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Components of interprofessional education programs in neonatal medicine: A focused BEME review: BEME Guide No. 73

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ABSTRACT

Background: Care delivery in neonatology is dependent on an interprofessional team. Collaborative learning and education amongst professionals can lead to successful management of critically ill patients. This focused BEME review synthesized the components, outcomes, and impact of such interprofessional education (IPE) programs in neonatal medicine.

Methods: The authors systematically searched four online databases and hand-searched MedEdPublish up to 10 September 2020. Two authors independently screened titles, abstracts, full-texts, performed data extraction and risk of bias assessment related to study methodology and reporting. Discrepancies were resolved by a third author. We reported our findings based on BEME guidance and the STORIES (STructured apprOach to the Reporting in health education of Evidence Synthesis) statement.

Results: We included 17 studies on IPE in neonatal medicine. Most studies were from North America with varying learners, objectives, instruction, and observed outcomes. Learners represented nurses, respiratory therapists, neonatal nurse practitioners, patient care technicians, parents, early interventionists, physicians, and medical trainees amongst others. Risk of bias assessment in reporting revealed poor reporting of resources and instructor training. Bias assessment for study methodology noted moderate quality evidence with validity evidence as the weakest domain. IPE instruction strategies included simulation with debriefing, didactics, and online instruction. Most studies reported level 1 Kirkpatrick outcomes (76%) and few reported level 3 or 4 outcomes (23%). Challenges include buy-in from leadership and the negative influence of hierarchy amongst learners.

Conclusions: This review highlights IPE program components within neonatal medicine and exemplary practices including a multimodal instructional approach, asynchronous instruction, an emphasis on teamwork, and elimination of hierarchy amongst learners. We identified a lack of reporting on program development and instructor training. Future work should address long term knowledge and skill retention and impact on patient outcomes and organizations.

KEYWORDS
Interprofessional education; neonatal medicine; teamwork; curriculum

Introduction

Neonatal medicine encompasses the care of critically ill newborns affected by a multitude of disease processes. These include respiratory failure, congenital cardiac disease, infection, and gastrointestinal anomalies to name a few. These patients represent a vulnerable population that requires comprehensive care provided by multidisciplinary healthcare staff and families. The ability to provide optimal care is based on all providers working synergistically as a team in the intensive care environment.

Interprofessional education (IPE) is a process that *'Occurs when learners from two or more professions learn about, from, and with each other to enable effective collaboration and improve health outcomes'* as noted by the World Health Organization (WHO) (Gilbert et al. 2010). Interest in the IPE educational strategy has increased over the years, especially in pre-professional undergraduate and medical student education (Reeves et al. 2016). The importance of multidisciplinary healthcare team education in various learning environments including classroom sessions, skills labs, and clinical rotations are frequently utilized in undergraduate and medical school programs. Such models are used to emphasize and develop important team-building competencies comprising systems-based practice, communication skills, and efficiency (Kashner et al. 2017). IPE has the potential to strengthen healthcare teams and impact patient outcomes in a multi-disciplinary clinical environment such as neonatal intensive care and neonatal resuscitation.

The National Academy of Medicine's (NAM) (formerly called Institute of Medicine (IOM) until 2015) most recent consensus statement stresses the need for rigorous evidence in evaluating the role of IPE in continuing medical education (IOM 2015). Optimizing patient care to improve outcomes requires the involvement of multiple stakeholders with a common mission, vision, and goal. A recent

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Practice points

- IPE in neonatal medicine should be explicit in and report the conceptual framework and program development.
- Pedagogy with a combination of synchronous and asynchronous methods including didactics, virtual learning and simulation may be successful for IPE.
- Best practices for IPE included soliciting buy-in from leadership, adequate representation and elimination of hierarchy amongst professional groups to better understand roles, access to teaching sites including schedule flexibility and location, and a focus on communication.
- Future innovations need to focus on interventions that promote flexibility due to asynchronous or virtual methods and demonstrate the impact of the educational interventions on enhancement of patient health and organizational practice changes.

systematic review on IPE suggests that it can improve learner's attitudes, skills, and knowledge along with a greater appreciation of collaborative learning (Reeves et al. 2016). Establishing effective and safe collaborative practice in an organized manner may narrow gaps in knowledge, sustain knowledge content, and potentially reduce errors in patient care by highlighting the value of shared accountability (Golom and Schreck 2018).

TeamSTEPPS (Team Strategies and Tools to Enhance Performance and Patient Safety) and CRM (Crisis Resource Management) are standardized curricula for team training that have shown effectiveness in role understanding, team behaviors, and compliance with established unit protocols within intensive care medicine (Low et al. 2018). TeamSTEPPS is a robust system (with training tools), and commonly includes multi-professional personnel to enhance its training effectiveness. Emerging evidence suggests that IPE has a role in healthcare due to its effective promotion of collaboration within a shared learning environment that fosters a culture of teamwork, collegiality, and psychological safety (Frenk et al. 2010). In conjunction with established team-training programs, IPE can be a useful approach to implement programs to promote principles of safety, communication, and satisfaction for patients and providers (Low et al. 2018).

Evidence-based guidance in the development of IPE programs is paramount for designing the most effective programs. Educational methods for IPE that are based on varying theories and their effect on provider and patient outcomes need to be systematically studied. There has been extensive literature reported on the model of IPE and its development and implementation. However, scholars have recently critiqued the IPE model's applications for being insufficiently grounded in theories, pragmatic constraints due to complexity and cost, and the absence of a link to important outcomes (Paradis and Whitehead 2018). Some evidence in IPE practice exists in neonatal medicine, but with unclear knowledge about what make up better practices for IPE within the field where inter-professional collaborative practice is critical. This BEME review will focus on effective IPE programs that address knowledge, behavior, and outcomes for professionals working in neonatal medicine.

Review of objectives

- To review the literature by systematically searching online medical and education databases and identify and summarize data involving IPE in neonatal medicine
- To describe the IPE program in regard to setting, participants, content, context, educational methodology, and scope
- To evaluate the outcomes of the IPE program using Kirkpatrick's levels of evaluation (Kirkpatrick et al. 2004)
    - Self-reported satisfaction
    - Self-reported confidence
    - Measures of change in knowledge, skills, and attitudes of health care professionals participating in IPE
    - Measures of patient outcomes or organizational changes
- To identify the effect of IPE programs on patient outcomes
- To formulate a conceptual framework and recommendations for developing an IPE program based on the results of this focused review

Methods

We reported the review in accordance with the STORIES statement, publication standards for healthcare education evidence synthesis (Gordon and Gibbs 2014), and the focused review deployed in line with specific guidance (Gordon et al. 2019). Preliminary searches were performed to refine the search syntaxes, clarify the inclusion and exclusion criteria, and develop a search strategy for the review.

