A systematic review of contemporary competency-based education and training for pharmacy practitioners and students

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A R T I C L E   I N F O

A B S T R A C T

Background: The use of competency-based education (CBE) worldwide is increasing and has been advocated for by key reports in health professional education. Recent developments, including the first global competency framework for pharmacists published by the International Pharmaceutical Federation (FIP) in 2012, can help facilitate CBE adoption. However, adopting CBE is complex and involves various features and stages of development.

Objective: This systematic review examines pharmacy education and training to identify features of CBE-related approaches currently in use worldwide to develop a picture of contemporary CBE-related activity in pharmacy for the purpose of guiding future development.

Method: Scopus, Web of Science, Medline, Embase, and ERIC electronic databases were searched to identify relevant literature. Studies associated with CBE or training of pharmacy practitioners and related postgraduate or undergraduate students were included. Studies were limited to those published in English from 2010 to 2021. Two authors performed the screening and selection of studies, and a 3rd author resolved any discrepancies. The review followed PRSIMA guidelines and was registered with PROSPERO under CRD42022296424. The findings were analysed using an inductive approach and presented descriptively.

Results: Twenty-eight studies were included in the review, all of which originate from high-income countries, spanning a range of educational levels and research designs. A total of 20 features and 21 supporting components were identified and categorised, connected to those previously identified in the closely linked medical literature, and categorised into 6 overarching themes: design, teaching and learning, feedback and assessment, faculty, resources, and internal and external factors. A collective understanding of the concept of competency, in combination with a shared vision between education, regulation, and practice, underpins successful application of the CBE approach.

Conclusions: This review summarises common features of CBE across the globe which can be used to guide further developments in pharmacy education. Mutual consensus on the design and delivery of CBE features ensures that the intended learning outcomes are in alignment with the learner's experience and congruent with the realities of pharmacy practice.

1. Introduction

The health system needs to have high quality healthcare professionals to respond to current dynamic healthcare demands, both locally and globally. Healthcare professionals must be equipped to deal with vast and evolving medical and technical developments and contemporary health priorities; such as epidemiological shifts, ageing populations, conflicts, or pandemics.[1] Health professional education is not fit-for-purpose in relation to globalisation and contemporary health systems and population needs.[2] Reasons suggested for this include: a focus on technical skills without broader contextual understanding, competencies that are mismatched with people's needs, weak professional leadership, and imbalanced pressures on the health professional labour market.[2] Competency-based education (CBE) is advocated as an approach which can equip professionals with the necessary prerequisites to engage in patient and population-centred healthcare in a transformative, ethical, and locally and globally responsive way.[2]

Competency-based education (CBE) has been defined as 'education

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that derives a curriculum from an analysis of a prospective or actual role in modern society and attempts to certify students' progress on the basis of demonstrated performance in some or all aspects of that role'.[3] This definition stems from one that was designed to recognise the diversity within the competence-based movement in terms of theoretical orientation, scope of roles, extent of role reforms, and disciplinary focus.[4] It is adapted from Grant (1979) who recognised that the competence-based approach could take many forms and so a broad definition was derived that sought to distinguish the competence-based approach to that of more conventional programs. Grant stated that the aim of this movement was to 'be able to state that their students are competent at something or to do something rather than that they have accumulated so many course credits. This is the heart of competence-based educational reforms.'[4] Grant goes on to further explain that the institutions that use competence-based education 'approve student progress by means of performance directly related to this role, and they have tended to grant credit, degrees, or other awards more on the basis of these assessments than on the basis of time spent in the program'.[4]

In the book, 'The Question of Competence: reconsidering Medical Education in the Twenty-First Century', Hodges et al.[3] attempt to explore the complex idea of competence in relation to health care professionals, particularly in relation to the medical field. In agreement with Grant, Hodges et al. also suggest that the CBE educational model deemphasises the time spent learning and emphasises the achievement of competencies and demonstrable outcomes especially given the increasing need for medical education to satisfy accreditation bodies and exhibit social accountability.[3] CBE in pharmacy often follows developments in CBE for medicine. Bajis et al. endeavoured to further progress the concept of CBE in pharmacy education and suggest that the definition cited by Hodges et al. also applies to other healthcare professions, including pharmacy.[5] Frank et al. (2010) reviewed relevant medical CBE literature and found a high degree of heterogeneity.[6] A total of 173 records were analysed, and a working definition of CBE specific to physicians was developed—'Competency-based education (CBE) is an approach to preparing physicians for practice that is fundamentally orientated to graduate outcome abilities and organized around competencies derived from an analysis of societal and patient needs. It de-emphasises time-based training and promises greater accountability, flexibility, and learner-centeredness'.[6] These authors all have a similar theme in common when discussing CBE, which is that CBE is a complex and often debated concept.

