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Review

Assessment methods and tools to evaluate postgraduate critical care nursing students' competence in clinical placement. An integrative review

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ABSTRACT

Aim: To provide an overview of assessment methods and tools to evaluate postgraduate critical care nursing students' competence in clinical placement and to identify recommendations for future assessment methods.

Background: The purpose of postgraduate critical care nursing education is to educate professional, competent and caring critical care nurses and high-quality assessment strategies in clinical placement are of most importance.

Design: An integrative review following Whittemore and Knafl's framework and Prisma 2020 guidelines for systematic reviews.

Methods: Systematic searches were performed in June 2020 with an update in April 2021 using the following: Academic Search Premier, British Nursing Index, CINAHL, MEDLINE, SveMed+, Web of Science and the Joanna Briggs Institute databases. The systematic literature search and hand search yielded 380 studies. After screening and checking for eligibility, fifteen studies published between 2005 and 2020 were included in this review. The included studies were critically appraised using the Mixed Methods Appraisal Tool for empirical studies and the Joanna Briggs Institute Critical Appraisal tool for literature reviews.

Results: Four qualitative, six quantitative, three mixed-methods and two literature review studies were included in this review. We identified that competence in postgraduate critical care nursing is a multidimensional concept and it is recommended to use a combination of assessment methods like self-assessment, observation and mentor evaluation. It is necessary to have discussions and reflections between the student, preceptor and lecturer, as well as written self- and mentor evaluation to provide formative and summative feedback to the students.

The need to provide consistency and objectivity resulted in the development of competency assessment tools and they were mostly developed and validated as a collaboration between clinical sites and educational institutions. Most of the assessment tools consisted of domains reflecting holistic nursing, including both technical and non-technical skills. Domains reflecting evidence-based nursing practice were less common.

Conclusions: We need valid and reliable instruments to assess postgraduate critical care nursing student's competence in placement. Innovation and further research regarding effective and accessible assessment methods, such as digital assessment tools, are needed to meet future needs. This may also stimulate collaboration to improve the international inconsistency in critical care nursing educations. We should be working towards common, international educational competence descriptions and assessment tools that are in line with the ever-changing critical care environment, including holistic nursing and continuous learning.

1. Introduction

Health care is rapidly changing and has become increasingly specialized and complex. The goal of health care is to give safe and high-quality care and nurses 'competence is important to achieve this goal (ICN, 2020; Willman, Bjuresater, and Nilsson, 2020). High quality education is essential to develop competent health care professionals who can deliver safe, quality care (World Health Organization [WHO], 2016). Some critical care professional organizations claim that the complexity of nursing in intensive care units (ICU) requires a post-graduate education program to provide advanced specialist level nurses. There are reports of benefits like higher level of critical thinking,

Abbreviations: ICU, Intensive care unit; CCN, Critical care nursing; CCNs, Critical care nurses.

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increased confidence as team members in interdisciplinary teams, personal and professional growths, fewer ICU and hospital readmissions and improved survival and mental health outcomes that supports this claim (Gullick et al., 2019; Mykkeltveit, Gundersen, and Dysvik, 2021).

The aim of postgraduate critical care nursing (CCN) education is to educate professional, competent and caring critical care nurses (CCNs) who can integrate advanced theoretical knowledge and practical and interpersonal skills to take care of critically ill patients (DeGrande et al., 2018; Gullick et al., 2019). Clinical placement with an appropriate assessment strategy is an essential part of the students' educational process and supervision and assessment strategies are important to ensure postgraduate CCN students' learning and development (Immonen et al., 2019; Vae et al., 2018). The assessment of postgraduate CCN students' competence in clinical placement can be especially challenging and complex for educators. Since the students already are qualified nurses, it can be difficult to identify and assess what nursing competence is at a more advanced level. Moreover, the simultaneous assessment of students' competence and caring for critically ill patients and their next of kin can be challenging for preceptors (Helminen et al., 2017; Jølstad et al., 2019).

1.1. Background

It is important to both recruit and retain postgraduate CCNs, who are one of the most valuable resources in health care (Hansen et al., 2011; Kaldan et al., 2019; Moloney-Harmon, 2010). However, it is also necessary to ensure that the health care professionals have the appropriate knowledge and skills competencies relevant to the needs of the patients (WHO, 2013).

Since the time of the Nightingale school, it has been a tradition that learning the nursing profession takes place through practical training and mentoring from more experienced practitioners (Nyhagen and Strøm, 2016). There is an increasing demand for clinical nurses to mentor and assess students in clinical practice and both students and preceptors require support from academics in the assessment process (Wu et al., 2015). A formative appraisal allows the educator to evaluate and provide constructive feedback to students, which leads to the summative assessment that describe the students' ability to perform the required skills and competencies based on the learning outcomes (Helminen et al., 2016; Oermann, 2015).

A comprehensive description of postgraduate CCN competencies can articulate acceptable level of clinical skills and knowledge and allow competence to be measured (Zhang, Meng, and Chen, 2019). Identification of advanced practice nursing is challenging because of international inconsistency in terms, competencies, curricula and education duration and level. Globally, postgraduate CCN education should have a common goal and the necessary skills should be in line with the ever-changing critical care environment and critical care practices. (Gullick et al., 2019). For this review, CCN education was defined as a postgraduate certificate, postgraduate diploma or masters-level degree.

1.2. Study aim

The aim of this review was to provide an overview of assessment methods and assessment tools to evaluate postgraduate CCN students' competence in clinical placement and to identify recommendations for future assessment methods.

The research questions were as follows:

1. What assessment methods are used to evaluate postgraduate CCN students' competence in clinical placement?
2. How are the assessment tools developed and validated?
3. Which nursing domains are included in the assessment tools?

2. Methods

2.1. Study design

An integrative review as outlined by Whittemore and Knafl (2005) and Prisma 2020 guidelines (Page et al., 2021) was employed to obtain an overview of studies concerning the assessment of postgraduate CCN students' competence in clinical placement. A preliminary literature search revealed a limited research area that consisted of qualitative, quantitative, reviews and mixed-method studies, therefore the integrative review method was considered appropriate.

This integrative review method allows the combination of diverse methodologies and has the potential to play an important role in evidence-based practice for nursing. The review phases include problem identification, methodological literature research, data evaluation, data analysis and discussion of the findings. In this integrative design, studies are grouped by findings that are viewed as answering the same research question rather than by method (Page et al., 2021; Polit and Beck, 2020; Toronto and Remington, 2020; Whittemore and Knafl, 2005).

2.2. Search strategy

Eligible studies were identified from structured database searches in key electronic databases for nurse researchers: CINAHL, MEDLINE, Academic Search Premier, British Nursing Index, SveMed+, Web of Science and the Joanna Briggs Institute (JBI). Based on preliminary searches, a brief review of headings, abstracts, key words and the topic of review interest, final search terms were chosen using the databases' thesaurus or Medical Subject Heading definitions. The systematic search in databases used a combination of search terms as shown in Table 1. The searches were conducted by the first author and a professional librarian at the University in June 2020 followed by and update in April 2021. Additional studies were identified through manual search in websites (Google scholar, Oria.no) and through citation and reference list searching.

The PRISMA 2020 (Page et al., 2021) checklist with a flow diagram was used to indicate how the inclusion and exclusion of studies was performed (Fig. 1). Articles included in this review met the following criteria: peer-reviewed articles available in full text, primary research, or review articles, published in English or Scandinavian language, focused on assessment of CCN students` competence in clinical placement, postgraduate or master's level CCN education. The date range was without limits.

2.3. Search outcome

Database searching resulted in 356 studies. 24 studies were identified through other sources resulting in a total of 380 studies. After removing duplicates, the titles and abstracts of 289 studies were reviewed by two of the authors. After exclusion based on the titles and abstracts, 48 studies were read in full text and screened according to the content and relevance to the variables of interest. The two reviewers first screened and assessed the studies independently before consensus was reached through discussion. The reason for exclusion after reading full text studies was: 1. studies not focusing on postgraduate CCN education or 2. studies not focusing on assessment of postgraduate CCN students' competence in clinical placement. 15 studies published between 2005 and 2020 (four qualitative, six quantitative, three mixed-methods and two literature review studies) were included in this integrative review (Fig. 1).

2.4. Quality assessment

The first and last author performed a critical appraisal using the Mixed Methods Appraisal Tool version 2018 (Hong et al., 2018) for all the included qualitative, quantitative and mixed-method studies. The

Table 1
Search in databases.

