is composed of 56 closed ended questions based on a 7-point Likert scale. There are additional 3 open ended questions to gain further insight of teamwork performance. The domains included in the instrument include mission, meaningful purpose, goals, general relationships, team leadership, general role responsibilities and autonomy, communication and information exchange, decision-making and conflict management, community linkages and coordination of care, and patient involvement. The instrument provides good insight as to which dimensions of teamwork needs improvement on and where the team is lacking. The CPAT was developed to assist healthcare professionals in identifying strengths and weaknesses in their collaborative practice thereby providing opportunities for improvement in their clinical practice (Schroder et al., 2011). The design of the instrument was based on dimensions of collaboration identified in the literature and a review of existing instruments to assess perceptions of teamwork and collaboration in healthcare. The instrument was intended to be general in nature in order to allow for flexibility and application across a wide variety of

clinical practice settings and with a range of healthcare providers. The overall result from the two pilot tests indicates that the CPAT is a valid and reliable tool for measuring healthcare team members' perceptions of working collaboratively. In assessing levels of collaborative practice within teams, it provides a basis upon which teams can begin to explore domains that would benefit from educational interventions.

4.8 Mayo High Performance Teamwork Scale (MHPTS)

The Mayo High Performance Teamwork Scale (MHPTS) was designed to be short and to be used practically by participants in training and other settings to rate key behaviors of high-performance teams (Malec et al., 2007). This instrument can be used to assess a team's high-performance teamwork and crisis resource management (CRM) skills in a simulation setting. There are 16 questions that ask shared explicit goals and accountability, heedful interrelating, communication, adaptability, conflict resolution, and leadership. There is evidence of satisfactory reliability and initial support for the construct validity, however further evaluation is required to assess its validity in various educational and clinical settings. Nevertheless, the instrument show signs of promise as it has recently been translated to different languages and shows acceptable psychometrics properties when rigorously tested on nursing students (Gosselin et al., 2019)

4.9 Modified index for interdisciplinary collaboration (MIIC)

Bronstein originally developed the Index for Interdisciplinary Collaboration instrument to measure social workers' perception of interdisciplinary collaboration (Oliver, Wittenberg-Lyles, & Day, 2007). The Modified Index for Interdisciplinary Collaboration (MIIC) was later created

to include other healthcare professionals in the design of the instrument. The conceptual framework for this instrument was developed from four theoretic perspectives: a multidisciplinary theory of collaboration, services integration, role theory, and ecologic systems theory. The model identifies six components of collaboration: interdependence, newly created professional activities, flexibility, collective ownership of goals, and reflection on process. MIIC has demonstrated a capacity to measure and differentiate variances in the perception of collaboration within a hospice setting and to measure collaboration in expanded school mental health programs.

4.10 Nurse Physician Collaboration (ICU)

The ICU Nurse-Physician questionnaire was first developed by Shortell et al. (1991) and has been modified throughout the years by different researchers. The assumption of the questionnaire is that the nurses and physicians work in relational coordination. The instrument measures organizational climate, with a focus on unit culture, leadership, communication, coordination, problem-solving and conflict management. The original ICU N-P-Q is a 120-item scale derived from the Organizational Culture Inventory with response items ranked on a five-point Likert scale ranging from 1=strongly disagree to 5=strongly agree. A revised and shortened version of the instrument is also available as an 81-item scale. The scale includes separate questionnaires for physicians and nurses. Shortell et al. (1991) reported that Cronbach's α reliabilities ranged from 0.61 to 0.88 for subscales. Other researchers have reported reliabilities from 0.66 to 0.92.

Table 3. List of Robust Instruments

Author	**Name of instrument**	**Number of questions**	**Likert Scale (5 or 7 point)**	**Attributes of teamwork**	**Reliability**	**Internal Consistency**	**Validity**	**Theoretical Base**
Schroder et al., 2011	Collaborative Practice Assessment Tool (CPAT)	56 3 Qualitative Questions	7	*Mission *Meaningful purpose *Goals *General relationships *Team leadership *General role *Responsibilities and autonomy *Communication and information exchange *Decision-making and conflict management *Community linkages and coordination of care *Patient involvement		Pilot test #1—EFA seven domains; 42 items Cronbach's α = .73–.84 Pilot test #2 CFA—56 items; eight domains Cronbach's α =.67–.89 Overall score (α =.95) Cronbach's α = .72–.92 for domains	Face and content validity EFA and CFA in pilot tests with positive results	Based on constructs of collaboration identified in the literature and a review of existing tools to assess perceptions of teamwork and collaboration in healthcare
Parker Oliver, Wittenberg-Lyles, & Day, 2007	Modified Index of Interdisciplinary Collaboration (MIIC)	42	5	*Interdependence *Flexibility Newly created professional activities *Collective ownership of goals *Reflection on process	Original IIC—Test–retest correlation was .824 ($p < .01$)	Original IIC, overall Cronbach's α = .92 and all subscales Cronbach's α over .75 MIIC—overall Cronbach's α = .935 Subscales range .77–.87 (Kobayashi & McAllister, 2013: Parker Oliver et al., 2007)	CFA with four subscales	Based on Bronstein's model of interdisciplinary collaboration (2003) based on four theoretical perspectives

Cooper (2010)	Team Emergency Assessment Measure (TEAM)	11 items	5	*Leadership *Global perspective *Communication *Working together in tasks *Composure and control	Intraclass correlation coefficient of the global score was 0.93	Internal consistency (Cronbach's alpha) of 0.89	Content validity is high, with a content validity index of 0.96	
Shortell et al. (1991)	ICU Nurse Physician Collaboration	82	5 point	*Communication *Use of expertise *Coordination *Shared decision-making *Active conflict management *Effort *Respect	Reliabilities from 0.66 to 0.92	Alpha 0.62–0.9	7 Factor Model confirmed by CFA	
Anderson and West (1998)	Team climate inventory	38	7/5 points	*Shared workload *Shared decision-making *Communication *Coordination *Collaboration *Use of expertise *Respect *Group cohesion *Shared objectives *Social support *Psychological safety	The reliability of the total scale was 0.76.	Cronbach's alphas 0.88 to 0.93	Exploratory factor analysis confirmed the original four-factor model. Higher performance on the TCI has been associated with improved health outcomes better access to	Based on four-factor theory of climate for innovation

							care, improved patient satisfaction and improved job satisfaction and openness to innovation.	
Undre (2007)	OTAS (Observational Teamwork Assessment for Surgery)	45	7	*Communication *Communication *Coordination *Cooperation/backup behaviour *Leadership *Monitoring/awareness	Observer agreement was high (Cohen's κ ≥ 0.41)		Validity achieved by expert practitioners consensus and expert panels	
Malek et al (2007)	MHPTS (Mayo High Performance Teamwork Scale)	16	3	*Recognizing the leader *Balance between authority and team member participation *Clear understanding of roles *Involvement with the patient *Conflict solution and situation awareness		Cronbach's alpha = 0.85	Construct validity by Rasch (person reliability = 0.77	