For the purposes of this review, the broad and generalizable definition cited by Hodges et al. was used as a starting point to guide literature selection, as it captures the core concept of CBE which is to focus on the outcome of education in terms of what students can do in relation to a specific role. This is also the basis of the Miller's (1990) prism of clinical competence.[7] The principles of CBE in the field of medicine are frequently applicable to modern pharmacy practice, and the themes previously outlined by Frank et al.[6] were also utilised for this review as the basis for theme identification.

Competencies are the building blocks of competency and are described as the observable components of knowledge, skills, attitudes, and values expressed as actual behaviour which can be measured and assessed.[8] One of the core components that distinguish CBE from conventional education is the inclusion of predefined graduate abilities as the organising principle.[6] Competency frameworks consist of a structured assembly of behavioural indicators which describe the observable behaviours necessary to achieve a defined competency. When demonstrated collectively these determine the overarching competence, or capability, of a practitioner.[9] Both sector-wide, and sector specific competency frameworks have been developed in several countries across all of the World Health Organization (WHO) regions[10] as outlined by Udoh et al.[11] The International Pharmaceutical Federation (FIP) developed a Global Competency Framework (GbCF) which can be used as a mapping tool and adapted to reflect local needs.[9] The GbCF is sector-wide and aimed at early-career pharmacists; it was created

through global consultation and review of previous country-specific frameworks and recently updated in 2020 to reflect further consultation and developments in the profession.[12] However, the actual implementation of CBE, including the application of competency frameworks is a complex process.[8] A firm understanding of the concept of competency is required by all pharmacy education stakeholders for the adoption of the CBE approach. The rate and extent of CBE adoption globally is inconsistent.[13] Relevant literature from the Global South is particularly scarce in comparison to the Global North, indicative of less extensive use of CBE in some lower-income countries.[14,15]

The CBE approach is a viable option for preparing graduates to meet modern diverse healthcare needs.[16] Previous systematic reviews for CBE in pharmacy cover specific aspects such as leadership definitions and assessment methods,[17] and the applicability of competency frameworks.[9] A more general narrative review on the application of CBE, including its potential benefits and challenges, also provides a comprehensive summary of the literature.[18] These reviews highlight that although the use of CBE offers advantages for pharmacy education there is a disparity between the understanding, terminology, and application of the concepts of CBE. Furthermore, the implementation process of a CBE curriculum can be time-consuming and requires significant resources, cooperation, and commitment.[18] There are reports that provide useful and practical guidance for developing a CBE curriculum.[8,19] However, there are no systematic reviews for CBE in pharmacy that examine the research with the intention of capturing a global perspective on what features of CBE are used in pharmacy education. This review recognises that the definition of CBE is still not universally accepted, or even fully understood. Therefore, the research design endeavours to capture any studies that may be relevant to the elements of CBE, even if the education or training that the research is referring to is not a fully realised 'true' CBE curriculum or program.

The overall aim of the review is to describe modern global CBE related activity for pharmacy with the intention of using this evidence to inform and guide future CBE developments. The objective was to identify features of contemporary global pharmacy education related to CBE.

2. Methods

This systematic review of the international literature focuses on identifying the features, or prominent attributes or aspects, of CBE employed in pharmacy education and training. The population for this study is pharmacy students and pharmacists. No limitations on fields of pharmacy practice were stipulated.

2.1. Search strategy

Scopus, Web of Science, Medline, Embase, and ERIC electronic databases were used to identify relevant literature (Appendix 1). The database search terms used consisted of a combination of the following: "competency-based", "outcome-based", "CBE", "OBE", "pharmacy", "pharmacist", "education", "training", "curricula", "curriculum". The terms were combined using Boolean operators "AND" & "OR". The database search also included truncation of the search terms (for example competenc*, pharmac*, education*, curricul*). Relevant Medical Subject Headings (MeSH) terms were also used, where appropriate, to ensure inclusion of relevant literature from Medline and Embase. Pharmacy-related journals were manually searched for relevant studies (Currents in Pharmacy Teaching and Learning (CPTL), Research in Social and Administrative Pharmacy (RSAP), American Journal of Pharmacy Education (AJPE), International Journal of Pharmacy Practice (IJPP), Pharmacy Education Journal (PEJ)). Databases were searched on the January 29, 2021. The review protocol is published on PROSPERO under the registration number CRD42022296424.