Search sources and strategies

We initially performed a pilot search that informed our objectives, process, and outcomes of this protocol. A study protocol was completed *a priori* and uploaded into the study repository on the BEME website.

Our search sources included PubMed, Embase, Cumulative Index to Nursing & Allied Health Literature (CINAHL), Web of Science, Academic Search Complete, the Cochrane Central Register of Controlled Trials (CENTRAL) of the Cochrane library, and Ovid MEDLINE (up to 10 September 2020). In addition, Education Resources Information Center (ERIC), Database of Abstracts of Reviews of Effects (DARE), MedEdPublish and the Journal of Interprofessional Education were also searched.

We also searched abstracts of relevant conferences and Google (www.google.com and Google Scholar) and databases such as Opengrey for relevant grey literature such as organizational policy documents, clinical practice guidelines, and doctoral theses. We limited the search to English language and human studies. An a priori decision was made to screen only the first 100 Google search results after considering the time required for screening and the insignificant yield from further screening. Any article or

study with suggested 'similar articles' were further explored to include relevant literature such as abstracts.

We used a search strategy that included keywords and controlled vocabulary (e.g. MeSH). Examples of such keywords included:

- Interprofessional, inter-professional, interdepartmental, interdisciplinary, interdisciplinary, multidisciplinary, multi-disciplinary, inter-occupational, multi-professional, team, teamwork
- Education, training, curriculum, coursework, workshop, simulation, student, learner
- Neonatal, NICU, infant, newborn, baby

The final search strategy employed is listed in Supplemental Appendix 1.

The following elements were taken into consideration when a decision was made whether to include or exclude the abstract:

Study selection

Inclusion criteria

Studies were included only if they reported a formal IPE program in neonatal medicine comprising two or more of health professional groups. They could be interprofessional providers including physician providers, advanced practice providers, nurse practitioners, nurses, respiratory therapists, dieticians (nutrition), pharmacists, health professions learners (student, resident and fellow), and physical and occupational therapists. Additionally, studies were only included if they were reported in the English language and were human studies.

Exclusion criteria

Studies were excluded from the review if they met the following criteria:

- The article was a commentary or opinion
- The study relevant to general newborn care or newborn and infants in the outpatient setting (such as infants with disabilities)
- The study in which outcomes were primarily related to maternal care and maternal outcomes
- The study described interprofessional collaboration or care without formal interprofessional education programs
- The study described IPE that occurred with respect to neonates outside of the neonatal intensive care unit (NICU) such as emergency rooms, pediatric intensive care unit, cardiac intensive care unit, community public health programs, and outpatient settings
- The study described IPE as a small component of a larger Quality Improvement project
- The study described IPE related to breastfeeding unless it occurred in the setting of the NICU
- IPE with mixed maternal, perinatal, and neonatal components, unless there was a definite, discrete neonatal component involving neonatal providers

Two authors (SG and GG) independently reviewed the titles and abstracts for study selection. Two authors (SP and RS) independently reviewed full text articles using predetermined inclusion criteria. Disagreements about study inclusion were resolved by a third reviewer (MP).

Data extraction

Two authors (SP and RS) independently extracted data from included studies, the details of which are provided in Supplemental Appendix 2. Data were entered independently by SP and RS using Microsoft Excel, then compared and a consensus was reached. Contextual or process-oriented data (how conceptual framework is used to guide the study) was entered in descriptive text. The impact of the educational program was reported utilizing Kirkpatrick's four-level model of outcomes (Kirkpatrick et al. 2004). Disagreements were resolved by discussion with a third reviewer (MP).

Quality assessment

We used two distinct and complementary instruments to assess quality of the included studies. First, the Medical Education Research Study Quality Instrument (MERSQI) tool with validity evidence was used to assess quality of the study methodology (Reed et al. 2007; Cook and Reed 2015). Two authors (ST and SP) independently assigned scores on various domains of each study (Supplemental Appendix 3). Discrepancies were discussed to derive consensus. Any disagreement was resolved by achieving consensus with a third author (MP). Second, we used the Red-Amber-Green (RAG) (Supplemental Appendix 4) ranking system to determine risk of bias in study reporting. This system has been used in many systematic reviews (Gordon et al. 2020) as a modification from its original description by Reed et al. (Reed et al. 2005). We assessed whether authors adequately reported on five areas related to educational development underpinning theories, resource, setting, educational methods, and content (Supplemental Appendix 2) (Gordon and Gibbs 2014). Items were judged as being high quality and low risk of bias (green), unclear quality and unclear risk of bias (amber), or low quality and high risk of bias due to lack of reporting (red). Two authors (SP and RS) independently appraised the quality of the studies using the RAG system. Thresholds for judgments were discussed before data extraction. Disagreements were resolved through discussion with a third author (MP).

For both instruments, we chose to analyze the score or ranking within each domain without total score or overall rank. We tallied number of score (MERSQI) and color (RAG) by domain to provide insights to risk of bias of the evidence across studies and in different areas.

Evidence synthesis

Given the heterogeneity of the included studies, a meta-analysis was not possible. We synthesized extracted data as a narrative summary. We describe the timing of publication, study context including location, type and number of participants, focus of the program, and their outcomes. The