Database	Search terms	Search results (after duplicates removed)	Included research articles
CINAHL	critical care or intensive care or acute care or icu* AND nurse* or nursing, AND (student* N1 assess*) or (student* N1 apprais*) or (student* N1 evaluat*) OR (student* N1 perform*) OR (student* N1 competen*) AND (student* N1 placement*) OR (clinical N1 placement*) or (clinical N1 practice*) or (clinical N1 education*) or (practice* N1 placement*)	82 (65)	
Academic Search Premier	critical care or intensive care or acute care or icu* AND nurse* or nursing, AND (student* N1 assess*) or (student* N1 apprais*) or (student* N1 evaluat*) OR (student* N1 perform*) OR (student* N1 competen*) AND (student* N1 placement*) OR (clinical N1 placement*) or (clinical N1 practice*) or (clinical N1 education*) or (practice* N1 placement*)	14 (11)	
Medline	critical care or intensive care or acute care or icu* AND nurse* or nursing, AND (student* N1 assess*) or (student* N1 apprais*) or (student* N1 evaluat*) OR (student* N1 perform*) OR (student* N1 competen*) AND (student* N1 placement*) OR (clinical N1 placement*) or (clinical N1 practice*) or (clinical N1 education*) or (practice* N1 placement*)	25 (14)	1
British Nursing Index	(AB,TI,SU(("critical care" or "intensive care" or icu* or "acute care") AND (nurse* or nursing) AND (student* assess* or student* apprais* or student* valuate* or student* perform* or student* competen*) AND (student* placement* or clinical placement* or clinical practice* or clinical education* or practice* placement*)))	173 (135)	5
Joanna Briggs Institute	(critical care or intensive care or acute care or icu*).mp. [mp=text, heading word, subject area node, title] AND (nurse* or nursing) AND ((student* adj2 assess*) or (student* adj2 apprais*) or (student* adj2 evaluat*) or (student* adj2 perform*) or (student* adj2 competen*)).mp. [mp=text, heading word, subject area node, title] AND ((student* adj2 placement*) or (clinical adj2 placement*) or (clinical adj2 practice*) or (clinical adj2 education) or (practice adj2 placement*)).mp. [mp=text, heading word, subject area node, title]	23 (20)	
Svemed+	Critical care or intensive care or icu or acute care, AND nurse* or nursing AND student	30 (15)	
Web of Science	TS=("critical care" or "intensive care" or "acute care" or icu*) AND TS=(nurse* or nursing), TS=(student* NEAR/1 assess*) TS=(student* NEAR/1 apprais*) TS=(student* NEAR/1 evaluat*) TS=(student* NEAR/1 perform*) TS=(student* NEAR/1 competen*) #8 OR #7 OR #6 OR #5 OR #4 #9 AND #3 TS=(student*NEAR/1 placement*) TS=(clinical NEAR/1 placement*) TS=(clinical NEAR/1 practice*) TS=(clinical NEAR/1 education*) TS=(practice NEAR/1 placement*)#15 OR #14 OR #13 OR #12 OR #11 #16 AND #10	9 (5)	

MMAT allows for simultaneous evaluation of all empirical literature, making it appropriate for an integrative review. The JBI Critical Appraisal Tool (JBI, 2020) was used for quality assessment of literature reviews (Table 2). Most of the included studies were of high quality, but some of the studies were not rated high on quality due to research design (e.g., discussion or reflection papers and not systematic literature reviews). Studies were not excluded based on quality if they answered the research question, as recommended by Whittemore and Knafl (2005).

2.5. Data analysis

Data analysis was performed as described by Whittemore and Kanfl (2005). The researchers moved from the whole of the articles to the parts that corresponded to the aim and the research questions to create a new whole, which constitutes the results of the literature review. Additionally the researchers used Braun and Clark's (2006) thematic analysis to guide the inductive analysis process.

During the first stage the selected studies were read several times by the research team to obtain an overview of the content. Then a review matrix (Table 3) was created to abstract data from the included studies. We identified the aim, setting and method from each study. Thereafter, the reading focused on the results from each article and themes consistent with the research question like assessment methods, development, validity and content of assessment tools were extracted and put in the review matrix (Table 3).

During the analytic process the research team identified the need to map the nursing domains present in assessment tools of the included studies (Table 4). The content in Tables 3 and 4 was done by the first author. To ensure accuracy, the research team had several discussions about the content of the two tables and the second and third author cross-checked the extracted data with the full text of each study. Throughout the analysis process the research team searched across the review matrix to find repeated patterns and the specific review questions and aim of the study guided this process (Braun and Clarke, 2006; Toronto and Remington, 2020).

3. Results

The 15 included studies, published between 2005 and 2020, were conducted in Australia (5), the United Kingdom (5), Sweden (2), Cyprus (1), Finland (1) and Iran (1).

3.1. Assessment methods

The assessment methods have changed from behavioristic assessment models to more generic and holistic models with a focus on competence (Hanley and Higgins, 2005a). Competence in postgraduate CCN is a multidimensional concept and it is highly recommended to use a combination of different assessment methods, such as self-assessment, observation and mentor evaluation, to assess postgraduate CCN students in clinical placement (Bromley, 2014; Ebadi et al., 2016; Gill et al., 2006; Hanley and Higgins, 2005b; Hatfield and Lovegrove, 2012; Lakanmaa et al., 2014; Lovegrove and Hatfield, 2012; Mårtensson et al., 2020; Mattsson and Stevens, 2016; Ross et al., 2017). The use of competency assessment instruments facilitated changing of student assessment from observation of nursing skills using rating scales and checklists to assessors assisting students to develop their clinical performance (Gill et al., 2006; Hanley and Higgins, 2005a; Lovegrove and Hatfield, 2012). Moreover, a competency assessment tool helps to both assess student performance and facilitate the learning process (Hadjibalassi et al., 2012; Mattsson and Stevens, 2016).

The change to more continuous competency assessment methods necessitated the student and assessor to spend more time together (Gill et al., 2006; Hanley and Higgins, 2005a). Some studies indicate that it is necessary to have discussions and reflections between the student, preceptor and lecturer, as well as written self- and mentor evaluation to provide formative and summative feedback to the student (Gill et al., 2006; Lovegrove and Hatfield, 2012; Mårtensson et al., 2020; Mattsson and Stevens, 2016). Only one of the included studies reported the use of a digital clinical performance assessment tool (e-CPAT). e-CPAT provided better and more opportunities to reflect, give feedback and add

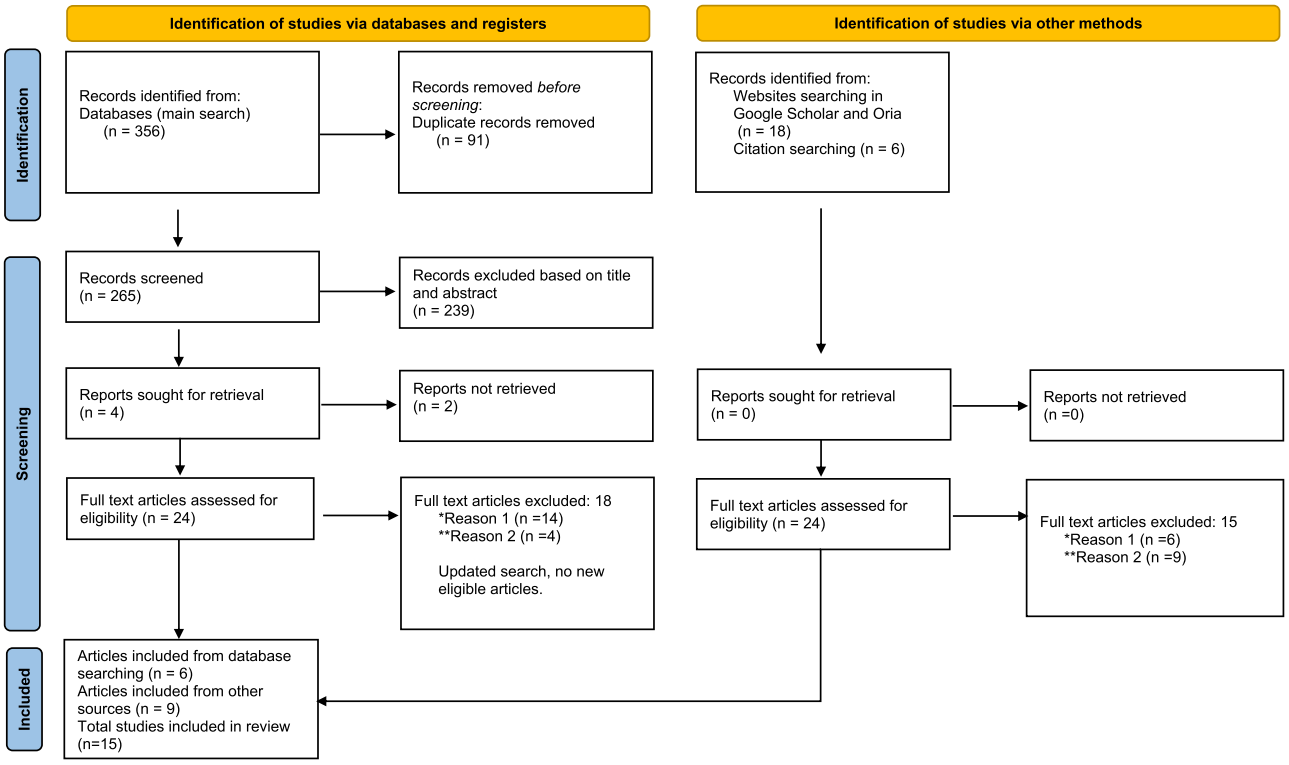

Fig. 1. PRISMA 2020 flow diagram. *Reason I: Not focusing on postgraduate CCN education. **Reason 2: Not focusing on assessment of postgraduate CCN student's competence in clinical placement.From: Page MJ, McKenzieJE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020statement: an updated guideline for reporting systematic reviews. BMJ2021;372:n71. doi: 10.1136/bmj.n71.

evidence; however, a face-to-face meeting between the student and educators was still required (Ross, 2017).