2.2. Inclusion and exclusion criteria

Literature was restricted to studies published in English from 2010 to 2021. The literature was limited to this date range to capture studies relevant to *current* pharmacy education and training and recent CBE related developments, such as the FIP GbCF in 2012,[12] and the influential 2010 Lancet report on healthcare professionals' education.[2] Studies relating to all levels of education and training in pharmacy including undergraduate (initial education or pre-registration degree, e. g., MPharm or BPharm), postgraduate (graduate students studying for a second qualification, e.g., Masters or Post Graduate Diploma), and professionals undertaking workplace based training (post pre-registration degree) were included. Firstly, to enable description of a wide picture of educational activity that may be valuable in guiding any level of pharmacy CBE related development. Secondly, to capture details relevant to the continuum of competency development across the various stages of education and training in pharmacy, as it is paramount that the competencies attained in initial education are maintained and developed in professional practice.[5]

Any study, that fulfilled the above criteria, and was related to CBE (as defined by Hodges et al.[3]) or elements of CBE in line with the core concepts of a competency-based approach (i.e. a focus on the outcome of education in terms of what students can *do* in relation to a specific role), were considered for inclusion. This included studies, even if not part of a fully realised CBE curriculum, concerned with relevant individual elements of CBE with guidance from the themes of CBE definitions previously identified by Frank et al.[6] Pharmacy education often follows a similar trajectory to the development of medical education, the definitions of Hodges (2012) and Frank (2010) are also applicable to other healthcare professions and were, therefore, deemed appropriate guides for the identification of studies for inclusion.

The inclusion criteria were intentionally broad to capture any studies related to CBE activity in recognition that studies pertaining to the achievement of a fully integrated CBE curriculum are scarce due to the complicated and resource intensive process. Therefore, it was expected that availability of global studies relating only to this strict definition may be limited and that useful information could still be gathered from studies that were associated with programs or curriculums that were using some principles of CBE but were not necessarily part of a fully integrated and purposely designed CBE curriculum. Furthermore, information from these studies was considered relevant to the objective of this study, which is to characterise the global picture of pharmacy education related to features of CBE.

Studies were excluded if they were commentaries, reviews, and letters or pertained to one narrow subject topic only, e.g., nutrition or geriatrics. Studies that focused on the process of creating competencies or competency frameworks were included if they involved broader discussion of subsequent application, or evaluation of these competencies or frameworks in relation to education and training in pharmacy but were excluded if the study referred only to the process of gathering or creating competencies or frameworks.

2.3. Literature selection and data extraction

Two reviewers screened the titles and abstracts of each article independently for applicability to the research topic and population. Full studies were then assessed for selection against the inclusion and exclusion criteria where a consensus was reached on the final studies selected, utilising a third reviewer to resolve any discrepancies. A summary of the literature selection process can be seen in Fig. 1, presented using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[20] General characteristics of the studies are summarised in Table 1. Two authors (JM and LP) independently identified lists of specific features of CBE from the studies which
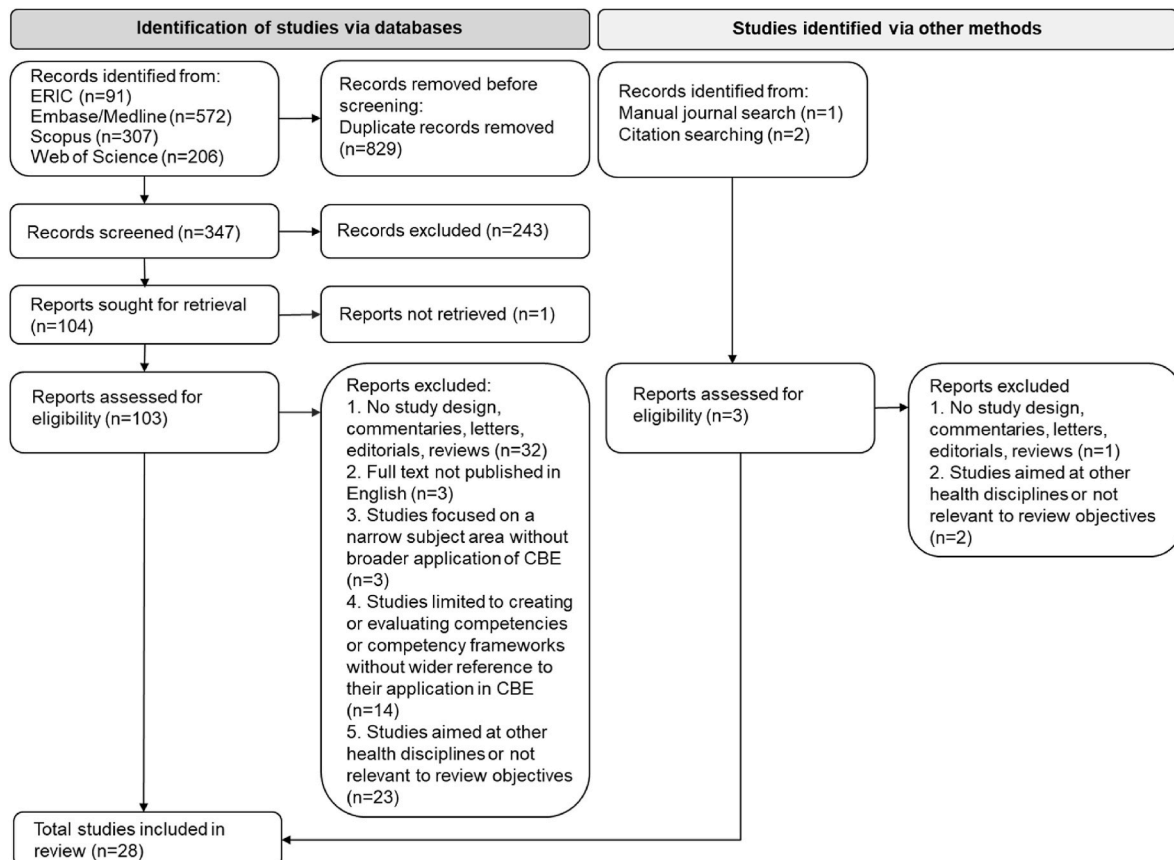