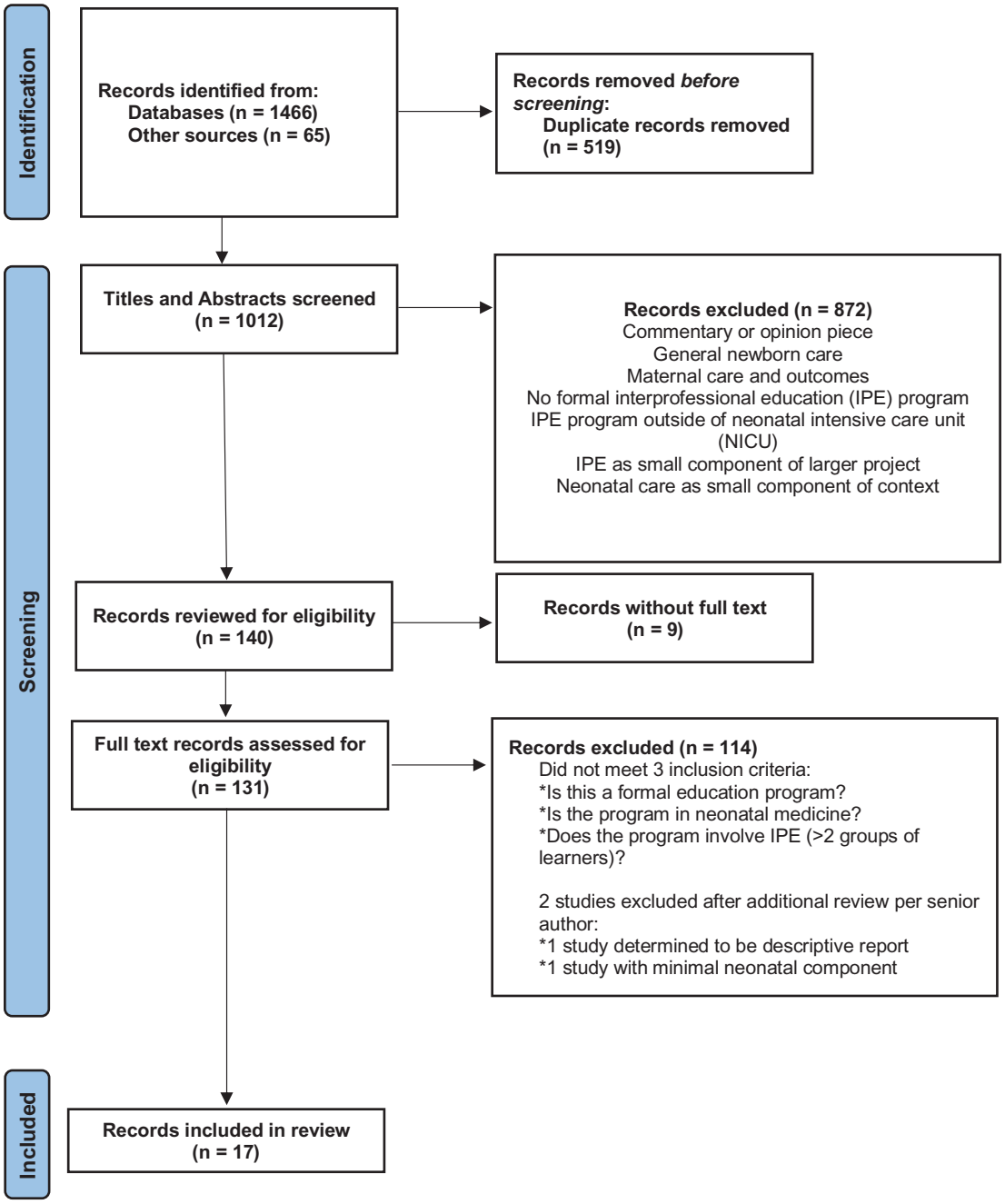

Figure 1. PRISMA flow diagram for the literature search and included studies.

outcomes were classified based on Kirkpatrick's model of outcomes to represent how authors evaluated the IPE, and not to infer hierarchy of evidence or quality of the individual program.

Results

We identified a total of 1466 records through database searching and a further 65 through hand searching. We retained 142 studies after deduplication and title and abstract screening, which then underwent full-text assessment for eligibility. We excluded 112 studies for describing developments not involving neonatal medicine or IPE. Of the 28 studies that remained, we excluded 9 due to lack of full-article availability and an additional 2 studies after additional review. Seventeen articles published from 1996 to 2020 were ultimately included within this review. The study inclusion process is depicted in Figure 1 with the reasons for article exclusion at the full-text eligibility stage (Page et al. 2021). Supplemental Appendix 2 provides a written summary of all the primary studies included in this review.

Geographical location and local specific details

Thirteen (75%) of the 17 studies were published between 2013 and 2019. The geographical distribution is depicted in Figure 2(A), and the majority of the studies were performed in North America; nine in the United States, one in Canada, two in Mexico, and one in Guatemala. Three studies were conducted in Europe: the United Kingdom, Sweden, and Switzerland and one from Asia (India). Study settings included academic institutions (9), private hospitals (5) with tertiary and quaternary NICUs along with community hospitals, and one rural clinic, while two studies did not specify the setting (Figure 2(B)).