Practice portfolios and objective structured clinical examinations (OSCEs) are alternative ways of assessing postgraduate CCN students' competence regarding clinical skills (Baid, 2011; Hanley and Higgins, 2005a; Lovegrove and Hatfield, 2012). Introducing an OSCE offered benefits such as standardized assessment and strengthening of links between university education and practice. OSCEs require a lot of resources, but this drawback is balanced by the educational advantages (Baid, 2011). Notably, practice portfolios received limited attention in the included studies.

In this review, the definitions of competence varied from "knowledge, skills and attitudes" (Baid, 2011; Ebadi et al., 2016; Hanley and Higgins, 2005a) to more dynamic, complex and holistic definitions that also included aspects such as reflection and critical thinking (Gill et al., 2014; Hadjibalassi et al., 2012; Hanley and Higgins, 2005b; Hatfield and Lovegrove, 2012; Lakanmaa et al., 2014; Lovegrove and Hatfield, 2012; Mårtensson et al., 2020; Mattsson and Stevens, 2016). Clear competencies descriptions and examples of practice reflecting what is expected of students may successfully serve as learning objectives. A baseline defining the student's starting point can identify individual learning needs and objectives (Gill et al., 2006; Mattsson and Stevens, 2016) and competence can be defined and measured (Hatfield and Lovegrove, 2012).

The possibility of subjectivity and personal interpretations was discussed in several of the included studies (Bromley, 2014; Hanley and Higgins, 2005b; Hatfield and Lovegrove, 2012; Mattsson and Stevens, 2016; Ross et al., 2017). The assessment of clinical competence is performance-based and relies on observation and assessment in the context of clinical settings (Ross et al., 2017). Bromley (2014) stated that self-assessment, direct observation and practice portfolios are methods that lack validity and reliability and the assessors may be making judgments on imperfect evidence that is subjective. An attempt to provide some consistency and objectivity in the assessment of students` competence has led to the development of competency assessment tools (Bromley, 2014; Gill et al., 2015; Lakanmaa et al., 2014).

Seven of the included studies explored the use of assessment tools based on competencies (Ebadi et al., 2016; Gill et al., 2014; Hadjibalassi et al., 2012; Hatfield and Lovegrove, 2012; Lakanmaa et al., 2014; Mårtensson et al., 2020; Mattsson and Stevens, 2016). The assessment instruments facilitated assessors to help students develop their clinical performance and promote critical thinking (Gill et al., 2006). Moreover, a competence scale provides a holistic dimension for the assessment of competence in postgraduate CCN (Hadjibalassi et al., 2012; Lakanmaa et al., 2014; Mårtensson et al., 2020). Familiarity with the assessment tool increases the assessor's confidence. Furthermore, the assessment instruments help in assessing students' performance and reveal knowledge gaps. When domains and competencies are easy to understand, they can reflect course objectives and clinical practice and be helpful during formative and summative assessments to make progression clear and visible (Mattsson and Stevens, 2016).

3.2. *Development and validation of assessment tools*

The studies included in this review reported on the development of nine assessment tools for postgraduate CCN education (Ebadi et al., 2016; Gill et al., 2014, 2015; Hadjibalassi et al., 2012; Hanley and Higgins, 2005b; Hatfield and Lovegrove, 2012; Lakanmaa et al., 2014; Lovegrove and Hatfield, 2012; Mårtensson et al., 2020; Mattsson and Stevens, 2016; Ross et al., 2017). Most of the assessment tools were developed as a collaboration between clinical sites and educational institutions using multiphase and mixed-method studies (Table 3). Five assessment tools were developed based on a nursing framework or standards (Gill et al., 2014, 2015; Hatfield and Lovegrove, 2012; Lovegrove and Hatfield, 2012; Mårtensson et al., 2020; Mattsson and Stevens, 2016; Ross et al., 2017), whereas others were initially based on literature reviews and/or expert group consensus (Ebadi et al., 2016; Hadjibalassi et al., 2012; Lakanmaa et al., 2014). Students' views were

Table 2
Critical appraisal of included studies.

Author/year/ study design	Clear research question?	Suitable data collection?	Question	Question	Question	Question	Question
Baid (2011). Qualitative study (Process of reflection study)	✓	Not relevant	1.1 ✓	1.2.✓	1.3 -	1.4 -	1.5 -
Hanley and Higgins (2005a) Qualitative study	✓	✓	1.1✓	1.2✓	1.3✓	1.4✓	1.5✓
Lovegrove and Hatfield (2012) Part 1. Qualitative study (Discussion Paper)	✓	Not relevant	1.1 -	1.2 -	1.3-	1.4 -	1.5 -
Mattson & Stevens (2016) Qualitative study (Action research)	✓	✓	1.1✓	1.2✓	1.3✓	1.4✓	1.5✓
Gill, a) et al. (2014) Quantitative survey study (E-Delphi)	✓	✓	4.1✓	4.2✓	4.3✓	4.4✓	4.5✓
Hatfield and Lovegrove (2012) Part 2 Quantitative study (Audit)	✓	✓	4.1✓	4.2✓	4.3✓	4.4×	4.5×
Ross et al. (2017) Quantitative study	✓	✓	4.1✓	4.2 -	4.3✓	4.4×	4.5✓
Ebadi et al. (2016). Quantitative (Methodological study)	✓	✓	4.1✓	4.2✓	4.3✓	4.4✓	4.5✓
Gill, b) et al. (2014) Quantitative (A structured multiphase project)	✓	✓	4.1✓	4.2✓	4.3✓	4.4 -	4.5✓
Lakanamaa et al., (2014) Quantitative (Multi-phase and multi-method)	✓	✓	4.1✓	4.2 -	4.3✓	4.4 -	4.5✓
Gill et al. (2006) Mixed Method (A descriptive correlational study)	✓	✓	5.1✓	5.2✓	5.3✓	5.4✓	5.5✓
Hadjibalassi et al. (2012) Mixed Method study	✓	✓	5.1✓	5.2✓	5.3✓	5.4✓	5.5✓
Mårtensson (2020) Mixed Method (National consensus group study)	✓	✓	5.1✓	5.2✓	5.3✓	5.4✓	5.5 -
Bromley (2014) Literature review (Not systematic)	1.✓	2.×	3. ×	4. ×	5. ×	6. ×	7. ×	8.-	9. ×	10.-	11. ✓
Hanley and Higgins (2005b) Literature review (Not systematic)	1.✓	2.×	3. ×	4. ×	5. ×	6. ×	7. ×	8.-	9. ×	10.-	11.✓

Abbreviations: Yes: ✓ Unclear: - No: ×
Mixed Methods appraisal Tool (MMAT), version 2018 Qualitative: 1.1 Is the qualitative approach appropriate to answer the research question? 1.2. Are the qualitative data collection methods adequate to address the research question? 1.3. Are the findings adequately derived from the data? 1.4. Is the interpretation of results sufficiently substantiated by data? 1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation? Quantitative descriptive: 4.1. Is the sampling strategy relevant to address the research question? 4.2. Is the sample representative of the target population? 4.3. Are the measurements appropriate? 4.4. Is the risk of nonresponse bias low? 4.5. Is the statistical analysis appropriate to answer the research question? Mixed Methods: 5.1. Is there an adequate rationale for using a mixed method design to address the research question? 5.2. Are the different components of the study effectively integrated to answer the research question? 5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted? 5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed? 5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved? Joanna Briggs Institute Critical Appraisal of reviews, 2020 I. Is the review question clearly and explicitly stated? 2. Were the inclusion criteria appropriate for the review question? 3. Was the search strategy appropriate? 4. Were the sources and resources used to search for studies adequate? 5. Were the criteria for appraising studies appropriate? 6. Was critical appraisal conducted by two or more reviewers independently? 7. Were there methods to minimize errors in data extraction? 8. Were the methods used to combine studies appropriate? 9. Was the likelihood of publication bias assessed? 10. Were recommendations for policy and/or practice supported by the reported data? 11. Were the specific directives for new research appropriate?

considered in five of the assessment tools (Ebadi et al., 2016; Gill et al., 2014, 2015; Lakanmaa et al., 2014; Mattsson and Stevens, 2016; Ross et al., 2017), but health consumers' views were considered in only two (Gill et al., 2014; Hadjibalassi et al., 2012).

Five of the included studies reported on the influence of learning theories in the development of assessment tools. The most common theory was Benner's (1984) "From novice to expert" (Hadjibalassi et al., 2012; Hanley and Higgins, 2005b; Lakanmaa et al., 2014). Mattson and Stevens (2016) and Lovegrove and Hatfield (2012); (2012) were inspired by a constructivist and sociocultural learning perspective that emphasized student-centered and self-directed learning.

Gill et al.'s (2006) study was the first to report on the reliability and validity testing of assessment tools. A psychometric evaluation was performed for four of the included assessment tools and all of them had face and content validities with high scores (Table 3) (Ebadi et al., 2016; Gill et al., 2014; Hadjibalassi et al., 2012; Lakanmaa et al., 2014). Furthermore, we found that both the oldest (Hanley and Higgins, 2005a, 2005b) and the newest (Mårtensson et al., 2020) published assessment tools were presented without validity and reliability testing.