Fig. 1. PRISMA flow diagram of search strategy and selection of studies.

Table 1
Summary of studies.

	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
1	Al-Haqan et al. (2020)[24]	Kuwait	Evaluation of the effectiveness and feasibility of a structured Continuing Professional Development (CPD) training program supplemented by the Kuwait Foundation Competency Framework (KFCF).	a. Mid-point survey with a 5-point Likert scale to assess perceptions of impact and satisfaction with the training program b. Post-intervention survey to inform larger scale implementation c. CPD record content analysis for effectiveness, adaptation and feasibility of the program d. Focus group interviews on experience and perceptions focused on content, delivery, barriers to CPD, feasibility and recommendations for implementation.	Hospital pharmacists in Kuwait enrolled on the structured CPD program. a. n = 15 b. n = 16 c. n = 35 (18 1st entry, 17 2nd entry) d. n = 10	A guiding competency framework in addition to a continuous feedback structure was found supportive to pharmacists during the CPD program and considered to help deliver an impactful translation of education to practice. Using the KFCF as a structured self-assessment tool helped pharmacists identify strengths and areas to improve. More support from colleagues and higher authorities was suggested in the focus groups. Policies and regulations were highlighted as an important component for sustainability of the program.
2	Al-Haqan et al. (2021)[25]	Kuwait	Description of the development, implementation, and evaluation of OSCEs for final year pharmacy students in Kuwait. Comparison of students' performance in two academic years (2015-16 and 2016-17).	a. Student OSCE scores were correlated to total course grade. Median percentage total OSCE scores from 2015 to 16 and 2016-17 were compared. Percentage competency scores and frequencies from 2015 to 16 and 2016-17 were compared. b. Student survey of the OSCE experience using a 5-point Likert scale and open ended questions. c. Staff feedback form to assess perception of the OSCE experience in terms of difficulty, timing, comments and suggestions.	Final year pharmacy students at Kuwait University a. n = 84 b. n = 84 c. n = 66	Design, implementation, and evaluation of the OSCE was technically feasible and provided a broad assessment of competency to ensure an acceptable level before graduation. Correlation between a high OSCE score and a high total course grade was observed. Students reported OSCEs as a positive experience for the opportunity to practice real-life scenarios in a safe learning environment. However they suggested more formative practical sessions earlier in the curriculum to prepare for summative OSCEs. A working group reviewed literature and followed a systematic evidence-based approach to OSCE design and implementation. Blueprinting was deemed crucial for ensuring relevance and validity, clarifying competencies and providing a road map for the development of case scenario and training for assessors.
3	Al-Haqan et al. (2021)[26]	Kuwait	Develop a Kuwait Foundation Competency Framework (KFCF) for pharmacists using the FIP GbCF in an adopt and adapt approach	a. Initial consensus panel validation on degree of relevance of GbCF behavioural statements using a 4-point Likert scale and panel discussions. Delphi process not applied due to small number of participants. b. National online cross-sectional survey of relevance of GbCF using 4-point Likert scale. c. Final consensus panel discussion with policy and decision makers and pharmacists using focus groups.	a. n = 9 Mixture of early career (n = 5) and experienced pharmacists (n = 4) b. n = 1483 pharmacists registered with Kuwait Pharmaceutical Association (KuPhA), c. n = 23 pharmacists (n = 18), and policy and decision makers (n = 5)	Competencies should be separated in to 3 domains: core for all pharmacists, supplementary for private sector and supplementary for public sector because of the differences in practice for the public/private sectors. A national foundation pharmacy training program delivered through collaboration with Kuwait University (KU), KUPhA and the Ministry of Health (MoH) is recommended to provide continuing support and training necessary to master the KFCF behaviours. Future work should focus on expanding the scope of practice based on advanced pharmaceutical services via collaboration between education, practice and policy due to the lack of clear policies and regulations that would facilitate the advancement of pharmacy practice in Kuwait.