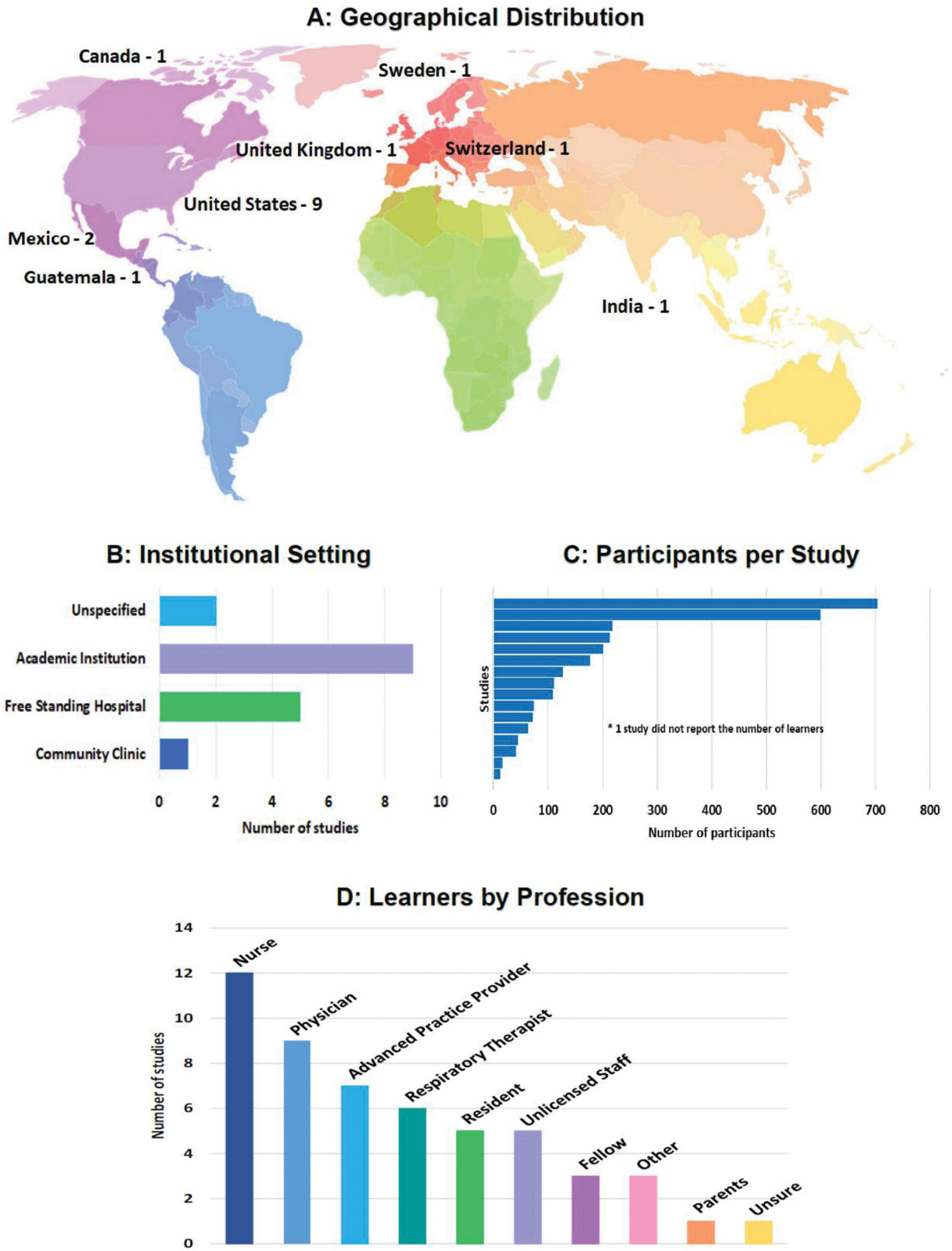

Figure 2. Infographic Summarizing Key Findings. (A) Geographical distribution of included studies, (B) Institutional setting, (C) Participants in included studies, (D) Learners identified by profession, (E) Instructors identified by profession and (F) Instructional methods from IPE programs. Source: Author.

Participant and instructor professions and characteristics

The number of learners in each study ranged from 13 to greater than 700. Seven studies provided instruction to fewer than 100 learners, an additional 7 studies instructed 100–220 learners, and 2 studies enrolled more than 600 learners (Figure 2(C)). The distribution of learners across multiple professions is shown in Figure 2(D). Learners included nurses, respiratory therapists, neonatal nurse practitioners, patient care technicians, unit communication associates, parents, early interventionists, physicians (neonatologists, anesthesiologists, obstetricians), traditional birth attendants, and medical trainees (neonatology fellows, pediatric residents, midwifery students, physician assistant students, and nursing students). Six studies included two different categories of learners, and the remaining 11 had three or more learner categories.

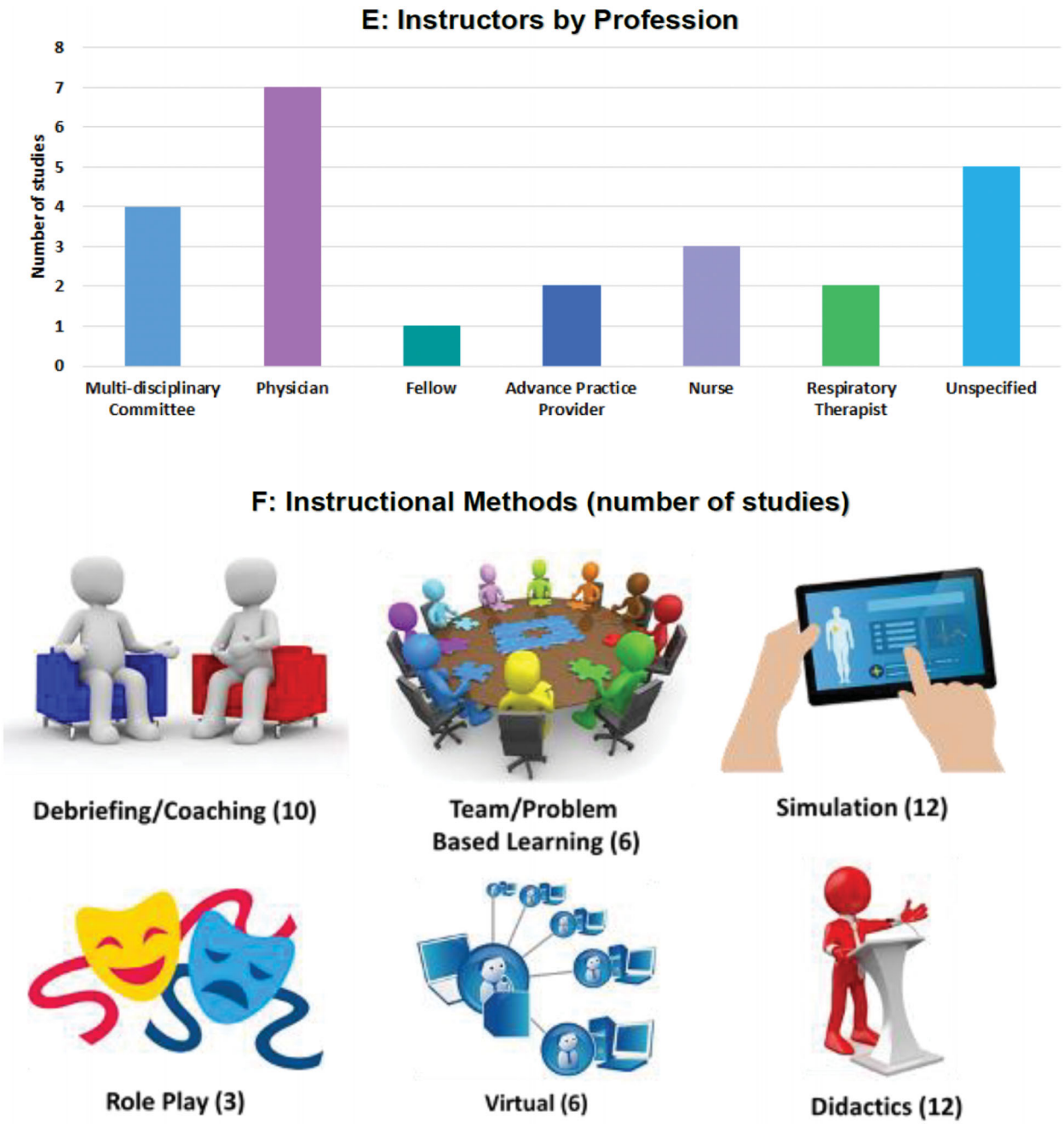

Figure 2. Contined.

Instructor education and training varied widely amongst the studies as depicted in Figure 2(E). Six studies provided no details about the instructors. Seven studies reported multidisciplinary instructors belonging to physicians of various specialties (neonatology, obstetrics, and anesthesia), nurse practitioners, registered nurses, respiratory therapists, and neonatology fellows. Four studies listed instructors of 1–2 disciplines only (physicians, nurses, NICU education team, etc.). Only four studies included details on the training provided to instructors, which varied in length from 2 days to 1 week prior to the educational intervention (Wilson et al. 1996; Greer et al. 2019; Zell et al. 2019; Johnson et al. 2020).