* Empty cell represents unknown information

4.11 Observational Teamwork Assessment for Surgery (OTAS)

OTAS consists of five behaviours that team members in the operating room exhibit during surgery (Undre, Sevdalis, Healey, Darzi, & Vincent, 2007). Taken together, these behaviours provide an index of the quality of interprofessional teamwork in the operating room. The five behavioural dimensions of teamwork are communication, coordination, cooperation and back up behaviour, leadership, team monitoring and situational awareness. This instrument can be used in real-time observation in the operating room or a relevant video recording of a surgery. The questionnaire is on a 7-point Likert scale (from 0-6), where 6 means exemplary behaviour and very highly effective in enhancing team function whereas 0 means problematic behaviour and team function severely hindered. OTAS assumes various healthcare professionals including surgeons, anaesthetists, and nurses (scrub nurses and circulating nurses) to work together to provide best patient care. Because of this, the observer provides separate behavioural scores for each of the three sub-teams: the surgical sub-team (surgeon and assistants), the anaesthetic sub-team (anaesthetist and anaesthetic nurse), and the nursing sub-team (scrub nurse/practitioner and circulating nurses).

4.12 Team Climate Inventory (TCI)

TCI was developed by organizational psychologists to evaluate team functioning. The term climate is defined as the cognitive schema approach and the shared perceptions approach. TCI is based on four-factor theory of climate for innovation: (a) *participative safety* acknowledges that trust is essential for members' involvement; (b) *support for innovation* is the expectation of and support for the introduction of new ways of doing things; (c) *vision* refers to valued outcomes and a common higher goal as motivating factors; and (d) *task orientation* refers

to a shared concern for excellence (Anderson & West, 1998). There are many different variations with differing number of questions and different versions of other languages. There is also a version that has a five-factor model (Ouwens et al., 2008). The four-factor model is based on vision, participative safety, task orientation, and support for innovation (Beaulieu et al., 2014. This instrument has been validated in many populations, countries, and organizational contexts including hospital and community-based health and social services, and primary care. Face and content validity were rigorously established at the time of development. The Team Climate Inventory (TCI) (Anderson & West, 1998) is among the few instruments that have been validated and used in a variety of contexts and countries (Lemieux-Charles & McGuire, 2006). TCI has been validated in different languages, and the four-factor structure has always been confirmed (Strating & Nieboer, 2009). Higher performance on the TCI has been associated with improved health outcomes better access to care, improved patient satisfaction and improved job satisfaction and openness to innovation (Lemieux-Charles and McGuire 2006; Tseng, Liu, & West, 2009)

4.13 Team emergency assessment measure (TEAM)

TEAM uses a five-point scale and cover three categories: leadership, teamwork and task management. Encompassed within these categories are nine elements – leadership control; communication; co-operation and co-ordination; team climate; adaptability; situation awareness (perception); situation awareness (projection); prioritization; and clinical standards. TEAM was found to be a valid and reliable instrument and should be a useful addition to clinicians' instrument set for the measurement of teamwork during medical emergencies. The content, construct and concurrent validity, internal consistency, inter-rater reliability, re-test reliability

and feasibility ratings all had satisfactory levels. Although the instrument was primarily designed for cardiac resuscitation teams, it has also been found to be a valid measure for teams managing simulated patients who are deteriorating and is likely to be of use to trauma and medical emergency teams.

4.14 Findings Summary

The goal of this research was to identify the most robust instruments that could measure teamwork within healthcare teams. A systematic literature search of the systematic reviews was done to achieve this goal. The review articles identified from the literature had a wide range of objectives. Some articles aimed to identify instruments that would be appropriate to a specific context whereas some articles aimed to identify all instruments within the context of a general healthcare setting. There were common overlaps within the dimensions identified, which served as the base of theoretical underpinnings. Although there were numerous instruments identified, seven instruments were identified to be most robust and applicable to variety of healthcare settings.

Chapter 5 – Discussions

This study was conducted to identify robust instruments and make it more manageable for researchers and clinicians to navigate the literature. This chapter discusses the significance of the findings, limitations of the literature and the study, implications for practice and directions for future research.

5.1 Significance of Findings

As more healthcare professionals work collaboratively, it is important to properly evaluate healthcare teams and identify successful models of care. Hundreds of surveys have been created to measure the different types of healthcare teams. However, a problem that has risen is that there is an overwhelming amount of surveys and majority of them have yet to be validated. Therefore, the goal of this research was to conduct a systematic overview of reviews to identify robust instruments and create an overview of the properties and limitations of the instruments. It was determined 16 instruments were frequently identified and seven of them received the most attention in the literature: Collaborative Practice Assessment instrument (CPAT), Mayo High Performance Teamwork Scale (MHPTS), Modified index for interdisciplinary collaboration (MIIC), Nurse Physician Collaboration (ICU), Observational Teamwork Assessment for Surgery (OTAS), Team Climate Inventory (TCI), and Team emergency assessment measure (TEAM).

Although the seven surveys identified in this research are arguably the most frequently identified in the literature, the practicality of these surveys remain in question. For example, CPAT has 56 questions. In a time-constraint workload for the healthcare professionals, the high number of questions to fill out the survey may be too time consuming. Reducing the number of questions without losing the validity of the surveys would provide efficient manner in which

healthcare professionals can fill out the survey. Similarly, the original ICU N-P-Q is a 120-item scale with a revised and shortened version being an 81-item scale. This is still a relatively high number of questions and will act as a deterrent for healthcare professionals to complete the survey. Unfortunately, the quality of the responses may also be affected. Furthermore, some researchers suggest that training is required before using the instrument to assess the team because of the complexity (Undre, Sevdalis, Healey, Darzi, & Vincent, 2007). This makes the instrument impractical and limits the use for healthcare teams or researchers. For example, OTAS suggests training before the survey should be used. The complexity of the survey makes it extremely difficult for those without training to use the survey.

Furthermore, these instruments all had different dimensions of teamwork in assessing teamworking in healthcare teams, which also provides insight to the underlying assumptions of the theoretical underpinnings of the instruments. Understanding the dimensions of teamwork and the theoretical underpinnings of the instrument are very important given that it influences what measures are used in understanding teamwork performance (Anderson & West, 1998). For example, those that want to understand teamwork performance as modeled by partnership synergy framework, should not be using TCI or Edmondson's psychological safety questionnaire because these two instruments base their teamwork performance on psychological safety and group climate for innovation (Anderson & West, 1998; Edmondson, 1998). Likewise, those who believe psychological safety is a key component of teamwork should not use CPAT as CPAT does not measure any form of psychological safety in their dimensions of teamwork (Schroder et al., 2011).