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Table 1 (*continued*)

	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
4	Allen et al. (2016)[27]	United Kingdom	Determine students views on their experience with using the iSED® (individualised Skills Evaluation and Development) program developed by the Leicester School of Pharmacy and understand how students perceive their own learning when using iSED in a simulated clinical exercise.	a. Retrospective questionnaire. Five-point Likert scale was used and extent of students indicating favourable views towards iSED® was reported as a mean where a score, >3 indicated a positive view. b. Focus groups c. Focus groups divided into smaller groups of 7 or 8 Focus group discussions were audio recorded, transcribed and analysed according to a qualitative thematic framework.	a. n = 108 Year 2 pharmacy students, the first to use iSED® in their first year b. n = 7 Year 2 students c. n = 30 Year 3 students (with no experience of iSED®) invited to attend an iSED® workshop prior to the focus group).	Following data entry, iSED® generates feedback on performance compare to gold standard and is colour coded (red, amber, and green) to indicate competence in 4 areas: 'communication skills, information retrieval, the recommendation, and follow-up advice'. Feedback is also provided according to behavioural indicators of competence within these 4 areas. The colour-coding of feedback was indicated by students to be a helpful visualisation for identifying strengths and weaknesses Students particularly found instant feedback, visualisation of feedback, video feedback and reflection on their own performance according to gold standards to be positive aspects.
5.	Alves da Costa et al. (2020)[28]	Portugal	A case study of sharing best practice between academics, practitioners and the Portuguese Pharmaceutical Society (PPS), developing the Education and Practice Platform (EPP). The EPP bridge the interests of academia and practice, gathering information about key competencies.	a. The EPP's mission, vision and values were set by the steering group creating a common path and a one-year plan. Activities included workshops on teaching methods and internships, involvement in international events, updating EPP representatives on global advances in pharmacy education and facilitating national sharing of curricular details for constructive criticism and benchmark b. Narrative review exploring the alignment of education and professional practice with the research question; 'Are there teaching experiences at the undergraduate level that better meet the needs of pharmacy practitioners?'	a. A representative from each pharmacy faculty, of which there are 9, and from the 6 Councils of Speciality Boards of Practice (CSBP). b. 21 studies included in qualitative synthesis	The vision of the EPP is 'the alignment of education and practice with the PPS' statutes to ensure the validation of the competencies defined for each practice area, and compliance with the guidance from international organisations.' Workshops focused on creating a more practice-centred and student-centred curriculum taking into account student views. A concern shared in common with academia, hospital and community pharmacy was the need for more clinical training, practice-partnerships were highlighted as a possible solution. To make this work sustainable it was suggested that the EPP should have independence to maintain alignment between education and practice, with or without political support. The literature review showed four references with research on educational programs developing specific competencies. Due to the limited number of publications in the review as controlled trials or with suitable designs for gathering adequate evidence it was not possible to answer the research question. Recommendations for developing a competent workforce to meet societal demands include involving all stakeholders, academic curricula development without engagement of practitioners, services, service users and other professionals is no longer acceptable.