3.3. Nursing domains in assessment tools

The assessment tools consisted of various nursing domains, ranging from four to seven domains in each assessment tool (Table 4). Some areas were postgraduate CCN-specific, but most of the domains were more general and the use of terms was inconsistent. We found that the following overreaching domains were present in most of the tools: care/nursing, teamwork/management, ethical/professional practice and practical/technical skills. The domain examinations and treatments and more non-technical skill domains, such as critical thinking, decision-making, communication/interpersonal skills and patient safety, were less common in the assessment tools. Domains reflecting the need for lifelong learning and evidence-based nursing practice, such as scholarship/development work and knowledge and comprehension, were only present in a few of the assessment tools (Table 4).

4. Discussion

The included studies presented a broad understanding of clinical assessment methods and the development, content and validity of assessment tools, in line with the objective of this review and may help identifying recommendations for future assessment methods.

4.1. Assessment methods

Results from this review identified that the introduction of a new assessment approach presented difficulties such as the assessors' resistance to changing from a familiar approach as the task oriented to a continuous competency-based assessment. The preceptors describe clinical supervising as a dual role because they have a responsibility for the students to achieve their learning outcomes and at the same time, they must care for critically ill patients and ensure patient safety (Jølstad et al., 2019). It is necessary to use high-quality assessment strategies to ensure that postgraduate CCN students are competent in caring for

Table 3
Included studies.

Author/ year/ location	Study design/ methods	Purpose	Setting/sample	Assessment methods/ Nursing domains	Framework/ learning theory/ competence definition	Key Findings	Issues and concerns	Validity/ reliability
(Baid, 2011)UK	Qualitative method. (Process of reflection study). Methods: Reflection using "The six thinking hats tool (De bono, 1999)	To reflect on introducing OSCE into intensive care nursing program	Post- registered intensive care nursing program Sample: Perspective/ reflections of one teacher	The objective structured clinical observation examination (OSCE). The OSCE involves the student demonstrating a skill during a simulated clinical situation in a controlled environment instead of using real patients in the practice setting). Domains: Not reported	Framework: Not reportedLearning theory: Benner`s from novice to expert. Bloom`s taxonomyCompetence definition: Knowledge, psychomotor skills, and attitude	OSCE provided a standardized assessment, strengthened the connection between university and practice and provided opportunity to assess clinical judgment away from the practice	Implementing an OSCE required a lot of time. The OSCE should be recorded to increase the transparency.	Not reported
(Bromley, 2014)Australia	Narrative Literature reviewMethods: Not reported	To explore the evaluation of clinical competence in nursing. Compare the concept of competence.	Post graduate student in neonatal critical care nursing Sample: Not reported(45 references)	Direct observation, self-assessment, and practice portfolios. Assessment tools and competency standards as a mean of assessing competence in practice Domains: Advanced clinical and ethical decision making, critical thinking, counseling skills, cultural awareness, application of research findings, and appropriate use of technology.	Framework: Nursing and Midwifery board of Australia (NMBA, 2006). Learning theory: Benner`s from novice to expert Competence definition: "Competence reflects that clinical practice is complex and multidimensional, it is holistic and embodies concepts of knowledge, skill, attitudes and values"	The most common assessment methods are direct observation, self-assessment, and practice portfolios. These methods lack validity and reliability.	Self-assessment can be problematic for students and inexperienced nurses. Practicing clinicians may not be well supported or prepared for assessment making, and evaluation tools can be complex and difficult to use.	Not reported
(Ebadi, Tabanejad, Pazokian, and Yasser, 2016)Iran	Quantitative (Methodological study)Methods:1. Development of the instrument by literature review and expert consensus.2. Test the validity and reliability of the instrument	To develop and do a psychometric evaluation of the Competence Inventory instrument to evaluate the competencies of students.	Post graduate CCN education in 16 nursing schools. Sample:University professors (n = 11) and students (n = 15) examined the validity. Reliability by students (n = 12). Construct validity by students (n = 217)	The clinical-competency inventory Domains: Care management, technical competency, individual management, human oriented care, scholarship-oriented care.	Framework: Not reportedLearning theory: Not reported Competence definition: Competency in CCN; five major dimensions: knowledge base, skill base, attitude base, experience base and individual base(ref. Lakanmaa, 2014)	The assessment instrument can be used to evaluate the clinical competency of CCN students and guide educational planning. It`s best to use a combination of assessment methods.	Developing awareness of clinical competency and identifying attitudes can help developing safer and more efficacious nursing care	The final 44 items examined for construct validity: content validity index 0.90. The content validity ratio from 0,75 to 1.0. Reliability: Cronbach`s alpha 0.95, test-retest reliability 0.96 (p = 0.001)
(Gill, Gavin, and Southerland, 2006) Australia	Mixed methods. A two-phase descriptive correlational study. Methods: Phase 1: questionnaire and interview.Phase 2:	To evaluate the effectiveness of the CPAT based on the Australian Competency Standards for Specialist Critical Care Nurses.	Post graduate level in pediatric and adult CCN.Sample: Phase 1: experienced specialist nurses (n = 6). Phase 2:students (n = 8) from ACC /PIC and	CPAT (clinical performance assessment tool) Domains: Not reported	Framework: Australian Competency Standards for Specialist Critical Care Nurses (ACCCN, 2002) Learning theory: Benner`s from novice to expert (five	CPAT benefits: Assessors can help students develop their clinical performance based on objectives and	CPAT difficulties: insufficient time together, unclear competencies descriptions, difficult writing clinical objectives,	Phase 1:Validity criteria overall high-Clarity rating (46/47 at least 83%)- Apparent internal consistency (44/47 items at least 83%)-Content

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Table 3 (*continued*)

Author/ year/ location	Study design/ methods	Purpose	Setting/sample	Assessment methods/ Nursing domains	Framework/ learning theory/ competence definition	Key Findings	Issues and concerns	Validity/ reliability
	Interviews and document analysis. Phase 3:Survey and document analysis		experienced nurses (n = 7)Phase 3: students (n = 13) from ACC/ PIC and experienced nurses (n = 9)		stages)Competence definition: Not reported	individual learning needs.	over-simplifying advanced practice and the use of rating scale.	validity (47/47 at least 83%)
(Gill, Leslie, Grech, Boldy, and Latour, 2015)Australia	Quantitative survey study (E-Delphi) Methods: First round) 84 statements organized in six domains, developed from a literature review, analysis of critical care courses and input from health consumers Three rounds of surveys to a national expert panel.	To develop critical care nurse education practice standards	Post-graduate CCN education Sample: A panel of critical care nurse experts (advisory group, course coordinators, practice stakeholders and course graduates9Round 1: (n = 92)Round 2: (n = 85)Round 3: (n = 73)	SPECT tool.Domains: Patient and family-centered care, Quality of care and patient safety, Resuscitation, Assessment, monitoring, and data interpretation, Critical care management, Teamwork and leadership	Framework: Australian graduate critical care courses(Miller's assessment framework, 1990 and CoBaTrICE collaboration, 2006: Learning theory: Not reportedCompetence definition: Not reported	The graduate practice standards provide *a* clear definition for professional health workforce standards. CCN graduates are expected to independently care for critically ill patients in most contexts.	Health consumers input is important to develop practice standards for CCN education and is essential to improve patient safety and quality care.The European and UK step 3 describes *a* more advanced level than in Australia	88% completed survey round I, 92% round II and 73% round III. Of 98 statements 75 were rated high level of importance (median 7), 14 r moderate level (median 6) and 9 low level of importance (median 4)
(Gill, Leslie, Grech, Boldy, and Latour, 2014)Australia	Quantitative A structured multiphase project Methods: Previous phases: literature review, document analysis, focus group interviews and eDelphi. Last phase: Test the SPECT instrument using a survey and expert panel.	To develop and test the SPECT assessment tool.	Post graduate level in CCN.(6 of 7 states) Sample: Pilot panel: CCNs (n = 5) tested face validity.Panel 1: CCN course coordinators(n = 6) Panel 2: clinical assessors (n = 23) and graduates (n = 13) tested reliability and feasibility.	SPECT (Standards of Practice and Evaluation of Critical -Care-Nursing -Tool) consisting of 86 standards Domains: Not reported	Framework: Not reportedLearning theory: Not reportedCompetence definition:Moving from a focus on CCNs clinical expertize to developing clinical and psychosocial competence in supporting patients and families.	The SPECT have clinical feasibility, validity, and reliability, and provide a clear definition for the expected practice level for graduates of critical care education program. The SPECT can provide standardization of minimum criteria for critical care nursing qualification, and is the only standards that have included consumer input as a component	Further work will be required to explore the international differences in practice expectations.	Validity: CVI= 1.0, for six statements CVI= 0.83, statement CVI= 0.66Reliability: Cronbach`s alpha ranged from 0.915 to 0.961 in round I, from 0.865 to 0.976 in round II. Spearman rank correlation round I and II 0.772–0.887
(Hadjibalassi et al., 2012) Cyprus	Mixed method. Methods: First stage: qualitative focus group and interviews.Second stage: Likert scale questionnaires	To develop and test an instrument to determine what competencies are expected of post graduate CCNs.	Postgraduate level CCN.Sample: First stage:CCN clinical nurses and educators (n = 24)Second stage: clinical critical care nurses (n = 234)	The Critical Care Competency Instrument Domains:-Leadership /management-Decision-making/ and management of emergencies-provision of care and professional practice-Ethical practice	Framework: Not reportedLearning theory: P. Benner Competence definition: The development of critical care skills must be based on competencies combining knowledge, skills, and attitudes	The tool incorporates the ethos of critical care and essence of caring with the complexity of advanced knowledge and skills required. The competencies are consistent to the findings of several	CCN education should have a problem-solving approach to learning and an integration of theory.	All factors were highly reliable with Cronbach`s alpha ranging from 0.895 to 0.974