It is suggested that CPAT provides the best option when the goal is to measure teamwork in a non-specific healthcare setting. The dimensions are derived from current literature and it is

one of few surveys that includes a patient dimension. Although there are 56 questions and 3 open ended questions, it provides the most comprehensive evaluation of the healthcare team. For those specifically wanting to measure healthcare teams in operating rooms, it is recommended to use OTAS (Undre, Sevdalis, Healey, Darzi, & Vincent, 2007). This, however, has challenges given that it is highly recommended in receiving training before use. For those that put heavy emphasis on the important of psychological safety in teamwork, it is recommended to use TCI (Anderson & West, 1998). Furthermore, TCI has been validated numerous times and has multiple version in different languages. There is also different version with varying lengths. TCI is highly respected and recommended when measuring teamwork in general healthcare settings.

5.2 Limitations of the literature

Among the seven surveys identified, they all fail to include patients as part of the team from the patient perspective. This is a gap in the literature because ultimately, it is the patient that the healthcare professionals are treating. Recent literature has gone so far to suggest that patients are valid members of the healthcare team and should be encouraged to be included in all aspects of patient care (LaDona et al, 2017). Although some surveys do include a patient dimension within their domains, the instruments still fail to include patients as part of the team. For example, CPAT includes patients as one of their dimensions to assess healthcare teamwork, but the intended audience of the surveys are healthcare professionals and thus fails to include patients as part of the team (Schroder et al., 2011). This is a problem because it contradicts the principals of patient-centered care (Fix et al., 2018). Although there isn't a clear consensus as to what patient-centered care means, most healthcare professionals and researchers agree that it is a shift from paternalistic, disease-focused approach to one that engages with the patient and

integrates patients' perception and consultation in all aspects of the treatment. Adopting to meet the principals of patient-centered care is important because research has shown to improve patient satisfaction and outcomes (McMillan et al., 2013).

Although the literature suggests that the teams do not necessarily have to be co-located, majority of the surveys assume that the teams are bounded. More specifically, the surveys are limited to only core clinical teams or contingency teams, which are formed during emergencies, and rarely ever includes other non-clinical members as part of the team. Because of this, surveys are very limited in function and may not capture the performance of teamwork in larger unbounded teams or teams across different departments or sectors. In other words, the instruments fail to address teams that cross different sectors of healthcare because executives are seldom included in assessing teamwork.

5.3 Limitation of the review

This study carefully followed the PRISMA guidelines in all aspects of the research (Moher, Liberati, Tetzlaff, Altman, & Group, 2009). This ensured that this study followed proper steps in conducting a systematic overview. Although PRISMA guidelines were created for the purpose of conducing systematic reviews of randomized trials, it was found to be a valid guideline for other types of research including qualitative reviews. Bias was reduced as there were multiple researchers assessing the potential articles as to whether they should be included for final review or not. Multiple meetings were set to carefully examine each article and exclude irrelevant articles. Furthermore, risk of bias using ROBIS checklist was done by two independent researchers. By having multiple reviewers examine the articles and assessing risk of bias, we were able to establish strong inter-rater reliability. Careful examinations and data extractions were done with optimal care. This study, however, is not without flaws.

One limitation of the study is that the search date range is up to September 2017. Given that a year has passed since writing this thesis, it is recommended to search the databases to a more recent time period to include relevant articles published in 2018 and 2019. Another limitation is that since the methodology of the study was an overview of reviews, most recent surveys created in the recent years may not have been identified during the data extraction process since the review article had to identify them first. In other words, surveys that were developed in recent years are missing from this study. However, the purpose of this study was to identify robust articles and only of the highest evidence as presumed by systematic reviews. Therefore, although it is very probable that this study has not identified every existing survey in the literature, it is certain that robust instruments have been identified.

Another limitation was the pragmatism in which instruments are reported. Counting the frequency in which the instrument is mentioned in the systematic reviews may not suggest that the instrument is the best or optimal. It may very well be possible that newly created surveys are better with stronger validations. However, the goal of this research was to provide an overview of instruments that researchers and clinicians can use to measure their healthcare teams. The assumption was that those that are frequently identified in the systematic reviews are those that are more robust. However, the threshold of four references to be included in the final reporting may omit valid instruments. One such instrument is the Assessment of Interprofessional Team Collaboration Scale (AITCS; Orchard, King, Khalili, & Bezzina, 2012). This instrument has 37 items and measures three different dimensions: partnership, cooperation, and coordination. It was found to have good psychometric properties and asks few questions about patient involvement. Further research and testing have shown a revised version of AITCS to be valid and reliable with 23-item tool (Orchard, Pederson, Read, Mahler, & Laschinger, 2018) and have been translated

into an Italian version with promising signs of validity (Caruso et al., 2018). Therefore, the pragmatism in which the instruments are identified and reported is a limitation given that good instruments may be omitted in the study. Newly developed instruments may not have had enough time for exposure for systematic reviews to have identified them. Furthermore, even if a systematic review had identified them, the limited time period would have limited the number of references.

5.4 Implications for Future Work

Future research should aim to update the literature by conducting another systematic overview and including more instruments in the report. By having multiple iteration of the study, it is possible to capture more of the instrument that provide highest evidence. This is exceptionally important because existing surveys get revised and translated to different languages, which further validates the survey. Despite this study only observing systematic reviews, there were well over 100 surveys identified. In the current literature, there are hundreds of instruments. Many researchers suggest that existing surveys should be revised and tested in different healthcare settings. However, in practice, many choose to ignore this and create their own surveys. This raises another challenge because the current literature is already difficult to navigate with so many instruments existing. Future research should aim to take already existing instruments and modify them slightly to meet the characteristics of their specific teams.

5.5 Conclusion

This study aimed to identify robust instruments in the literature that measure teamwork in healthcare teams and report on its theoretical underpinnings, psychometric properties, and its practicality and limitations. A systematic overview of reviews was conducted to assess

systematic review in hopes to extract articles of highest evidence. It was determined that 15 articles met the criteria for full assessment. Of these 15 articles, there were well over hundred instruments reported. Out of pragmatism, frequently identified surveys were reported. Findings revealed that there were 16 frequently identified instruments in the literature with the majority of them showing good signs of psychometric properties.