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	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
6.	Bajis et al. (2018)[29]	Eastern Mediterranean Region	Exploration of the perspective of pharmacy stakeholders on pharmacy education and quality assurance.	Semi-structured interviews thematically analysed and mapped to FIP Global Quality Assurance Framework.	n = 31 Participants all had post graduate qualifications in pharmacy and were made up of educators, practitioners, employers, regulators, and policymakers.	Political and socioeconomic circumstances were identified as barriers to training and advancement of pharmacy education. Shortage of expertise and specialised pharmacy educators in universities was also attributed to political/social struggles, including migration. Translation of knowledge to practice was identified as important with modern teaching and learning methods, including varied assessments, identified as needed for adequate assessment of competency. Lack of quality assurance bodies was identified and some programs gained accreditation from Western countries for credibility. Variability in these procedures within the same country was linked to variability in competence of graduates. Hospitals reported using competency-based training, more so if Western accreditation or affiliation was present. Academic, regulatory and practice sectors are disjointed and there is absence of a shared vision so more collaboration is needed. Curriculum specific needs identified included modernisation and better alignment of educational outcomes with the country specific societal needs. PharmD qualification mismatched with career options and clinical services available highlighting requirement for a more needs-based approach especially when importing Western-based educational models. Competency frameworks were considered a favourable means of ensuring conformity of curricula content to meet competency standards across pharmacy schools.
7.	Bayram and Köksal (2019)[30]	Turkey	The National council of Deans of Faculties of Pharmacy in Turkey defined competencies for pharmacy. This is a quantitative mapping of a particular curriculum to analyse if it fulfils the competency requirements.	Each member of academic staff on the pharmacy program evaluated if their course content did or did not meet the sub-competencies defined by the council by assigning a score of 0 (not met) or 1 (met). The average of the scores for the sub-competencies were expressed for the competency as a whole using a percentage. The scores for each course (the 63 compulsory courses of the program were included in the analysis) were then collated to indicate the overall score indicative of how the competencies were met for the entire 2017–2018 program.	Each member of academic staff on the pharmacy program at the University of Yeditepe, Turkey. Full-time (n = 34) and part-time (n = 6) faculty members.	Strengths and weaknesses of the program were highlighted by the competency scores. Lowest scores were in 'prepares biotechnological products', 'develops a drug formulation', 'performs microbiological controls during drug production' and 'performs the microbiological analysis of cosmetics'. The academic members of the relevant departments revised the content of their course to address these weaknesses. Higher competency scores were found in the topics of clinical pharmacy and analytical techniques, two areas which the author describes as previous priorities for the university. The author suggests that binary rating scores

Table 1 (*continued*)

	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
						are preferred over a Likert-type scale to avoid ambiguity and argues that curricula could be mapped in this way according to any chosen predefined competencies.
8.	Boyle and Myford (2013)[31]	United States of America and Canada	Determine whether pharmacist's expectations of the competency of entry-level pharmacists differ according to their degree level, practice setting or preceptor experience.	Analysis of pre-existing online cross-sectional survey data. The National Association of Boards of Pharmacy (NABP) distributed a National Pharmacy Practice Survey in 2009. Pharmacists rated 43 competency statements using criticality and frequency scales from a 1 (low) to 5 (high) score. The study analysed the ratings for criticality against the variables of pharmacy degree, practice setting and preceptor experience.	Pharmacists licensed in the USA or Canada and actively practicing or engaged in the education of pharmacists. n = 2986 (n = 2244 from the United States and n = 714 from Canada)	Pharmacists working in inpatient settings rated the competencies higher than those in outpatient or 'no-patient' (reference) settings No significant difference in competency measures for practice setting or preceptor experience. Preceptors did not rate competencies higher or lower than non-preceptors. Academics rating of criticality was higher than non-academics. Variety in practice settings appeared to have no significant effect on ratings Authors suggest that this type of analysis can be used to align educational outcomes with standards of practice and highlight the need for regulators, educators and practitioners to share their visions for the profession.
9.	Bray et al. (2017)[32]	United States of America	Measurement of student performance and experience after the development and implementation of a CBE assessment model using Honours, Satisfactory and Fail (H-S-F) levels of performance.	Cohort Study Student scores were collected and compared to previous cohorts. Preceptors rated student performance. Student experience of the assessment model was assessed via survey. Student performance was aggregated according to semester and the 155 competency sub-categories within the overarching 6 outcome categories in the curriculum Attrition and progress of students was measured against 2 previous cohorts (class of 2015 and 2016)	PharmD students and staff at Washington State University starting year one in 2013 with the CBE assessment model with subsequent sequential adoption as the cohort transition into year 2 and 3 (n = 85–134 depending on class size)	Feedback was to be given within 48hrs using ExamSoft® software. Computer based tagging and coding categorised questions according to Competency-based curriculum outcomes for the school and ACPE accreditation standards and Bloom's taxonomy. Majority of students on all assessments demonstrated competency in 1 or 2 attempts. Students were given 3 attempts to pass and varied methods of re-engagement to identify and resolve knowledge gaps – a process the authors describe as important for self-directed learning. Preceptor evaluations were consistent with those from the previous letter graded system Progression statistics for students improved within the Honours, Satisfactory, or Fail (H-S-F) assessment model. Administrative staff included a block-testing coordinator was employed to coordinate this.
10.	Kary et al. (2019)[33]	Canada	Compare strategies of Canadian residency programs for assessing and evaluating competencies set by the Canadian Pharmacy Residency Board (CPRB). Looking at tools used, persons involved, frequency, scheduling and repetition of curricular components.	Survey of residency programs distributed electronically between February and March 2018. Program coordinators for CPRB accreditation programs were invited to respond. Categorical data were analysed descriptively. Open responses and comments were summarised with those from academic modules associated with pharmacy practice.	n = 20 programs, including 100% of general practice programs and 70% of multicentre organisations largely focused on direct patient care (37 invited to participate).	Programs were all similar in terms of assessment methods. All programs used care plan review, direct observation, journal clubs, creation of project timelines, and ethics submission. Main evaluation methods used were presentations, written manuscripts, drug information rotations, longitudinal evaluations. Standardized assessment forms were used, defined by Bloom's taxonomy. And the CPRB