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Table 3 (*continued*)

Author/ year/ location	Study design/ methods	Purpose	Setting/sample	Assessment methods/ Nursing domains	Framework/ learning theory/ competence definition	Key Findings	Issues and concerns	Validity/ reliability
						research studies. Patients and relatives' views were taken into consideration		
(Hanley and Higgins, 2005a)Ireland (UK)	Literature reviewMethods: Not described	To explore the literature on assessment of clinical practice	Postgraduate CCN courseSample: Not described(80 references)	Rating scales and checklists, OSCE, Portfolios, competence-based assessment. Different models of assessment: The behavioristic approach, the generic model of competence, the holistic model: knowledge, attitudes, values and skills.Domains in tools are inter-professional.	Framework: Not reportedLearning theory: Most tools/ assessment practices use Steinaker`s and Bell`s taxonomy and Benner`s taxonomy of professional expertise Competence definition: Competence requires knowledge, appropriate attitudes and mechanical or intellectual skills.	Benefits of competency assessment is reported to the acquisition and integration of higher-level behavior in the cognitive, affective, and psychomotor domains. It can provide effective and detailed feedback to students on their level of competence.	There is a lack of clarity of the term competence	Not reported
(Hanley and Higgins, 2005b)Ireland (UK)	Qualitative Methods: A combination of semi-structured interviews (6) and focus group interview	To explore the students` perceptions and experiences of the clinical competency assessment tool.	Postgraduate CCN courseSample: Intensive care students (n = 11) in 2 large hospitals	The clinical competence assessment tool. Domains: Professional and ethical practice, interpersonal skills, practical and technical skills, critical thinking and clinical decision making and management of care.	Framework: Not reportedLearning theory: P. Benner`s level of skill acquisition (from novice to expert). Competence definition:Knowledge, skills, and attitude. Clinical competence assessment: integrated assessment to combine knowledge, understanding, problem solving, technical skills, attitudes and ethics.	The language must be easy to understand (not ambiguous), and the assessment tools must incorporate the context of CCN. The action plan gave the students a sense of failure more than a tool for improvement and learning.	The variance among assessors raised concerns about reliability of the tool.The students perceived action plans as being punitive, and they had minimal use of portfolios.	Not reported
(Hatfield and Lovegrove, 2012)UK	Quantitative(An audit). Methods: Questionnaires(and an analysis of theory and practice marks)	To evaluate the validity and reliability of an assessment tool to grade clinical competence in critical care nursing education	Post registered level in CCNhigher education (level 6)Sample: 65 (of 171) questionnaires distributed to clinical mentors and assessors in intensive care units (9), coronary care units (8) and neonatal units.	Skill inventory assessment tool (Grading tool for practice based on *a* performance outcomes model of competence) Domains: Professional conduct, knowledge and comprehension-performance of skills, reflection on and evaluation of practice	Framework: NHS knowledge and skills framework (Department of health, 2004)Learning theory: Not reportedCompetence definition: Successful achievement of competence is not just about knowledge, skills and attitudes, but integration of all	Consistency between assessors can be avoided by using clear and user-friendly grading tools. Familiarity with the tool increase confidence in the assessor.	Some assessors felt that the use of grading tools could result in higher mark than expected, and that face-to-face assessment might favor the confident student.	Low response rate (38%)
(Lakanmaa et al., 2014) Finland	Quantitative(Multi-phase and multi-method)Methods:	To develop and validate an assessment scale to assess basic competence	Postgraduate CCN(7 hospitals)Sample: Pilot tested 2 times:	ICCN-CS =Self-assessment test consisting of 108	Framework: Literature review and DelphiLearning theory: P. Benner "From	The ICCN-CS-1 can be used for basic competence	It is recommended to combine different	Validity:High content validity (Delphi consensus 80% &

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Table 3 (*continued*)

Author/ year/ location	Study design/ methods	Purpose	Setting/sample	Assessment methods/ Nursing domains	Framework/ learning theory/ competence definition	Key Findings	Issues and concerns	Validity/ reliability
	The scale was developed in 3 phases:Literature review to develop scale content.2-round pilot testing and 2- round Delphi study.	in intensive and critical care nursing	CCN students (n1 = 18, n2 = 56) and CCNs: (n1 = 12, n2 = 54) Psychometric testing: Graduating CCN students (n = 139) and CCNs (n = 431).	items.Domains: Clinical competence: Nursing care, Clinical guidelines, Nursing interventions Professional competence: Ethical and legal activity, decision-making, development work, collaboration	novice to expert"Competence definition: knowledge, skills, attitude, value and experience. Basic competence is divided into clinical competence; direct patient care, and professional competence; the profession in general	assessment in development discussions and mentor evaluations. ICCN-CS-1 gives a holistic dimension to assessment of competence in CCN and is based on self-assessment.	assessment methods to obtain a trustworthy outcome (self-assessment, portfolios, mentor- or peer evaluation and observation.	internal consistency. Reliability: Cronbach`s alpha 0.98 for both students and nurses. Correlation 0.25–0.81 for students, 0.22–0.70 for nurses
(Lovegrove and Hatfield, 2012)UK	Qualitative (Discussion paper) Methods: The skills were selected and designed by senior clinical nurses and educational representatives	To review the development and introduction of an assessment tool to grade competence in higher education	Post-registration CCN course(Level 6) Sample: Not described	A skills inventory assessment tool; individual skills specific to a clinical area of practice. Domains: Professional conduct, performance of skill, knowledge and comprehension, reflection on and evaluation of practice	Framework: National Occupational standards (2004)Learning theory: "A socially situated concept"Competence definition: A holistic approach to competence	Self-assessment aids the assessor's judgement of the students 'ability to reflect and evaluate. Grading practice was more subjective and less robust then grading theory.	The risk of bias if the assessors become familiar with the student if assessed over time. Alternatively, when assessed as snapshots the students can be affected by nerves and local circumstances.	All skills template were based on the National Occupational Standards.
(Mattsson and Stevens, 2016)Sweden	Qualtative study (Action research) Methods: 6 steps:1. Diagnosing2. Action planning3. Action taking4. Evaluating5. Specifying learning6. Final evaluation	To develop an assessment instrument to assess performance in clinical setting	Post graduate CCN educationSample: Focus group interviews:Students 4 groups (n = ?), educators 1 group: faculty members (n = 2), clinical educational leaders (n = 3).	Individual Assessment Instrument for CCN students (Swedish version of the SPECT) Domains: Assessment and management of critically ill patients, communication, patient safety, teamwork, ethical consideration	Framework: Competencies designed by EfCCNa, AnIva and CoBaTrICE collaboration Learning theory: Constructivist and sociocultural perspective. Bloom's taxonomyCompetence definition: What individuals know or are able to do in terms of knowledge, skills and attitude".	The instrument was easy to understand and helped prioritize learning goals.	The students and preceptors emphasized the focus on self-directed learning, and the instrument guided this process.	Not reported
(Mårtensson, 2020) Sweden	Mixed- methods. (A national consensus-group study) Methods: 5 workshops were AssCE-master was presented and revised. Two versions of AssCE were compared and discussed. A questionnaire was used in the validation processes.	To update and validate the AssCE-master tool for use in clinical practice in postgraduate nursing education.	Postgraduate/master level CCN education (One-year master`s degree)Sample: Lecturers from 23 universities (28–56 participants at each workshop).	AssCE-master level, 21 factors in 5 areas: Domains: Communication and teaching, nursing process, examination and treatments, management and co-operation and professional approach. The tool is used for systematic and continuous assessment to give	Framework: AssCE tool for bachelor nursing (based on international guidelines and Swedish higher education act and ordinance.Learning theory: Not reported Competence definition: A holistic model that involves the student`s ability to use theoretical theory, judgement, critical thinking, and professionalism.	A valid assessment tool can enhance the clarity of the assessment and feedback to students.The criteria are objective examples of student behavior, and the tool includes rating scale with marked intervals	The lecturer should participate in assessment meetings to discuss students' achievements, raise critical questions, contribute theoretical and scientific perspectives, and to provide	It was reported to be unsuitable to perform statistical validation methods.