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Appendices

Appendix A – Data Extraction Table of Instruments

Author	Instrument Name	Bookey-Bassett (2016)	Clary-Muronda (2016)	Cooper (2010)	Cooper (2013)	Fransen (2017)	Havyer (2014)	Havyer (2016)	Rosenman 2015	Valentine (2015)	Whittaker (2015)	Onwochi (2017)	Jacob (2017)	Walters (2016)	Dougherty (2005)	Shoemaker (2016)	Count
Vanhaecht, De Witte et al. (2007)	Care Process Self-Evaluation Tool (CPSET)													X			1
Ohman (2007)	"Using Learning Teams for Reflective Adaptation" or ULTRA survey															X	1
Temkin-Greener et al. (2004)	Adapted ICU Nurse Physician Questionnaire												X			X	2
Kolb	Adapted Leadership Behavior Description Questionnaire (LBDQ)			X					X								2
Fletcher et al (2004)	Anaesthetists' nontechnical skills (ANTS)				X		X	X									3
Curran	Attitudes Toward Health Care Teams						X	X								X	3
Wright	Behaviorallyanchored Team Skill Rating Scale							X									1
Guise (2008)	Clinical Teamwork Skills (CTS)					X			X			X					3
Baggs (1994)	Collaboration and Satisfaction about Care Decisions									X					X		2
Kahn and McDough (1997)	Collaboration Scale									X							1
Masse et al. (2008)	Collaboration Scale									X							1
Hollar	Collaborative Healthcare Interdisciplinary Relationship Planning (CHIRP) Scale							X									1
Schroder et al (2011)	Collaborative Practice Assessment instrument (CPAT)	X								X			X	x			4
Weiss S, Davis H.	Collaborative Practice Scale (CPS)														X		1
Frankel et al. (2007)	Communication and Teamwork Skills (CATS) Assessment							X								X	2
Monge et al	Communication Competency Questionnaire			X													1
Loughry et al. (2007)	Comprehensive Assessment of Team Member Effectiveness.															X	1
Alexander et al. (2005)	Cross Functional Team Processes									X							1
Pinto et al. (1993)	Cross-Funcional Cooperation									X							1

Berendsen, Benneker et al. (2010)	Doctor's Opinion on Collaboration (DOC)													x			1
Rezken (2003)	Emergency Medicine Crisis Resource Management Scale (EMRCM)							X	X								2
Bradley	Emergency Team Dynamics (ETD) scale			X				X									2
Sudikoff (2009)	Global Competency Score (GCS)								X								1
Kim (2009)	Global Rating Scale (GRS)					X			X			X					3
Vinokur-Kaplan (1995)	Group Effectiveness Interdisciplinary Collaboration									X							1
Peterson (2012)	Group Emotional Intelligence Individual Regulation (GEIQ–IR) scale															X	1
Slack	Group Growth Evaluation Form							X									1
Sorra and Nieva (2004)	Hospital survey on patient safety									X							1
Morgan (2007)	Human Factors Rating Scale (HFRS)					X			X			X					3
Mellin et al (2003)	Index of interprofessional team collaboration for expanded school mental health (IITC-ESMH)												X	x			2
Nuno-Solinis, Berraondo Zabalegui	Inter-Professional Collaboration between two Different Levels of Care (IPC-DLC)													x			1
Basran	Interdisciplinary Education Perception Scale (IEPS)							X									1
Dadiz et al., 2013	Interdisciplinary simulation-based training to improve birthing room communication		X														1
Cameron	Interprofessional Attitudes Questionnaire (IAQ)							X		X							2
Curran	Interprofessional Collaborator Assessment Rubric (ICAR)							X									1
King, Shaw et al. (2010)	Interprofessional Socialization and Valuing Scale (ISVS)							X						x			2
Korner and Wirtz (2013)	IPS													X			1
Hojat	Jefferson Scale of Attitudes Toward Physician–Nurse Collaboration						X	X							X		3
Jones and Barry (2011)	Jones Synergy Scale												X				1
Jones and Barry (2011)	Jones Trust Scale												X				1
Sigalet et al., 2013	KidSIM Team Performance Scale checklist		X														1
Grant et al. (2012)	Leadership and communication skills' (LCS)															X	1

Carlson	Leadership and Team Behavior Management Tool							X									1
van Beuzekom et al (2007)	Leiden Opening Theater and Intensive Care Satefy (LOTICS)									X						X	2
Malek et al (2007)	Mayo High Performance Teamwork Scale (MHPTS)			X				X	X							X	4
Hall	McMaster– Ottawa Team Observed Structured Clinical Encounter (TOSCE) Observer Score Sheet							X									1
Weaver (2010)	Medical Performance Assessment Tool for Communication and Teamwork (MedPACT)								X								1
American Heart Association	Megacode performance Score Sheet (ACLS)								X								1
Parker Oliver, Wittenberg-Lyles, & Day, 2007	Modified index for interdisciplinary collaboration (MIIC)	X						X					X	x			4
Mazur	Modified Team Opinion Questionnaire							X									1
Calhoun et al., 2011	Multi-rater Team Performance During Simulated Crisis Instrument (TPDSCI)		X														1
Kenaszchuk, Reeves et al. (2010)	Multiple Group Measurement Scale (MGMS)													x			1
Violato (2003)	Multisource Feedback (MSF)										X						1
Jukkala & Henly, 2007	Neonatal Resuscitation Experience Index		X														1
Amin et al., 2013	Neonatal Resuscitation Simulation Self-Assessment Questionnaire		X														1
Meier	Non-technical Skills Scale (NOTECHS)							X									1
Yule (2006)	Nontechnical Skills for Surgeons (NOTSS)				X				X		X						3
Steinmann (2011)	Nontechnical Skills System Modified for trauma (T NOTECH)								X								1
Ushiro (2009)	Nurse Physician Collaboration									X						X	2
Shortell et al (1991)	Nurse Physician Collaboration (ICU)						X			X			X		x		4
Adams A, Bond S, Arber S.	Nurses Opinion Questionnaire NOQ)														X		1
Kalish et al. (2010)	Nursing Teamwork Survey									X						X	2
Walker (2011)	Observational Skill-based clinical assessment instrument for resusitation (OSCAR)								X								1
Healey at al (2004) Undre (2007)	Observational Teamwork Assessment for Surgery (OTAS)								X		X	X		X			4
Tregunno (2009) Morgan (2012)	Obstetric Team Performance (AOTP)					X			X			X					3