Table 1 (*continued*)

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	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
						"levels and ranges" guidance document. Self-assessment and pharmacy team assessment was used in all competencies. CPRB accreditation standards published in 2010 defined competencies which align with current practice and this was the driver for change to competency-based education for pharmacy residents. These align with professional competencies for Canadian pharmacists at entry to practice by the National Association of Pharmacy Regulatory Authorities (NAPRA). Many of the programs were in keeping with these guidelines. This study identifies where attention may be needed as national alignment is introduced.
11.	Kirton and Kravitz (2011)[34]	United Kingdom	Compare objective structured clinical examinations (OSCEs) and traditional assessment methods for recent pharmacy graduates from the University of Hertfordshire (UH).	Test scores for OSCEs were compared with those from academic modules associated with pharmacy practice using Pearson's correlation coefficient. OSCE scores for year 1, 3, and 4 were also compared for measures of progress.	Students who graduated from the UH School of Pharmacy in the summer of 2009, n = 39.	Correlation between year 3 OSCE score and Year 3 Medicines and Pharmacy Practice (MPP3) examination grade was not seen (r = 0.6). 100% scored better in year 1 compared to year 3 OSCEs. 80% scored better in year 4 compared to year 1 OSCEs. The differences may be attributed to different skill sets compare to OSCEs and traditional examination. Although strong knowledge base can improve clinical competence, a correlation may not be expected because of the distinction between capabilities being assessed. Individual-specific environment and circumstance can influence competency and performance as included in the Cambridge-Model for assessing competence, which the authors suggest could also explain the results e.g. the stress of a multi-station assessment. Authors also note that the MPP3 exam is crucial for progression to the final year whereas the OSCE isn't. 20% did not perform better in year 4 compared to year 3 OSCEs this is attributed to external factors as final-year project dissertation was also due at the same time. The authors also comment that repeated performance over a series of OSCEs is required to accurately measure competence. They feel it is not feasible to do this because of the resource-intensive nature of these assessments and do not think it is fair to use their current OSCEs as barriers to progression. They do however mention that they examine different skills to traditional methods and should be used in conjunction with traditional methods.

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	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
12.	Mann et al. (2018)[35]	United States of America	Examine opinions of pharmacists regarding competency development in terms of departmental value, personal confidence and frequency of use for 9 competency topics	An electronic survey to better understand the perceptions of pharmacists on competency-based programs and identify which 9 competencies should take priority to guide future program development. Department values and personal confidence with the competencies were measured on a 5-point Likert scale (strongly disagree – strongly agree). Frequency of competency utilisation was measured on a 4-point scale range (never-always).	Pharmacists and pharmacy residents from a large non-profit academic medical centre in the southeast of the USA. Including clinical, operational and leadership pharmacists which were proportionally representative of the pharmacy positions in the department, n = 105 eligible survey responses included in the analysis.	The view was to design a competency program that covered requirements of pharmacists from a professional stance which also align with organisational and individual perspectives. Pharmacist involvement via the survey early on in program development was thought to be useful to ensure stakeholder involvement, boost awareness of competency development initiatives, obtain employee support and guide resource allocation. All 9 competencies were identified as valuable with a general agreement regarding their significance irrespective of practice setting. 'Therapeutic knowledge/was highly valued, frequently utilised, and an area in which individuals lacked confidence in their abilities. And was so selected as a competency area for initial piloting to promote pharmacist acceptance and participation with the new competency program initiative. Authors suggest research could be benefited from participants outside of pharmacy, especially as healthcare models increasingly involve team-based patient care.
13.	Meštrović et al. (2012)[36]	Croatia	Measure community pharmacists' progress in competency development using the General Level Framework (GLF) as an educational tool in a longitudinal study	Patient care competencies of 100 community pharmacists were evaluated before and after the introduction of an educational program based on the GLF using an overt observation method. This included new services, standard operating procedures (SOPs) and pharmacists keeping patient care contribution portfolios. Pharmacists' performance was rated against the GLF behavioural statements on a 4-point scale.	Pharmacists employed in Croatia's largest community pharmacy chain in different regions and in different pharmacy sizes situated in small and large towns, n = 100.	Post-qualification training for pharmacists at the time of this study was mostly through traditional continuing education and passive learning. CPD points were used for pharmacists' license renewal every 6 years. This competency-based approach therefore was novel and unique in that it identified education and developmental needs and then provided tailored education and training. Prior to training the concept of competency in pharmacy practice was introduced to the pharmacist and developed through lectures and workshops. Pharmaceutical care activities were recorded in pharmacists' portfolios made mandatory by the chain in 2009, along with complimentary patient care SOPs. Self-assessment took place following the GLF for pharmacists to identify which competencies needed further development. Significant difference (p < 0.05) between the values (never, rarely, mostly, consistently) from 2009 to 2010 was seen for all competencies. Variability between pharmacists' ratings decreased by half from 2009 to 2010 and the authors suggest that the GLF is an educational tool that can improve setting standards and uniformity of pharmaceutical care.