Educational outcomes

All of the included studies reported level 2 outcomes of Kirkpatrick's model, which correlate to acquisition of knowledge and skills (Figure 3). Thirteen studies reported participant reaction (level 1), four studies reported an impact on behavior (level 3), and four studies reported an impact at the organizational level or on patient care (level 4). Due to the heterogeneity amongst the studies and their reported outcomes, we were unable to perform a quantitative meta-analysis.

Quality assessment of included studies

Risk of bias in study reporting

None of the studies were rated as low risk of bias across all five domains. The distribution of the risk assessments is presented in Figure 4. Only one study was rated as low risk in four domains, with the exception of resource bias (Brodsky et al. 2013). Eight studies reported varying amounts of detail in all five domains (Wilson et al. 1996; Walker et al. 2012; Boss et al. 2013; Brodsky et al. 2013; Sawyer et al. 2013; Puchalski 2015; Johnson et al. 2020; Naef et al. 2020). It is worth noting that 53% of the papers

were determined to have low risk of educational bias by providing sufficient details on instructional methods. Two exemplary papers, deemed at a low risk of bias, clearly described useful information pertaining to theoretical underpinning, program development, and Kirkpatrick's outcomes (Brodsky et al. 2013; Puchalski 2015). The individual ratings and complete quality assessments of the included studies are depicted in Supplemental Appendix 2 (column risk of bias in study reporting).

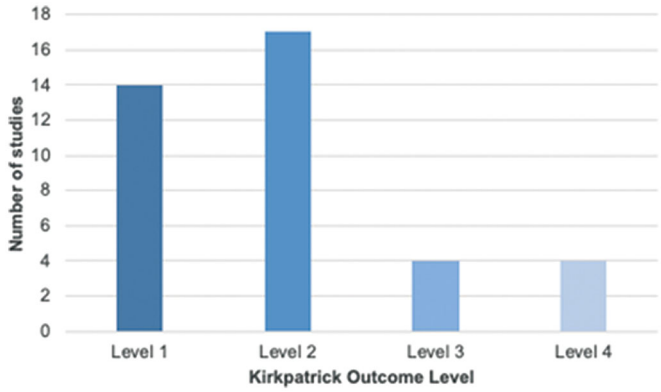

Figure 3. Kirkpatrick levels reported amongst the studies.

Risk of bias in study methodology

Overall, the quality of study methodology using MERSQI revealed low scores across most domains, with the exception of participant response rate and objective data assessment (Supplemental Appendix 2, column risk of bias in study methodology (MERSQI)). Most studies were of moderate quality, with a few performing with exceptional rigor across multiple domains (Walker et al. 2012, 2014, 2015). The results were further examined to assess patterns in the data (Figure 5). Single-group pre-post design was the most commonly utilized. Only one study utilized a non-randomized two group design. The majority of studies sampled a single institution and the remaining sampled three or more institutions. Sampling response rates were $\geq$75% in all studies except one with a response rate $<$50%. Thirteen studies presented objectives, while the remaining focused on assessment by study participants. Validity evidence was not reported in six studies and was the weakest domain noted on assessment. Data analysis sophistication and appropriateness were one of the strongest domains and went beyond descriptive analysis in nearly all studies with the exception of one. Kirkpatrick outcomes distribution showed five studies reporting satisfaction/attitudes/perceptions, five studies reporting knowledge/skills, four studies reporting behaviors, and three studies reporting patient/healthcare outcomes.

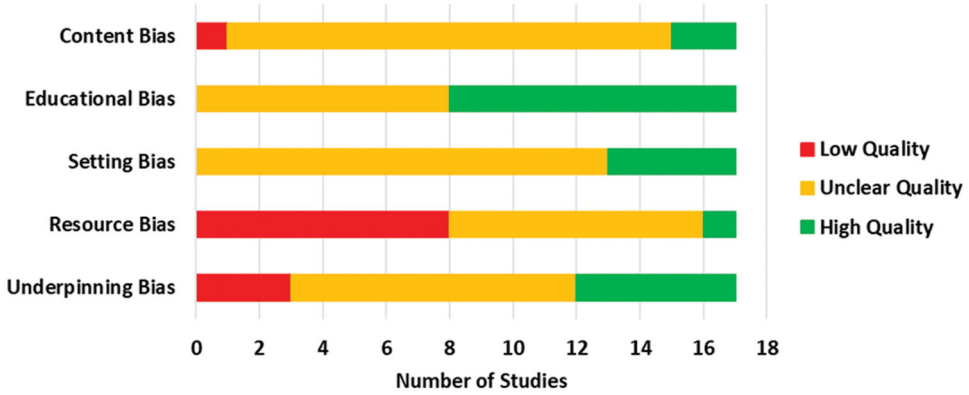

Figure 4. Risk of bias in study reporting by the RAG system.

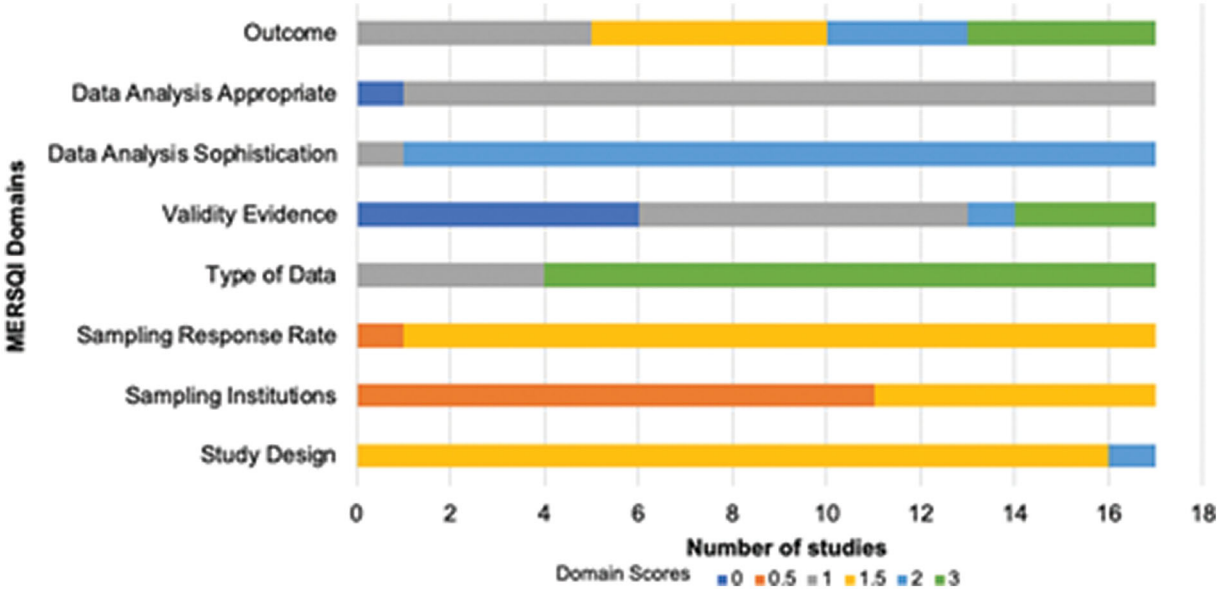

Figure 5. Risk of bias in study methodology by the MERSQI instrument.