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Table 3 (*continued*)

Author/ year/ location	Study design/ methods	Purpose	Setting/sample	Assessment methods/ Nursing domains	Framework/ learning theory/ competence definition	Key Findings	Issues and concerns	Validity/ reliability
				feedback to the student's.			substance for course grading.	
(Ross et al., 2017) Australia	Quantitative Methods: Data from the e-CPAT (students' self-assessment and nurse educator's assessment) were extracted into excel and analyzed using SPSS version 22.0	To describe CCN students' performance, and to compare student and educator assessments	Postgraduate CCN education$ample: students (n = 126) and clinical nurse educators (n = 126) from 5 specialty areas: cardiac, emergency, ICU and peri-anesthesia and peri-operative	e-CPAT (electronic Clinical Performance appraisal Tool)34 criteria and 4 Domains:Provision and coordination of care, critical thinking and analysis, collaborative and therapeutic practice, professional practice provided	Framework: Australian college of critical care nurses (ACCCN, 2006) and Nursing and midwifery board of Australia (2006, 2015)Learning theory: Formative and summative assessment/feedback should improve the student results.Competence definition: Not reported	The domains of collaborative, therapeutic practice and professional practice indicated student performance that was largely independent. Using the e-CPAT provided increased opportunities to add evidence, reflection and feedback.	A face-to face meeting was required to enable a discussion to optimize a shared understanding of the appraisal.	Not reported

patients (Helminen et al., 2014). According to Levett-Jones et al. (2011), general clinical performance is consistent with the results of clinical assessment. Hadjibalassi (2012) stated that the issues with clinical practice studies are as follows: precepting, student identity, learning culture and supported reflection, the practice–competencies gap and the practitioner–student gap. Further, time spent with the student and the possibility of personal interpretations could have an impact on the assessment of postgraduate CCN student (Fuentes-Pumarola et al., 2016; Hanley and Higgins, 2005b).

Many traditional forms of assessment can be unreliable and subjective and clinicians may not be well supported or prepared for assessments, making them hesitant to fail students (Bromley, 2014; Gill et al., 2006; Gullick et al., 2019; Lovegrove and Hatfield, 2012). It has been reported that failure on the grounds of unsatisfactory clinical performance in student placement is quite rare. The concept of "failure to fail" in nursing education describe the reluctance from assessors to fail student nurses even when they display unsatisfactory clinical practice (Hughes, Mitchell, and Johnston, 2016). Failing students in clinical placement is an emotional experience for assessors and they require confidence as well as personal, professional and organizational support. Further, assessors need guidelines that provide transparency and consistency in the decision-making process (Hughes, Mitchell, and Johnston, 2021).

This review revealed that consistency between assessors was a concern, but can be assisted using clear competence descriptions, suitable grading tools and the assessment of individual skills by trained assessors (Hatfield and Lovegrove, 2012; Zhang et al., 2019). The criteria must be clear and specific to avoid individual interpretation (Ross et al., 2017). Identification of competencies that relate to practice is essential for quality care and specialty development (Gullick et al., 2019; Lakanmaa et al., 2014). Students' assessment is dependent on reliability. Lecturers, students and preceptors need to understand how to use the assessment tool (Mårtensson et al., 2020).

The need to grade and measure practice is driven by regulatory requirements. When assessing, a "gut feeling" of students' practice is often formed before marks are awarded. However, the score obtained from the assessment tool matches this "gut feeling". Some assessors felt that the use of grading tools resulted in higher-than-expected scores (Gill et al., 2006; Hatfield and Lovegrove, 2012). Moreover, the value of degrees that reflect academic ability only is limited and the assessment tool strives to reward clinical excellence (Gullick et al., 2019; Levett-Jones et al., 2011).

Other reported difficulties were as follows: students finding it challenging to write learning objectives, oversimplifying advanced practice and placing too much emphasis on the psychosocial domain. The students also found it difficult to use complex rating scales (Gill, 2006) and Mattson and Stevens (2016) discovered that a lack of a Likert scale in the assessment tool was viewed positively because such scales can be biased and interpreted differently.

We identified that during clinical placement, postgraduate students appreciate precepting that involves reflection and discussions and having theoretical knowledge transformed into practice (Nyhagen and Strøm, 2016; Sundler et al., 2019). There is a great demand on clinical nurses to mentor and assess students in clinical placement (Wu et al., 2015). Nevertheless, students report not having enough time for reflection and supervision with their preceptors during clinical placement (Sundler et al., 2019).

The OSCE approach has gained popularity in nursing education; however, it is time consuming and, at best, a simulation of practice (Hatfield and Lovegrove, 2012; Lovegrove and Hatfield, 2012). OSCEs should be recorded to increase transparency. Moreover, some students were stressed/nervous and had problems articulating their thoughts under exam conditions (Baid, 2011).

Table 4
Nursing domains in assessment tools.

Care/ nursing	Teamwork/ management	Ethical/ professional practice	Practical/ technical skills/managing emergencies	Critical thinking	Communication / interpersonal skills	Decision making	Examination and treatments	Patient safety	Scholarship/ Development work	Knowledge and comprehension
Art.1 "Organization and Management of care"	**Art.1** "Organization and Management of care"	**Art.1** "Professional and ethical practice"	**Art.1** "Practical and technical skills"	**Art.1** "Critical thinking and clinical decision making"	**Art.1** "Interpersonal skills"	**Art.1** "Critical thinking and clinical decision making"	**Art.5** "Assessment, monitoring and data interpretation"	**Art.5** "Quality of care and patient safety"	**Art.4** "Development work"	**Art.3** "Knowledge and comprehension"
Art.2 "Provision of care and professional practice"	**Art.2** "Leadership /management and professional development"	**Art.2** "Provision of care and professional practice". "Ethical practice"	**Art.2** "Decision-making and management of emergencies"	**Art.2** "Leadership /management and professional development"	**Art.7** "Communication"	**Art.2** "Decision-making and management of emergencies"	**Art.7** "Assessment and management of critically ill patients"	**Art.7** "Patient safety"	**Art.6** "Scholarship oriented care"	**Art.4** "Clinical guidelines"
Art.4 "Principles of nursing care"	**Art.4** "Collaboration"	**Art.3** "Professional conduct"	**Art.3** "Performance of skill"	**Art.3** "Reflection on and evaluation of practice"	**Art.9** "Communication and teaching"	**Art.4** "Decision-making"	**Art.9** "Examination and treatments"			
Art.5 "Patient- and family- centered care". "Quality of care and patient safety"	**Art.5** "Teamwork and leadership"	**Art.4** "Ethical and legal activity"	**Art.4** "Nursing interventions"	**Art.8** "Critical thinking and analysis"						
Art.6 "Care management" "Human oriented care"	**Art.6** "Individual management"	**Art.7** "Ethical consideration"	**Art.5** "Resuscitation" "Critical care management"							
Art.7 "Assessment and management of critically ill patients"	**Art.7** "Teamwork"	**Art.8** "Professional practice provided"	**Art.6** "Technical competency"							
Art.8 "Provision and coordination of care" "Collaborative and therapeutic practice"	**Art.8** "Collaborative and therapeutic practice"	**Art.9** "Professional approach"								
Art.9 "Nursing process"	**Art.9.** "Management and co-operation"									

Articles by numbers and name of nursing domains in assessment tools: 1. The clinical competence assessment tool (Hanley & Higgins, 2005). 2. The Critical Care Competency Instrument (Hadjibalassi et al., 2012). 3. Skill inventory assessment tool (Hatfield &Lovegrove2012; Lovegrove (Hatfield and Lovegrove, 2012; Lovegrove and Hatfield, 2012). 4. ICCN-CS (Lakanmaa et al., 2014). 5. The SPECT (Gill et al., 2014, 2015). 6. The clinical-competency inventory (Ebadi et al., 2016). 7. Individual Assessment Instrument for CCN students (Mattsson and Stevens, 2016). 8.e-CPAT (Ross et al., 2017). 9. AssCE-master Level (Mårtensson et al., 2020). When the domains in assessment tools can fit into two nursing domains they appear in both.

4.2. Development of and content in assessment tools

This review revealed that multiple interpretations and a lack of clarity of the term "competence" may have contributed to unreliable and invalid assessment methods (Gill et al., 2006). The definition of clinical competence has been widely discussed in nursing research. A consensus on a holistic view is emerging and this definition includes the practitioner's knowledge, skills, values and attitudes (Taylor et al., 2019). The outcome of nursing care has been shown to depend on nurses 'competence (Willman et al., 2020) and by identifying competencies it is possible to provide a comprehensive description of critical care nursing (Zhang et al., 2019).

It is challenging to develop a reliable and valid assessment tool, but it is crucial to ensure reliability and validity to avoid different interpretations among students, preceptors and lecturers. When the tool is easy to understand, it may help the student in planning how to achieve the learning goals, clarify the assessment and feedback to students and support an open discussion between the student, preceptor and lecturer about the learning process (Mårtensson et al., 2020; Mattsson and Stevens, 2016).

In this review, we found that the development and validation of assessment tools have mostly been a collaboration between clinical sites and educational institutions. Some of the tools were developed with reference to the competency standards set by the National Board of Nursing (Table 3). Only two assessment tools (Gill et al., 2014, 2015; Hadjibalassi et al., 2012) included user involvement in the development process. Health consumers' input is important to develop practice standards for postgraduate CCN education and essential to improve patient safety and quality care (Gill et al., 2015). Psychometric evaluation was performed for only four of the included assessment tools and surprisingly, even newer assessment tools lacked this quality assessment (Table 3).