Paige	Operating Room Teamwork Assessment Scale (ORTAS)							X									1
Wallin	Operating Team Resource Management Survey (OTRMS)							X									1
Passauler-Baierl, Huller et al. (2014)	OTAS-D													X			1
Brannik et al. (1993)	Overall performance on simulator task									X							1
Mishra et al (2009)	Oxford nontechnical skills system (NOTECHS)				X						X					X	3
Weiss, Anderson, & Lasker, 2002)	Partnership Self-Assessment Tool (PSAT)	X															1
Henry et al. (2013)	Patients' Insights and Views Observing Teams (PIVOT) survey															X	1
Rousseau et al. (2012)	Perception of Interprofessional Collaboration Model PINCOM-Q REVISED												X				1
Odegard (2005)	Perception of Interprofessional Collaboration Model Questionnaire (PINCOM-Q)												X				1
Copnell et al. (2004)	Perceptions about interdisciplinary collaboration scale									X						X	2
Curran	Perceptions of Effective Interprofessional Teams Scale							X									1
Lockyer et al., 2006	Performance Checklist to Assess Neonatal Resuscitation Megacode Skill		X														1
Nagpal (2011)	Postoperative Handover Assessment Tool (PoHAT)								X								1
De Wet et al. (2010)	Primary Care Patient Safety Climate									X						X	2
Erickson et al (2004)	Professional Practice Environment Revised Scale (PPE)												X				1
Adams et al. (1995)	Professional Working Relationships									X							1
Edmonson (1999)	Psychological Safety and Teamwork Learning									X						X	2
Wauben (2011)	Questionnaire Perception of communication, teamwork and situation awareness															X	1
Atack	Readiness for Interprofessional Learning Scale (RIPLS)							X									1
Gitell (2002)	Relational Coordination									X							1
Sexton et al. (2006)	Safety Attitudes Questionnaire						X			X						X	3
Hojat	Scale of Attitudes Towards Physician– Pharmacist Collaboration							X									1

van der Heide et al., 2006)	Scoring Instrument for the Assessment of Neonatal Resuscitation Skills		X														1
Mitchell et al (2013)	Scrub Practitioners list of intraoperative nontechnical skills (SPLINTS)										X						1
Morgan et al (2015)	Situation Awareness Global Assessment Scale (SAGAT)				X							X					2
Hänsel	Situation Awareness Global Assessment Technique (SAGAT)							X									1
Hobgood	Standardized Patient Evaluation (SPE) of Teamwork Skills Performance							X									1
Posmontier	Team Attitudes Questionnaire							X									1
Posmontier et al (2012)	Team Attitudes Questionnaire (TAQ)											X					1
Anderson and West (1998)	Team Climate Inventory (TCI)	X		X			X			X						X	5
Batorowicz and Sheperd (2008)	Team Decision Making Questionnaire (TDMQ)												X			X	2
Wageman et al. (2005)	Team diagnostic survey									X						X	2
Curran	Team Dynamics Observation Checklist							X									1
Pearce and Sims (2002)	Team Effectiveness									X						X	2
Cooper (2010)	Team emergency assessment measure (TEAM)				X				X	X		X					4
Strasser et al. (2002)	Team functioning									X							1
Robertson	Team Knowledge Test							X									1
Seers (1989)	Team Member Exchange (TMX)									X							1
Fernandez Castelao77	Team Member Verbalization							X									1
La Duckers et al. (2008)	Team organization									X							1
Slack	Team Orientation and Behavior Inventory							X									1
Thompson	Team Performance Scale (TPS)							X									1
Doolen et al. (2003)	Team process									X						X	2
Denison et al. (1996)	Team process domain									X						X	2
Hauptman and Hirji (1999)	Team process quality									X							1
Robertson	Team Skills Checklist Video Rating							X									1
Curran	Team Skills Scale							X									1
Millward and Jeffries (2001)	Team Survey									X						X	2

Senior and Swailes (2007)	Team survey									X						X	2
Meier	TeamSTEPPS Knowledge Exam							X									1
Agency for Healthcare Research and Quality, 2014	TeamSTEPPS Teamwork Perceptions Questionnaire		X														1
Garbee	Teamwork Assessment Scale (TAS)							X									1
Frengley (2011)	Teamwork Behavioral Rate (TBR)								X								1
Chesluk et al (2012)	Teamwork Effectiveness Assessment Module (TEAM)															X	1
Mayer (2011)	Teamwork Evaluation of Nontechnical Skills (TENTS)								X								1
Qvist et al. (2010)	Teamwork Failure Prevention Questionnaire (TFP) Questionnaire															X	1
MacDonnell	Teamwork Global Rating Scale							X									1
Wholey et al (2012)	Teamwork in assertive community treatment scale (TACT)												X				1
	Teamwork Measurement Tool (TMT)					X											1
Hoegl and Gemeunden (2001)	Teamwork Quality Survey									X						X	2
Friesen et al. (2008)	Teamwork Scale									X						X	2
Hutchinson et al. (2006)	Teamwork Scale									X							1
	Technical and non-technical rating scale for septic shock			X													1
Orchard, King et al. (2012)	The Assessment of Interprofessional Team Collaboration Scale (AITCS)	X												x		X	3
Upenieks, Lee et al. (2010)	The Healthcare Team Vitality Instrument (HTVI)													x		X	2
	The Ottawa Crisis Resource Management Global Rating Scale			X													1
	The Trauma Team Evaluation Tool			X													1
Finley (2013)	The Work Relationships Scale (WRS)															X	1
Catchpole (2007)	Tool for Resusitation Assessment Using Computarized Simulation (TRACS)								X								1
Capella (2010)	Trauma Team Performance (TPOT)								X								1
Warrier	Value of Teams Survey							X									1
Curran	Weekly Team Inventory							X									1
Campion (1993)	Work Group Effectiveness									X						X	2

Appendix B – Data Extraction Table of Review Articles

Article	Healthcare setting	Purpose of article	List of frameworks mentioned and purpose (Ie: systematic framework, data extraction framework, quality framework)	Dimensions team or team attributes mentioned
Bookey-Bassett (2016)	CDM in community living older adults	1) to critically review the psychometric properties of the existing instruments that measure IPC in order to determine the strengths and limitations of these measures as they relate to community-based CDM for CLOA. 2) to compare the dimensions of IPC within each of the instruments with the salient attributes of IPC, identified in the literature, to determine the tool with the best concordance	Review of the selected instruments was guided by the methodological criteria identified by Streiner and Norman (2003).	1) shared planning and decision-making 2) interdependence and cooperation 3) partnership with trust and respect among team members 4) shared power and leadership 5) coordination and communication 6) patient/family involvement 7) team evaluation
Clary-Muronda (2016)	Obstetrics - Neonatal Resuscitation	To identify instruments appropriate to measure interprofessional team performance in neonatal resuscitation (NR), describe the validity and reliability of extant NR instruments, and determine instruments for use in interprofessional birthing room NR simulations.	Social Ecological Model Oxford and Oxford Centre for Evidence-Based Medicine (2011) Levels of Evidence tool were used to guide this integrative review.	
Cooper (2010) - Measuring non-technical skills in medical emergency care: a review of assessment measures	Medical Emergency	To review the literature on non-technical skills and assessment methods relevant to emergency care.		1) leadership 2) team behavior 3) personality

Cooper (2013) - Measuring situation awareness in emergency settings: a systematic review of tools and outcomes	Acute care/emergency settings - The final selection included 14 papers drawn from the fields of emergency medicine, intensive care, anesthetics, and surgery	This paper reviews and describes indirect and direct measures of situation awareness applicable for emergency settings		
Fransen (2017)	Obstetrics	The aim of the current study is to (1) identify the available assessment tools to evaluate obstetric teamwork performance in a simulated environment, and (2) evaluate their psychometric properties in order to identify the most valuable tool(s) to use.	Accreditation Council for Graduate Medical Education (ACGME) Committee on Educational Outcomes. The included studies were also assessed according to the Oxford Centre for Evidence Based Medicine (OCEBM) levels of evidence	1) communication 2) situational awareness 3) leadership 4) decision making
Havyer (2014)	Internal Medicine		PRISMA Guideline	
Havyer (2016)	undergraduate medical education (UME)	To summarize characteristics and validity evidence of tools that assess teamwork in undergraduate medical education (UME), and provide recommendations for addressing the interprofessional collaboration competencies of the Association of American Medical Colleges (AAMC).	Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.	