Learning objectives

Nine papers described IPE focused on improving neonatal resuscitation skills (Walker et al. 2012; Fang et al. 2014; Walker et al. 2014, 2015; Malmstrom et al. 2017; Swamy et al. 2018; Greer et al. 2019; Zell et al. 2019; Johnson et al. 2020). Three papers described curricula to enhance teamwork and communication skills amongst providers (Boss et al. 2013; Brodsky et al. 2013; Sawyer et al. 2013). The remaining five papers described education to address specific neonatal processes encountered during hospitalization. Two papers described education aimed at improving family-centered care and early intervention protocols during the inpatient experience (Wilson et al. 1996; Naef et al. 2020). One paper centered on enhancing the awareness of multi-disciplinary collaboration within perinatal-neonatal palliative care (Price et al. 2019). One paper described a curriculum to improve knowledge of non-invasive ventilation (Paterson et al. 2016) and another paper addressed the identification and management of neonatal abstinence syndrome (Puchalski 2015).

Theoretical frameworks

We identified the underpinning frameworks explicitly reported in the papers including theories, conceptual frameworks, models, and principles (Mann et al. 2011) (Supplemental Appendix 2, column conceptual framework). Six papers described the use of TeamSTEPPS to support the program development (Walker et al. 2012; Brodsky et al. 2013; Sawyer et al. 2013; Walker et al. 2014, 2015; Greer et al. 2019). Some other frameworks included multimedia, adult learning, and action research process (Wilson et al. 1996; Price et al. 2019; Johnson et al. 2020). Most articles utilized only one framework; however, two papers reported up to three (Puchalski 2015; Swamy et al. 2018). The authors of one paper used a recognized approach, the Calgary Family Assessment and intervention model (Naef et al. 2020). Three papers did not mention the use of any frameworks to guide development (Fang et al. 2014; Malmstrom et al. 2017; Zell et al. 2019).

Instructional methods

A variety of instructional methods were used for IPE. All studies incorporated at least two methods and most (76%) more than three **(**Figure 2(F)**)**. Twelve papers described the use of high-fidelity, virtual patient simulation (Wilson et al. 1996; Walker et al. 2012; Boss et al. 2013; Sawyer et al. 2013; Fang et al. 2014; Walker et al. 2014, 2015; Malmstrom et al. 2017; Swamy et al. 2018; Greer et al. 2019; Zell et al. 2019; Johnson et al. 2020). These studies also integrated structured debriefing sessions using various techniques such as the SHARP tool (Set learning objectives, How did it go, Address concerns, Review learning points, Plan ahead) (Johnson et al. 2020), Harvard method (Swamy et al. 2018), and video assistance (Walker et al. 2012, 2014, 2015; Malmstrom et al. 2017). Instructor and peer coaching were described as tools to provide real-time feedback to learners (Boss et al. 2013; Price et al. 2019; Zell et al. 2019; Naef et al. 2020). Role-play with trained actors and/or peer learners was used to facilitate discussion in small groups (Wilson et al. 1996; Boss et al. 2013; Naef et al. 2020).

Six papers employed team-based learning and problem-based learning to promote learner engagement and enhance interprofessional interactions (Wilson et al. 1996; Walker et al. 2012; Brodsky et al. 2013; Walker et al. 2014, 2015; Price et al. 2019). Didactic education was described in twelve papers with sessions ranging from thirty minutes to four hours (Wilson et al. 1996; Walker et al. 2012; Brodsky et al. 2013; Sawyer et al. 2013; Walker et al. 2014, 2015; Paterson et al. 2016; Malmstrom et al. 2017; Swamy et al. 2018; Price et al. 2019; Zell et al. 2019; Naef et al. 2020). In some papers, the didactic session was supplemented with hands-on technical skills training of procedures (Malmstrom et al. 2017; Swamy et al. 2018), simulation materials (Walker et al. 2012; 2014, 2015), non-invasive ventilation equipment (Paterson et al. 2016), and emergency evacuation equipment (Zell et al. 2019).

Resources utilized for instruction

The most commonly used resource was a physical room or space to conduct didactic sessions, workshops, simulation exercises, or other team training that allowed instructors and interprofessional learners to be present concurrently (Wilson et al. 1996; Walker et al. 2012; Boss et al. 2013; Brodsky et al. 2013; Sawyer et al. 2013; Walker et al. 2014, 2015; Paterson et al. 2016; Swamy et al. 2018; Price et al. 2019; Zell et al. 2019; Naef et al. 2020). Two programs specifically reported that the instruction occurred at a simulation center (Fang et al. 2014; Malmstrom et al. 2017). Only one paper required the use of trained actors (Boss et al. 2013). Few papers described the use of live-recording of simulations or video-conferencing software requiring real-time audiovisual link for instruction (Walker et al. 2012; Fang et al. 2014; Walker et al. 2014, 2015). Several articles reported utilization of previously recorded videos or online modules that were presented during the learning sessions or independently reviewed by the learner (Wilson et al. 1996; Brodsky et al. 2013; Sawyer et al. 2013; Puchalski 2015; Swamy et al. 2018; Johnson et al. 2020). Several papers highlighted use of materials to simulate neonatal or obstetric resuscitation including mannequins (low- or high-fidelity) including syringes, airway equipment, birth simulator and others (Sawyer et al. 2013; Fang et al. 2014; Paterson et al. 2016; Malmstrom et al. 2017; Greer et al. 2019). Learners required access to and the use of online-connected computers to view and complete online modules and knowledge assessments on rare occasions (Puchalski 2015; Johnson et al. 2020). No article mentioned the human resource, time investment for tool or session development, or financial costs of the program.