Some of the tools were based on learning theories, such as Benner's (1984) competence development theory and sociocultural and self-directed learning theories. According to Mattson and Stevens (2016) both the students and preceptors focused on self-directed learning and found that the assessment instrument helped this process. Self-assessment as a means of evaluating competence can be challenging, but it is important to develop self-assessment capabilities in clinical practice and nursing education (Bromley, 2014; Gullick et al., 2019; Lakanmaa et al., 2014).

We found that domains such as the nursing process, practical skills and professional attributes were the most common across the tools in this review. It is important to ensure that postgraduate CCN students can care for critically ill patients independently in most contexts after graduating (Gill et al., 2015). A postgraduate CCN is a core member of the of the ICU multidisciplinary team, whose competency is crucial to providing safe and effective care (Henriksen, Hansen, Wøien, and Tønnessen, 2021; Zhang et al., 2019). Specialty graduate outcomes need to address clinical practice and holistic nursing, as well as academic aspects and should prepare graduates for both caring for patients and supporting the socioemotional needs of patients and their families (Gill et al., 2014; Hadjibalassi et al., 2012). We further found that nursing domains such as patient safety, scholarship/development work and knowledge and comprehension, were less common. Lifelong learning strategies are important to deliver high-quality nursing care and should be an important part of the development of clinical competence (Zhang et al., 2019).

4.3. Future needs for assessment methods

Innovation in assessment methods, such as the development of digital assessment tools, is needed. Despite the digitalization in hospitals and educational institutions, only one of the included studies reported on the use of a digital assessment tool (Ross et al., 2017). A nursing shortage affects the critical care units all over the world (Hansen et al., 2011; Kaldan et al., 2019; Moloney-Harmon, 2010;) and the coronavirus disease 2019 pandemic has made the lack of qualified CCNs even more evident. Access to clinical practice at larger hospitals is one of the obstacles for specialist educations (Endacott et al., 2015). Mårtensson et al. (2020) expressed the need to develop a digital version of the assessment tool partly because of the need to offer distance and online education to postgraduate CCN students. We believe that digital assessment tools will be necessary to provide more effective and accessible interaction between students, preceptors and lecturers in the future. A recent, small study from Iran indicated that the use of a mobile application provided better opportunities to reflect and give feedback; however, a face-to-face meeting between the student and educators is still required (Ghafari et al., 2020).

There is a need for competence descriptions that reflects the postgraduate CCN's abilities to adapt to change, generate new knowledge and continue to improve their performance. We found that domains reflecting the need for continuous learning and evidence-based nursing practice were only present in a few of the assessment tools included in this review, but these competencies are essential for quality in health care and future development in the field of postgraduate CCN (Willman et al., 2020; Zhang et al., 2019).

Due to the lack of qualified postgraduate CCNs there will be an increasing need for postgraduate CCNs to become team managers in the care of critically ill patients, as well as to supervise ward nurses due to the implementation of rapid response systems in hospitals. These competencies should also be reflected in future assessment tools. There will probably be an increasing need for postgraduate CCNs to travel and work internationally. Hence, globally, postgraduate CCN education should have a common goal and the necessary skills should be in line with the constantly changing and challenging working environment (Gullick et al., 2019; Kaldan et al., 2019).

4.4. Limitations

The heterogeneous nature of the included studies represented a range of variations in the study design of the clinical assessment studies, which may limit the interpretation. In addition, a meta-synthesis could not be performed in this review. Further, only articles published in English and Scandinavian language were included and there may have been articles relevant to this review published in other languages. It is possible that we missed some relevant studies despite the use of a broad search strategy in numerous databases with librarian support, as well as conduct hand-searching of reference lists.

5. Conclusion

We need valid and reliable instruments to assess postgraduate CCN student's competence. Many traditional forms of assessment methods may be unreliable and subjective, but inconsistency between assessors can be assisted using clear skills descriptions and user-friendly assessment tools. Further, a competence scale may help students develop their clinical performance and promote critical thinking. The international inconsistency in terms of postgraduate CCN competence, education duration and level make it challenging to have a common goal. The education of postgraduate CCNs should be more harmonized and in line with the ever-changing critical care environment and future needs for lifelong learning. International research and collaboration may reduce this inconsistency. A research gap was identified regarding innovation in development of effective and accessible assessment tools to meet future demands and improve assessment practices in postgraduate CCN education.

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CRediT authorship contribution statement

Line J. Øvrebø: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Writing – original draft, Visualization. **Dagrunn N. Dyrstad:** Conceptualization, Methodology, Formal analysis, Supervision, Writing – review & editing. **Britt S. Hansen:** Conceptualization, Formal analysis, Investigation, Supervision, Writing – review & editing. Final approval of the version to be submitted: Line J. Øvrebø, Dagrunn N. Dyrstad, Britt S. Hansen.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

Baid, H., 2011. The objective structured clinical examination within intensive care nursing education. Nurs. Crit. Care 16 (2), 99–105. https://doi.org/10.1111/j.1478-5153.2010.00396.x.

Benner, P., 1984. From novice to expert: excellence and power in clinical nursing practice. Addison-Wesley, Menlo Park, Calif.

Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qual. Res. Psychol. 3 (2), 77–101. https://doi.org/10.1191/1478088706qp063oa.

Bromley, P., 2014. Clinical competence of neonatal intensive care nursing students: how do we evaluate the application of knowledge in students of postgraduate certificate in neonatal intensive care nursing? J. Neonatal Nurs. 20 (4), 140–146. ⟨https://search.proquest.com/docview/1672096318?accountid=136945⟩.

DeGrande, H., Liu, F., Greene, P., Stankus, J.-A., 2018. Developing professional competence among critical care nurses: an integrative review of literature. Intensive Crit. Care Nurs. 49. https://doi.org/10.1016/j.iccn.2018.07.008.

Ebadi, A., Tabanejad, Z., Pazokian, M., Yasser, S., 2016. Designing and psychometric evaluation of the competency inventory for postgraduate students of intensive care nursing. Nurs. Midwifery Stud. 5 (4) https://doi.org/10.17795/nmsjournal32677.

Endacott, R., Jones, C., Bloomer, M., Boulanger, C., Ben Nun, M., lliopoulou, K., Lliopoulou, K.K., 2015. The State of Critical Care Nursing Education in Europe: An International Survey, Vol. 41. Springer Nature, pp. 2237–2240.

Fuentes-Pumarola, C., Ballester-Ferrando, D., Gelabert-Vilella, S., Bosch-Farré, C., Malagón-Aguilera, M.C., Rascón-Hernán, C., Fernandez-Peña, R., 2016. Nursing student and professor perceptions and assessments of the achievement of practicum competencies: a mixed method approach. Nurse Educ. Today 45, 199–205. https://doi.org/10.1016/j.nedt.2016.08.013.

Ghafari, S., Yazdannik, A., Mohamadirizi, S., 2020. Education promotion based on "mobile technology" in the critical care nursing department: four-phase intervention. J. Educ. Health Promot. 9, 325. https://doi.org/10.4103/jehp.jehp_34_20.

Gill, F., Gavin, L., Southerland, K., 2006. Evaluation of a clinical performance assessment tool (CPAT) within a critical care context. Aust. Crit. Care 19 (3), 105–113.

Gill, F.J., Leslie, G.D., Grech, C., Boldy, D., Latour, J.M., 2014. Developing and testing the standard of practice and evaluation of critical-care-nursing tool (SPECT) for critical care nursing practice. J. Contin. Educ. Nurs. 45 (7), 312–320. https://doi.org/10.3928/00220124-20140620-02.

Gill, F.J., Leslie, G.D., Grech, C., Boldy, D., Latour, J.M., 2015. Development of Australian clinical practice outcome standards for graduates of critical care nurse education. J. Clin. Nurs. 24 (3–4), 486–499. https://doi.org/10.1111/jocn.12631.

Gullick, J., Lin, F., Massey, D., Wilson, L., Greenwood, M., Skylas, K., Gill, F.J., 2019. Structures, processes and outcomes of specialist critical care nurse education: an integrative review. Aust. Crit. Care 32 (4), 331–345. https://doi.org/10.1016/j.aucc.2018.09.007.

Hadjibalassi, M., Papastavrou, E., Lambrinou, E., Tsangari, H., Athini, E., Georgiou, E., Merkouris, A., 2012. Development of an instrument to determine competencies of postgraduate ICU nurses in cyprus. Nurs. Crit. Care 17 (5), 255–264. https://doi.org/10.1111/j.1478-5153.2012.00503.x.

Hanley, E., Higgins, A., 2005a. Assessment of clinical practice in intensive care: a review of the literature. Intensive Crit. Care Nurs. 21 (5), 268–275. ⟨http://search.ebscohost.com/login.aspx?direct=true&db=cmedm&AN=16182123&scope=site⟩.

Hanley, E., Higgins, A., 2005b. Asssessment of practice in intensive care: students' perceptions of a clinical competence assessment tool. Intensive Crit. Care Nurs. 21 (5), 276–283 doi:http://dx.doi.org/10.1016/j.iccn.2004.10.004.

Hansen, B.S., Gundersen, E.M., Bjørnå, G.B., 2011. Improving student supervision in a Norwegian intensive care unit: a qualitative study. Nurs. Health Sci. 13 (3), 255–261. https://doi.org/10.1111/j.1442-2018.2011.00609.x.