Rosenman (2015)	Surgery (clinical and simulated)	To summarize the characteristics of tools used to assess leadership in health care action (HCA - health care action) teams	The review was planned, executed and reported in adherence with the PRISMA standards for systematic reviews	Leadership behaviours: 1) Planning behaviours such as goal specification 2) Action processes, including monitoring 3) Interpersonal skills, such as affect management and communication
Valentine (2015)	Hospital settings	To identify and review survey instruments used to assess dimensions of teamwork and to provide a comprehensive review of the dimensions of teamwork along with psychometric validity of survey measures		1) Organizational context 2) Team design 3) Team task design 4) Cooperation 5) Workload sharing 6) Effort 7) Communication 8) Use of expertise 9) Strategy 10) Team learning 11) Use of resources 12) Information sharing 13) Team processes 14) Task interactions 15) Social support 16) Norms 17) Teamwork values 18) Team synergy 19) Psychological safety 20) General teamwork quality, 21) Collaboration 22) Respect 23) Active conflict management 24) Group cohesion 25) Role responsibility 26) Shared objectives
Whittaker (2015)	Surgery, Med School	Aims to provide an overview of teamwork assessment tools that evaluate trainee nontechnical performance.	PRISMA method for systematic reviews	1) Communication 2) Cooperation 3) Coordination 4) Shared leadership 5) Team monitoring and situation awareness
Onwochei (2017)	Obstetric emergencies	To find the tools available to assess team effectiveness in obstetric emergencies	PRISMA Guidelines	1) Communication 2) Leadership and role responsibility 3) Situational awareness 4) Coordination 5) Supervision 6) Teamwork 7) Task management 8) Error 9) Decision making

Walters (2016)	Any healthcare setting	To identify studies reporting the measurement properties of instruments that measure collaboration within healthcare settings that are populated with a complex mix of participants	COSMIN checklist (validated tool to assess methodological quality of studies used to construct and validate healthcare measurement tools) Data extraction: excel spreadsheet version of COSMIN was developed for data extraction	1) organizational settings, support structures, purpose and goals, 2) communication 3) reflection on process 4) cooperation 5) coordination 6) role interdependence and partnership 7) relationships 8) newly created professional activities 9) professional flexibility
Shoemaker (2016)	Primary care	To develop a conceptual framework of high functioning primary care teams to identify and review instruments that measure the constructs identified in the framework, and to create a searchable, web-based atlas of such instruments	Conceptual framework of team-based primary care	1) Continuous learning 2) Shared explicit goals and accountability 3) Evolving mental models of roles 4) Trust 5) Respectful interactions 6) Heedful interrelating 7) Commitment 8) Communication 9) Adaptable to context 10) Conflict resolution 11) Leadership
Dougherty (2005)	Hospital settings	To measure nurse-physician collaboration and compare the strengths and potential opportunities of each instrument		

Jacob (2017)	Children services, Collaborative practice	To identify tools that measure collaboration within interprofessional teams comprised of members from health and other disciplines and evaluate their psychometric properties	PRISMA Guidelines for systematic reviews Tool used for critical appraisal: "McMaster Critical Review Form (Quantitative)"	1) Interprofessional climate 2) Organizational culture 3) Organizational aims 4) Professional power 5) Group leadership and motivation 6) Exploitation 7) Exploration 8) Conflict 9) Constructive controversy 10) Psychological safety 11) Goal agreement 12) Information accessibility 13) Encounter preparedness 14) Consumer centered care 15) Reflection on process 16) Professional flexibility 17) Newly created professional activities 18) Role independence, 19) Decision-making 20) Team support 21) Learning, 22) Developing quality services 23) Internal motivation, 24) Control over practice 25) Leadership 26) Staff relationships 27) Cultural sensitivity 28) Communication 29) Mission 30) Purpose 31) Community linkages 32) Patient involvement 33) Independence 34) Flexibility 35) Team cohesion 36) Perceived team effectiveness 37) Synergy 38) Positive trust and mistrust

Appendix C – ROBIS Checklist

ROBIS: Tool to assess risk of bias in systematic reviews

Phase 1: Assessing relevance (Optional)

ROBIS is designed to assess the risk of bias in reviews with questions relating to interventions, aetiology, diagnosis and prognosis. State your overview/guideline question (target question) and the question being addressed in the review being assessed:

Intervention reviews:

Category assessed	**Target question (e.g. overview or guideline)**	**Review being**
Patients/Population(s): Intervention(s): Comparator(s): Outcome(s):		

For aetiology reviews:

Category assessed	**Target question (e.g. overview or guideline)**	**Review being**
Patients/Population(s): Exposure(s) and comparator(s): Outcome(s):		

For DTA reviews:

Category assessed	**Target question (e.g. overview or guideline)**	**Review being**
Patients): Index test(s): Reference standard: Target condition:		

For prognostic reviews:

Category assessed	**Target question (e.g. overview or guideline)**	**Review being**
Patients:		
Outcome to be predicted:		
Intended use of model: Intended moment in time:		

Does the question addressed by the review match the target question?
YES/NO/UNCLEAR

Phase 2: Identifying concerns with the review process

DOMAIN 1: STUDY ELIGIBILITY CRITERIA

Describe the study eligibility criteria, any restrictions on eligibility and whether there was evidence that objectives and eligibility criteria were pre-specified:

1.1 Did the review adhere to pre-defined objectives and eligibility criteria?

1.2 Were the eligibility criteria appropriate for the review question?

1.3 Were eligibility criteria unambiguous?

1.4 Were all restrictions in eligibility criteria based on study characteristics appropriate (e.g. date, sample size, study quality, outcomes measured)?

1.5 Were any restrictions in eligibility criteria based on sources of information appropriate (e.g. publication status or format, language, availability of data)?