Instructor disciplines and training

There was wide variation amongst the studies in the disciplines of the instructors and the training they underwent prior to the sessions **(**Figure 2(E)**)**. Physicians were the most frequently utilized group of instructors, specifically neonatologists (Walker et al. 2012; Boss et al. 2013; Brodsky et al. 2013; Fang et al. 2014; Walker et al. 2014; Greer et al. 2019; Johnson et al. 2020; Naef et al. 2020). Nurses were the next

most frequently reported group and participated in six programs (Walker et al. 2012; Brodsky et al. 2013; Walker et al. 2014; Malmstrom et al. 2017; Greer et al. 2019; Price et al. 2019). Only one paper identified neonatal nurse practitioners serving in the role of instructor (Brodsky et al. 2013) while three papers identified respiratory therapists (Brodsky et al. 2013; Paterson et al. 2016; Johnson et al. 2020). Trainees, while frequently learners, rarely served as instructors with the exception of a single program (Johnson et al. 2020). Varying nursing personnel such as clinical nurse specialist, manager, and midwife, were reported to have led programs in six papers (Brodsky et al. 2013; Walker et al. 2014; Puchalski 2015; Malmstrom et al. 2017; Price et al. 2019; Naef et al. 2020). Heterogenous, descriptive terms were used to describe cohorts of instructors, such as NICU Training Project group and TeamSTEPPS trainers, in four articles. However, the composition of instructors and additional details were not included (Wilson et al. 1996; Sawyer et al. 2013; Swamy et al. 2018; Zell et al. 2019). One paper did not identify any instructors (Walker et al. 2015).

In addition to the variation of instructor groups, there was also wide variation in instructor training and preparation reported. Only two articles reported formal training sessions for their instructors that consisted of either an intensive session of feedback or a 'Train the Trainer' institutional program (Boss et al. 2013; Brodsky et al. 2013). Informal coaching or a meeting in proximity to the sessions was reported in three papers (Fang et al. 2014; Price et al. 2019; Johnson et al. 2020). Instructional materials were distributed prior to teaching sessions for review by two programs (Johnson et al. 2020; Naef et al. 2020). The majority of the articles did not explicitly describe instructor training methods (Wilson et al. 1996; Walker et al. 2012; Sawyer et al. 2013; Walker et al. 2014, 2015; Puchalski 2015; Paterson et al. 2016; Malmstrom et al. 2017; Swamy et al. 2018; Greer et al. 2019; Zell et al. 2019).

Thematic analysis of program development

Additional insights and lessons learned

After reviewing the narrative summary, reading all included studies and being sensitized by contemporary IPE literature, two authors (SP and ST), with professional backgrounds in an intensive care setting requiring interprofessional collaborative practice, discussed and thematized interpretive insights through a constant comparison method.

Teams and teamwork as the omnipresence of interprofessional education. Though TeamSTEPPS was used as an explicit framework for over a third of the included studies, its components, leadership, communication, mutual support, and situation monitoring were shared objectives in most of the remaining studies. TeamSTEPPS, created by the US Department of Defense Patient Safety Program and the Agency of Healthcare Research and Quality, was aimed at training professionals in teamwork skills that yield improved patient outcomes (King et al. 2008). Despite being an exemplary curriculum, its focus is primarily on only one of the four domains of the core competencies of interprofessional collaborative practice. It is noteworthy that these well-established core competencies endorsed by the Interprofessional Education Collaborative were only briefly mentioned by one paper (Boss et al. 2013) out of the 17 included studies.

Using asynchronous instruction to increase participation and flexibility. Challenges to synchronous delivery include coordinating participation and scheduling multiple interprofessional staff due to clinical service obligations, remote location, or lack of availability. As a result, a few studies reported one of the limitations to be unequal distribution of interprofessional team members that altered the focus of the program or diminished the intended teamwork skill experience. To address these, two studies successfully delivered supplemental didactic modules asynchronously in addition to synchronous instruction. One study used a multimodal, interactive strategy that incorporated web-based learning modules, including a video (Johnson et al. 2020). Another study employed asynchronous online instruction as an adjunct to existing classrooms so the whole program successfully evolved into a complete asynchronous instruction (Puchalski 2015).

Greater insights from hidden curriculum. There are some insights gained from the included studies that shed some light on benefits of and essential features for successful IPE. While not explicitly stated in learning objectives, learners reported greater understanding of each other's roles in the workplace. One program identified the crucial role of empowering interprofessional learners and used a learner-centric approach by soliciting opinions and creating an iterative process throughout instruction (Brodsky et al. 2013). The authors attributed the elimination of hierarchy and allowing all participants to serve as 'leaders' and 'trainers' as a factor in enhancing the learning environment to maximize educational outcomes. In a workshop led by a non-physician instructor, the objectives and content were built around the premise that the roles and responsibilities of one discipline may not be apparent to others (Paterson et al. 2016). A collaboration amongst nursing and midwifery groups led to reports of value and understanding in learning from different professions and an understanding of mutual roles (Price et al. 2019). The authors surmised co-facilitation of instruction by staff from both groups may have contributed to this outcome.

Discussion

Summary of results

We identified and summarized data from 17 studies in teaching and training interprofessional staff that can serve to guide future educational program development in neonatology. The majority of the programs sought to disseminate existing knowledge and practices through workplace-based learning. Educators largely utilized synchronous formats that promoted team dynamics and communication. Asynchronous learning was apparently lacking as only two included studies described an asynchronous activity; one as a part and the other as an entire program (Puchalski 2015; Johnson et al. 2020). This method of instruction promotes flexibility and could be considered in future developments. Simulation with subsequent

debriefing and feedback, and didactics were the frequently used instruction modalities, with occasional use of online and team or problem-based learning. Most IPE programs involved instruction of neonatal resuscitation skills and behavior, teamwork and communication skills. A few studies addressed specific disease processes and their management, family-centered care, and palliative care.

Quality of evidence

Quality of study methodology and reporting were assessed to be low by the MERSQI and RAG risk of bias assessments. Reported IPE programs suffer from lack of methodological rigor with poor design, development without the guidance of theory, and reporting of low levels of Kirkpatrick outcomes. Reporting of resources was notably lacking as opposed to underpinning, educational methods, or content. Many of the authors shared various strategies to disseminate the content including supplemental appendices, website links, and detailed reporting within the article. None of the studies reported financial, human, or time costs to develop and deliver instruction. This lack of reporting is a pervasive gap within medical education literature and leads to replicating the development of costly 'new' programs that seek to achieve similar educational objectives. TeamSTEPPS was the predominant theory guiding the decisions amongst multiple programs and may serve as the gold standard for future programs. Additionally, the design and foci of many of the studies were founded on observing and responding within the environment to enhance learning and collaborative behaviors. Despite this aspect no study explicitly mentioned Bandura's social learning theory, which describes how learning can occur through observation and modeling of behaviors and can lead to change in a learner's actions (Bandura 1977). Without integrating the fundamentals of Bandura's theory into program design, significant domains that contribute to interprofessional work will remain unexplored.