Hatfield, D., Lovegrove, J., 2012. The use of skills inventories to assess and grade practice: Part 2 – evaluation of assessment strategy. Nurse Educ. Pract. 12 (3), 133–138. https://doi.org/10.1016/j.nepr.2012.01.013.

Helminen, K., Coco, K., Johnson, M., Turunen, H., Tossavainen, K., 2016. Summative assessment of clinical practice of student nurses: a review of the literature. Int. J. Nurs. Stud. 53, 308–319. https://doi.org/10.1016/j.ijnurstu.2015.09.014.

Helminen, K., Johnson, M., Isoaho, H., Turunen, H., Tossavainen, K., 2017. Final assessment of nursing students in clinical practice: perspectives of nursing teachers, students and mentors. J. Clin. Nurs. 26 (23–24), 4795–4803. https://doi.org/10.1111/jocn.13835.

Helminen, K., Tossavainen, K., Turunen, H., 2014. Assessing clinical practice of student nurses: views of teachers, mentors and students. Nurse Educ. Today 34 (8), 1161–1166. https://doi.org/10.1016/j.nedt.2014.04.007.

Henriksen, K.F., Hansen, B.S., Wøien, H., Tønnessen, S., 2021. The core qualities and competencies of the intensive and critical care nurse, a meta-ethnography. J. Adv. Nurs. https://doi.org/10.1111/jan.15044.

Hong QN, P.P., Fàbregues S., Bartlett G., Boardman F., Cargo M., Dagenais P., Gagnon, & M-P, G.F., Nicolau B., O'Cathain A., Rousseau M.-C., Vedel I.2018. Mixed Methods Appraisal Tool (MMAT), version 2018. Retrieved from ⟨http://mixedmethodsappraisaltoolpublic.pbworks.com/w/file/fetch/127916259/MMAT_2018_criteria-manual_2018–08-01_ENG.pdf⟩.

Hughes, L.J., Mitchell, M., Johnston, A.N.B., 2016. 'Failure to fail' in nursing – a catch phrase or a real issue? a systematic integrative literature review. Nurse Educ. Pract. 20, 54–63 https://doi.org/10.1016/j.nepr.2016.06.009.

Hughes, L.J., Mitchell, M.L., Johnston, A.N.B., 2021. Moving forward: barriers and enablers to failure to fail – a mixed methods meta-integration. Nurse Educ. Today 98, 104666. https://doi.org/10.1016/j.nedt.2020.104666.

ICN. 2020. Guidelines on Advanced Practice Nursing. Retrieved from ⟨https://www.icn.ch/system/files/documents/2020–04/ICN_APN%20Report_EN_WEB.pdf⟩.

Immonen, K., Oikarainen, A., Tomietto, M., Kääriäinen, M., Tuomikoski, A.-M., Kaučič, B.M., Mikkonen, K., 2019. Assessment of nursing students' competence in clinical practice: a systematic review of reviews. Int. J. Nurs. Stud. 100, 103414 https://doi.org/10.1016/j.ijnurstu.2019.103414.

JBI, J. B. I2020. Checklist for systematic Reviews and Reasearch Syntheses. Retrieved from ⟨https://joannabriggs.org/sites/default/files/2020–08/Checklist_for_Systematic_Reviews_and_Research_Syntheses.pdf⟩.

Jølstad, A.L., Røsnæs, E.R., Severinsson, E., Lyberg, A., 2019. A paradigm shift in nurse specialist clinical supervision—implementation of a competence program. SAGE Open Nurs. 5 https://doi.org/10.1177/2377960819844366.

Kaldan, G., Nordentoft, S., Herling, S.F., Larsen, A., Thomsen, T., Egerod, I., 2019. Evidence characterising skills, competencies and policies in advanced practice critical care nursing in Europe: a scoping review protocol. BMJ Open 9 (9). https://doi.org/10.1136/bmjopen-2019-031504.

Lakanmaa, R.-L., Suominen, T., Perttil, J., Ritmala-Castrén, M., Vahlberg, T., Leino-Kilpi, H., 2014. Basic competence in intensive and critical care nursing: development and psychometric testing of a competence scale. J. Clin. Nurs. 23 (5–6), 799–810. ⟨https://search.proquest.com/docview/1534276380?accountid=136945⟩.

Levett-Jones, T., Gersbach, J., Arthur, C., Roche, J., 2011. Implementing a clinical competency assessment model that promotes critical reflection and ensures nursing graduates' readiness for professional practice. Nurse Educ. Pract. 11 (1), 64–69. https://doi.org/10.1016/j.nepr.2010.07.004.

Lovegrove, J., Hatfield, D., 2012. The use of skills inventories to assess and grade practice: Part 1 – design and implementation. Nurse Educ. Pract. 12 (3), 127–132. https://doi.org/10.1016/j.nepr.2011.10.006.

Mattsson, J., Stevens, L., 2016. Development of an individual assessment instrument for critical care nursing students. MedEdPublish 5 (2). https://doi.org/10.15694/mep.2016.000041.

Moloney-Harmon, P., 2010. Retaining a most valuable resource in a healthcare crisis—critical care nurses. Aust. Crit. Care 23 (1), 2–3 https://doi.org/10.1016/j.aucc.2009.08.002.

Mykkeltveit, I., Gundersen, E.M., Dysvik, E., 2021. Master i spesialsykepleie i anestesi-, intensiv- eller operasjonssykepleie i Norge. Nord. sygeplejeforskning 2, 113–125. https://doi.org/10.18261/issn.1892-2686-2021-02-03.

Mårtensson, G., Lind, V., Edin, K., Hedberg, P., Löfmark, 2020. Development and validation of a clinical assessment tool for postgraduate nursing education: a consensus-group study. Nurse Educ. Pract. 44 http://dx.doi.org/10.1016/j.nepr.2020.102741.

Nyhagen, R., Strøm, A., 2016. Postgraduate students' perceptions of high-quality precepting in critical care nursing. Nurse Educ. Pract. 21, 16–22. https://doi.org/10.1016/j.nepr.2016.09.002.

Oermann, M. 2015. Teaching in nursing and role of the educator: the complete guide to best practice in teaching, evaluation and curriculum development.

Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Moher, D., 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. PLoS Med 18 (3). https://doi.org/10.1371/journal.pmed.1003583.

Polit, D.F., Beck, C.T., 2020. Nursing research: generating and assessing evidence for nursing practice (Eleventh edition.; International edition. ed.). Lippincott Williams & Wilkins, Philadelphia.

Ross, P., Cross, R., Sonneborn, O., MacDonald, B., Dean, C., Miller, C., 2017. Comparison of postgraduate student and educator appraisals: a retrospective analysis. Nurse Educ. Pract. 23, 82–91 http://dx.doi.org/10.1016/j.nepr.2017.02.009.

Sundler, A.J., Blomberg, K., Bisholt, B., Eklund, A., Windahl, J., Larsson, M., 2019. Experiences of supervision during clinical education among specialised nursing students in Sweden: a cross-sectional study. Nurse Educ. Today 79, 20–24 https://doi.org/10.1016/j.nedt.2019.05.009.

Taylor, I. , Bing-Jonsson, P.C. , Wangensteen, S. , Finnbakk, E.B. , Sandvik, L. , McCormack, B. , Fagerström, L. , 2019. The self-assessment of clinical competence and the need for further training: a cross-sectional survey of advanced practice nursing students. doi:https://doi.org/10.1111/jocn.15095.

Toronto, C.E., Remington, R., 2020. A Step-by-Step Guide to Conducting an Integrative Review, First ed. Springer, Toronto and Remington.

Vae, K.J.U., Engström, M., Mårtensson, G., Löfmark, A., 2018. Nursing students' and preceptors' experience of assessment during clinical practice: a multilevel repeated-interview study of student–preceptor dyads. Nurse Educ. Pract. 30, 13–19. https://doi.org/10.1016/j.nepr.2017.11.014.

Whittemore, R., Knafl, K., 2005. The integrative review: updated methodology. J. Adv. Nurs. 52 (5), 546–553. https://doi.org/10.1111/j.1365-2648.2005.03621.x.

WHO, W. H. O. 2013. Transforming and scaling up health professionals'education and training Retrieved from ⟨https://www.ncbi.nlm.nih.gov/books/NBK298953/pdf/Bookshelf_NBK298953.pdf⟩.

WHO., W. H. O. 2016. Nurse educator core competencies. Retrieved from ⟨https://apps.who.int/iris/bitstream/handle/10665/258713/9789241549622-eng.pdf;jsessionid=B66983AB82FA0510161234AD3058F720?sequence=1⟩.

Willman, A., Bjuresater, K., Nilsson, J., 2020. Newly graduated registered nurses' self-assessed clinical competence and their need for further training. Nurs. Open 7 (3), 720–730. https://doi.org/10.1002/nop2.443.

Wu, X.V., Enskär, K., Lee, C.C.S., Wang, W., 2015. A systematic review of clinical assessment for undergraduate nursing students. Nurse Educ. Today 35 (2), 347–359. https://doi.org/10.1016/j.nedt.2014.11.016.

Zhang, X., Meng, K., Chen, S., 2019. Competency framework for specialist critical care nurses: a modified Delphi study. Nurs. Crit. Care 25 (1), 45–52. https://doi.org/10.1111/nicc.12467.