Concerns regarding specification of study eligibility criteria
LOW/HIGH/UNCLEAR

Rationale for concern:

DOMAIN 2: IDENTIFICATION AND SELECTION OF STUDIES

Describe methods of study identification and selection (e.g. number of reviewers involved):

2.1 Did the search include an appropriate range of databases/electronic sources for published and unpublished reports?

2.2 Were methods additional to database searching used to identify relevant reports?

2.3 Were the terms and structure of the search strategy likely to retrieve as many eligible studies as possible?

2.4 Were restrictions based on date, publication format, or language appropriate?

2.5 Were efforts made to minimize error in selection of studies?

Concerns regarding methods used to identify and/or select studies LOW/HIGH/UNCLEAR Rationale for concern:

DOMAIN 3: DATA COLLECTION AND STUDY APPRAISAL

Describe methods of data collection, what data were extracted from studies or collected through other means, how risk of bias was assessed (e.g. number of reviewers involved) and the tool used to assess risk of bias:

3.1 Were efforts made to minimize error in data collection

3.2 Were sufficient study characteristics available for both review authors and readers to be able to interpret the results?

3.3 Were all relevant study results collected for use in the synthesis?

3.4 Was risk of bias (or methodological quality) formally assessed using appropriate criteria?

3.5 Were efforts made to minimize error in risk of bias assessment?

Concerns regarding methods used to collect data and appraise studies LOW/HIGH/UNCLEAR Rationale for concern:

DOMAIN 4: SYNTHESIS AND FINDINGS

Describe synthesis methods:

4.1 Did the synthesis include all studies that it should?

4.2 Were all pre-defined analyses reported or departures explained

4.3 Was the synthesis appropriate given the nature and similarity in the research questions, study designs and outcomes across included studies?

4.4 Was between-study variation (heterogeneity) minimal or addressed in the synthesis?

4.5 Were the findings robust, e.g. as demonstrated through funnel plot or sensitivity analyses?

4.6 Were biases in primary studies minimal or addressed in the synthesis?

Concerns regarding the synthesis and findings
LOW/HIGH/UNCLEAR Rationale for concern:

Y=YES, PY=PROBABLY YES, PN=PROBABLY NO, N=NO, NI=NO INFORMATION

Phase 3: Judging risk of bias

Summarize the concerns identified during the Phase 2 assessment:

Domain	**Concern**	**Rationale for concern**
1. Concerns regarding specification of study eligibility criteria		
2. Concerns regarding methods used to identify and/or select studies		
3. Concerns regarding methods used to collect data and appraise studies		
4. Concerns regarding the synthesis and findings		

RISK OF BIAS IN THE REVIEW

Describe whether conclusions were supported by the evidence:

A. Did the interpretation of findings address all of the concerns identified in Domains 1 to 4?

B. Was the relevance of identified studies to the review's research question appropriately considered?
C. Did the reviewers avoid emphasizing results on the basis of their statistical significance?

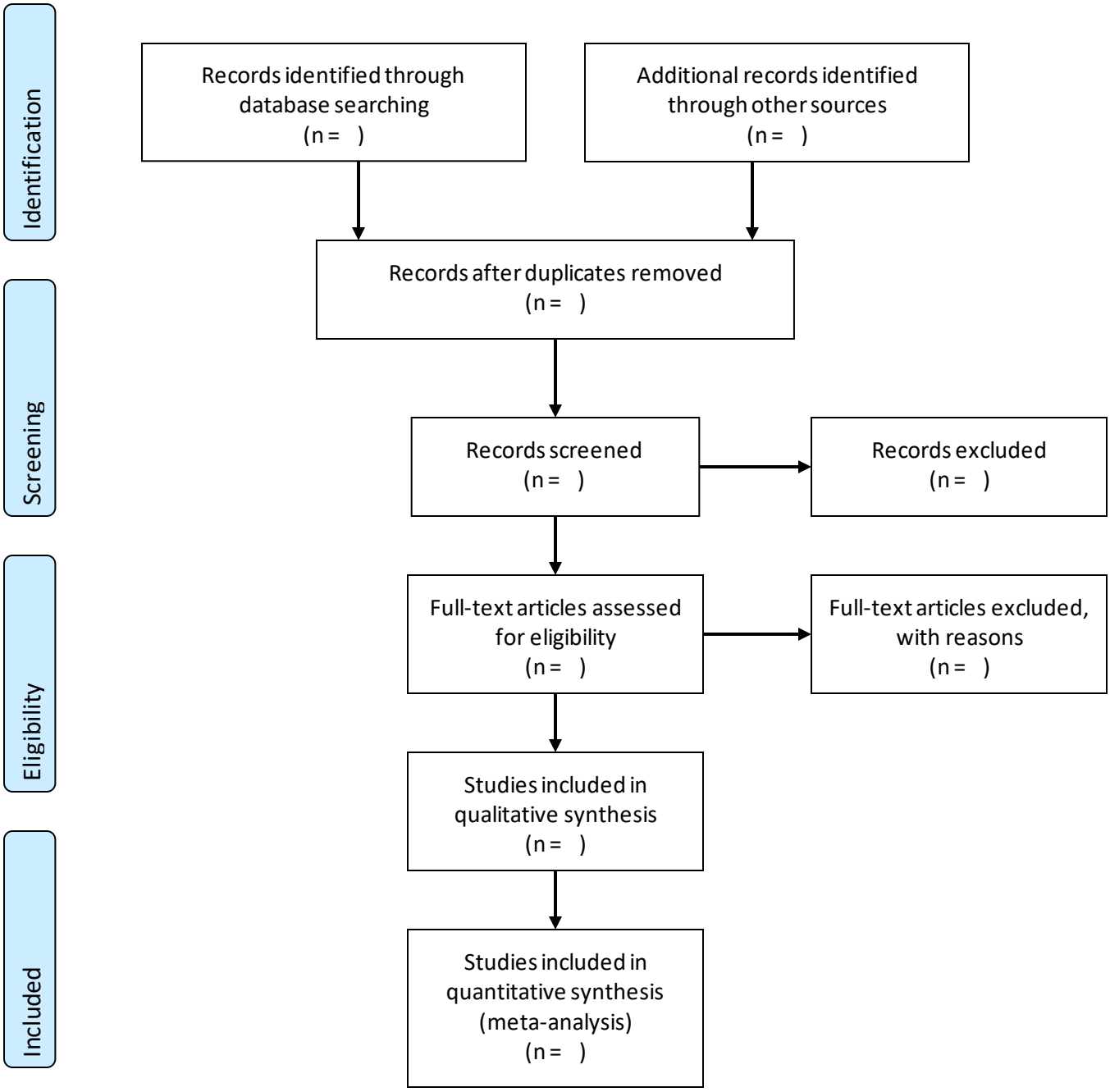
Risk of bias in the review RISK:
LOW/HIGH/UNCLEAR Rationale for risk:
Y=YES, PY=PROBABLY YES, PN=PROBABLY NO, N=NO, NI=NO INFORMATION