Few papers exhibited strong scholarship with a high-quality report of their development and results of their impact (Brodsky et al. 2013; Johnson et al. 2020; Naef et al. 2020). Brodsky et al. developed a team-based learning program with a focus on communication, leadership, peer support, and situation monitoring with the purpose of reducing medical errors and impacting patient outcomes (Brodsky et al. 2013). This program was an exception for its strong underpinning, construct, practicality, and effectiveness leading to process improvement of attendance and participation at team meetings and increased assistance in care delivery. Another paper delivered a multi-modal approach to neonatal resuscitation skill instruction that included asynchronous and synchronous components (Johnson et al. 2020). The authors concluded the education was effective in increasing knowledge of neonatal principles and led to a greater understanding of the interprofessional role of others. Naef et al. selected a longitudinal approach over eight months to improve family-centered care (Naef et al. 2020). While there was no reported change in attitudes of the participants, there was a reported increase in practicing the skills gained and greater competency in establishing a therapeutic relationship with families. Two of these studies reached Level 3 of Kirkpatrick's outcomes (Brodsky et al. 2013; Naef et al. 2020) and one reached Level 2 (Johnson et al. 2020).

Comparison with existing literature

Hammick et al. published a systematic review on evaluations of formal IPE experiences (Hammick et al. 2002), which was later updated by a follow-up systematic review (Reeves et al. 2016). The findings were reported using the 3-P model (presage-process-product) (Biggs 1993). This model of learning and teaching is based on identifying the presage factors (sociopolitical context affecting learners), process factors (instructional methods), and product factors (learning outcomes). Many of the findings parallel those found in our review, including the importance of resources such as time, spatial factors, and buy-in from management. These key determinants can support program establishment, creation of relevant context, and examination of complex interactions amongst team members. Previous reviews reported gender as a factor that influenced attitudes towards teamwork instruction and experience. This should be explored in future work given that women form a larger part of the neonatal workforce than men. A related scoping review by Chen et al. described curricula developed using the TeamSTEPPS framework (Chen et al. 2019). The framework provided flexibility and was applied in varying combinations to diverse health professions programs. As was also noted in our review, TeamSTEPPS framework was deemed adaptable to multiple educational contexts and hence should be utilized for future work. Engaging with other professions to improve intergroup relationships also supports findings that contact theory either implicitly or explicitly guides most IPE (Paradis and Whitehead 2018). Extrapolating from contact theory, developed by Allport in 1954, exposure to diverse roles may improve the quality of interactions. However, this is dependent on a sense of equality being established, anticipating that individuals who are compelled to interact together often respond negatively (Allport 1954). Amongst the findings of the review articles, learners reported a deeper appreciation of each other's disciplines which is emphasized by organizations such as the WHO and NAM (Paterson et al. 2016). These findings and contact theory supports our insights that a high-quality offering will aim to equalize status amongst learners to boost collaboration.

Strengths and limitations

The strengths of this review include utilizing '*a priori* protocol', a comprehensive search strategy, and rigorous assessment of study methodology and reporting using the MERSQI and RAG systems. We have a multidisciplinary author group including a nurse, respiratory therapist, neonatal nurse practitioner, librarian, and physicians which brought together varied expertise and skill sets, a strength of this review. The process of study selection and data extraction was performed independently by two authors and consensus achieved by a senior author.

While we created a consensus definition of an educational program, it is possible that innovations that did not align with our definition may have yielded valuable insight. Additionally, we may have limited the scope of our

understanding of interprofessional education by focusing on neonatal medicine and future reviews could focus on other health professions to expand knowledge.

Recommendations for future research and practice

Neonatal IPE has traditionally been delivered in synchronous, in-person classes with conventional instructional methods, which has been challenged by the COVID-19 pandemic. Many programs would have been completely stalled given logistic issues imposed by the pandemic. Emergency online learning replacing a classroom with a video conferencing platform, as experienced by all, have posed significant challenges to educators even in a regular session, let alone an IPE. Scholars have criticized an overreliance on contact theory for most IPE programs, bringing different professionals to learn together, as an overly simplified and maybe ineffective approach. Despite great intention, this approach often worsens professional stereotypes and reinforces hierarchies (Paradis and Whitehead 2018). We assert that technology-enhanced asynchronous learning (or a hybrid with remote learning), informed by proper theories or best practices, can facilitate formation of psychologically safe environment and flattened professional hierarchies that empower learners to engage in meaningful IPE. Greater consideration of using alternative methods such as asynchronous and flipped classrooms, particularly for topics such as communication and team dynamics, may lead to increased participation, similar learner engagement, and fulfillment of program objectives.

IPE programs should utilize conceptual frameworks to underpin their work, instructor development and training, and IPEC competencies of values and ethics for interprofessional practice, roles and responsibilities, interprofessional communication, and teamwork (IOM 2015). Any chosen pedagogical approach to address these competencies should prioritize elimination of hierarchy amongst learners to create psychological safety, promote dialogue, and enhance understanding of each other's roles. Finally, as Paradis et al. stated, 'health care is an inertial system' and IPE is insufficient to transform outcomes (Paradis and Whitehead 2018). In addition to IPE, we must also examine sociocultural contexts, financial, and organizational factors that impact health care delivery. Future work should incorporate theory evidence, longitudinal measures of knowledge and teamwork skills, particularly within the workplace-based environment.

Conclusions

This review highlights components of IPE programs within neonatal medicine and identifies best practices including a multimodal instructional approach, asynchronous instruction, an emphasis on teamwork, and elimination of hierarchy amongst learners during instruction. We identified a lack of reporting of the program development process and training of instructors. Future work should address the impact on long-term knowledge and skill retention in learners and report patient outcomes and organizational change. The dynamic instructional strategies identified in this review offer guidance for future IPE programs in neonatal medicine and other fields.

Plans for updating the review

The review team would be glad to update this review in the future in light of new information whenever appropriate.

Differences from the published protocol (posteriori changes)

Scopus could not be searched because the TMC library lost access. Instead, we searched the Web of Science. Additional exclusion criteria was determined through an iterative process of reviewing the search results to ensure alignment with the objectives of this focused review and those criteria were the following: the study described IPE that occurred with respect to neonates outside of the neonatal intensive care unit (NICU) such as emergency rooms, pediatric intensive care unit, cardiac intensive care unit, community public health programs, and outpatient settings, the study described IPE as a small component of a larger Quality Improvement project, the study described IPE related to breastfeeding unless it occurred in the setting of the NICU, and IPE with mixed maternal, perinatal, and neonatal components, unless there was a definite, discrete neonatal component involving neonatal providers.

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Glossary

Interprofessional education (IPE): Is a process that 'Occurs when learners from two or more professions learn about, from, and with each other to enable effective collaboration and improve health outcomes' as noted by the World Health Organization.

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