Appendix D – Literature Search

Search	Query
1	Search teamwork
2	Search team
3	Search "interprofessional collaboration"
4	Search "team-based"
5	Search interprofessional relations[MeSH Terms] Sort by: [pubsolr12]
6	Search "interdisciplinary collaboration" Sort by: [pubsolr12]
7	Search "multiprofessional collaboration" Sort by: [pubsolr12]
8	Search "interprofessional working" Sort by: [pubsolr12]
9	Search (((((("interprofessional working") OR "multiprofessional collaboration") OR "interdisciplinary collaboration") OR interprofessional relations[MeSH Terms]) OR "team-based") OR "interprofessional collaboration") OR team) OR teamwork Sort by: [pubsolr12]
10	Search surveys Sort by: [pubsolr12]
11	Search questionnaires Sort by: [pubsolr12]
12	Search instruments Sort by: [pubsolr12]
13	Search instruments Sort by: [pubsolr12]
14	Search measure Sort by: [pubsolr12]
15	Search measurement Sort by: [pubsolr12]
16	Search assess Sort by: [pubsolr12]
17	Search assessment Sort by: [pubsolr12]
18	Search evaluate Sort by: [pubsolr12]
19	Search evaluation Sort by: [pubsolr12]
20	Search (((((((((evaluation) OR evaluate) OR assessment) OR assess) OR measurement) OR measure) OR instruments) OR instruments) OR questionnaires) OR surveys Sort by: [pubsolr12]
21	Search ((((((((((evaluation) OR evaluate) OR assessment) OR assess) OR measurement) OR measure) OR instruments) OR instruments) OR questionnaires) OR surveys)) AND (((((((("interprofessional working") OR "multiprofessional

	collaboration") OR "interdisciplinary collaboration") OR interprofessional relations[MeSH Terms]) OR "team-based") OR "interprofessional collaboration") OR team) OR teamwork) Sort by: [pubsolr12]
22	Search ((((((((((evaluation) OR evaluate) OR assessment) OR assess) OR measurement) OR measure) OR instruments) OR instruments) OR questionnaires) OR surveys)) AND ((((((("interprofessional working") OR "multiprofessional collaboration") OR "interdisciplinary collaboration") OR interprofessional relations[MeSH Terms]) OR "team-based") OR "interprofessional collaboration") OR team) OR teamwork) Filters: Review Sort by: [pubsolr12]
23	Search ((((((((((((evaluation) OR evaluate) OR assessment) OR assess) OR measurement) OR measure) OR instruments) OR instruments) OR questionnaires) OR surveys)) AND ((((((("interprofessional working") OR "multiprofessional collaboration") OR "interdisciplinary collaboration") OR interprofessional relations[MeSH Terms]) OR "team-based") OR "interprofessional collaboration") OR team) OR teamwork))) AND review[Title/Abstract] Filters: Review Sort by: [pubsolr12]
24	Search ((((((((((((evaluation) OR evaluate) OR assessment) OR assess) OR measurement) OR measure) OR instruments) OR instruments) OR questionnaires) OR surveys)) AND ((((((("interprofessional working") OR "multiprofessional collaboration") OR "interdisciplinary collaboration") OR interprofessional relations[MeSH Terms]) OR "team-based") OR "interprofessional collaboration") OR team) OR teamwork))) AND review[Title] Filters: Review Sort by: [pubsolr12]

Appendix E - PRISMA Flow Diagram



Appendix F – PRISMA Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	

Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	

Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: **www.prisma-statement.org**.

Appendix G – Curriculum Vitae

Hosung (Joel) Kang

EDUCATION

Master of Science **2017-2019**
Health and Rehabilitation Science
Health Promotion
Western University, London, Ontario

Bachelor of Science **2012-2017**
(Honors Specialization in Neuroscience with distinction)
Western University, London, Ontario

- Dean's Honor List

RESEARCH EXPERIENCE

Research Assistant **Fall 2016**
Language and Working Memory Lab, London, Ontario

- Created an experiment using E-prime 2.0 software.
- Manipulated raw data onto excel spreadsheet to transfer onto SPSS.
- Performed ANOVA and t-tests to determine statistical significant results.

Honors Thesis **2015-2016**
Neuroscience 4000E
Adult statistical word segmentation across two speakers
Under the supervision of Dr. Lisa Archibald
Western University, London, Ontario

- Conducted experiments on undergraduate students to determine whether typical adults could detect high transitional probabilities between syllables to segment words in an artificial language speech stream and whether variations in speaker (male & female voice) make a difference to the level of segmentation ability.
- Clearly articulated the significance of the study, background information, methods, results, reasoning behind the results, and future directions.

LEADERSHIP SKILLS

Maritime Surface Sub-surface Officer **April 2014-April 2017**
Rank: Acting Sub-lieutenant
HMCS Prevost, DND, London, Ontario

- Flew every summer since 2014 to Victoria, B.C. to undergo Basic Military Officer Qualification, MARS II, MARS III, MARS IV.

- Sailed and trained on ORCA class vessel and minor warship Kingston Class vessel (HMCS Summerside) within the Gulf Islands of the west coast as well as the east coast (PEI, Nova Scotia, Newfoundland and Labrador).
- Learned military leadership, weapons handling, sea survival, damage control and firefighting on-board ship, costal and pilotage navigation, emergency drills (man-overboard, steering gear breakdown, etc).

TEACHING EXPERIENCE

Graduate Teaching Assistant **Fall 2017**
- Course: Health Management 3040A

Graduate Teaching Assistant **Winter 2018**
- Course: Personal Determinants of Health 1001B

CONFERENCE PARTICIPATION

Symposium on Research in Child Language Disorders **June 2018**
Madison, Wisconson
- Implicit learning of semantic information depends on contextual cues.

HRS Graduate Research Conference **February 2017**
Western University, London, Ontario
- Systematic overview of reviews of instruments measuring healthcare teams.

Undergraduate Awards 2017 **November 2017**
Dublin, Ireland
- Adult statistical word segmentation across two speakers.

Western Inspiring Young Women in STEM Conference **March 2016**
Western University, London, Ontario
- Adult statistical word segmentation across two speakers.

SCHOLARSHIPS, ACADEMIC & NON-ACADEMIC AWARD

Undergraduate Awards **Nov 2017**
- Highly commended entrant (thesis submission was ranked top 10% globally)
- Attended the global summit held in Dublin, Ireland
- Kang, Hosung, "Adult statistical word segmentation across two speakers" (2017). *2017 Undergraduate Awards*. 13. https://ir.lib.uwo.ca/undergradawards_2017/13

Commodore Michaud Trophy **2016**

- *Awarded by Commodore Marta Mulkins for being the top MARS IV Candidate.*

Canadian Forces Continuing Education Program (2x $2000) **2014-2016**

Western Scholarship of Distinction ($1000) **2012**

CERTIFICATION AND TRAINING

Accessibility in Service (AODA) **2017**
WHMIS **2017**
Worker Health and Safety Awareness **2017**
Safe Campus Community **2017**
TCPS-2 **2017**