Table 1 (*continued*)

	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
14.	Nash et al. (2016)[37]	Australia	An analysis of data from the Traffic Light Report (TLR) project which combines Miller's pyramid, technology and student voice to examine a curriculum for Assurance of Learning (AoL). The "Traffic Light Reporting" aspect involves the students to identify where more work is needed on a competency standard by marking it as red, amber or green.	Summative assessments were mapped to the National Competency Standards Framework for Pharmacists in Australia (NCS) alongside level of performance as per Miller's pyramid of competence and students' self-reflected performance. Students and educators describe different understanding of expected performance levels and this paper seeks to explore possible reasons for this. There were four units per semester. Each unit has 2–8 summative assessments. Educators mapped each assessment unit against the NCS and the level of performance expected on Miller's pyramid into a database.	a. Students across all 4 years of study were invited to self-reflect on their performance in each competency standard after the semester exams against the NCS and Miller's pyramid level of performance and the TLR system via an online survey, n = 69 semester 1 (42% response rate), n = 52 semester 2 (26% response rate). b. Student feedback comments, n = 73 semester 1 (45% response rate), n = 31 (16% response rate). c. Educator's mapping of performance level was compared to that selected by the students	In 21.14% of instances students self-reported their performance level higher than their educators. In 33.07% of instances students' self-reflection was in agreement with educators. In 45.79% of instances, students self-reported their performance lower than their educators. Students expressed that they didn't feel confident compared to the educator's assessment. Scaffolding in domain 3 (Leadership and management) was demonstrated to be weaker than some of the other domains and this highlights an area that may need to be introduced earlier in the course to ensure graduates can be leaders of the profession. Students may not fully understand the concept of Miller's pyramid and this may account for some of the disagreement. Particularly where students' asses themselves at the "does" performance level without adequate foundational knowledge which ensures safety (e.g. pharmacology and therapeutics knowledge in dispensing). A science vs practice split was highlighted by some of the students' comments. They did not see how the NCS related to the curriculum. This suggests poor integration of knowledge, skills and attributes for performing at the "does" level. Authentic assessment choice is suggested by the authors to assist with integration of competencies which can be assessed formally and help students enter practice with confidence in their ability to perform. Authors highlight the importance of assurance of learning (AoL) through sound curriculum design that builds a solid knowledge foundation integrating professional standards within the curriculum and ensuring assessed curriculum translates to the intended learning.
15.	Nash et al. (2017)[38]	Australia	Determine how competence training can help with quality in professional development.	a. Quantitative survey on how pharmacists understand the Pharmacy Board of Australia's (continued professional development) CPD framework. b. Qualitative and quantitative survey on pharmacists' current knowledge, use and acceptance of the National Competency Standards Framework (NCS) c. Thematic analysis of social media comments posted on Australian pharmacist forums relating to CPD plans.	a. n = 278 (1% of 25,944 registered Australian pharmacists) b. n = 158 (less than 1% of registered Australian pharmacists) c. pharmacists commenting on commonly accessed professional pharmacy forums, n = 55 comments.	The majority of pharmacists (77%) did not use NCS when planning their CPD and just over half (57%) of pharmacists did not use NCS for annual registration. This study applied triangulation from the 2 surveys and social media comments and conclude that pharmacists want mentoring, support, education and clear instruction on the expectations of the profession when using the NCS for CPD and lifelong learning. The Australian pharmacy council requires Australian pharmacy courses to provide evidence that their courses align with the NCS. The surveys were distributed prior to the

Table 1 (*continued*)

	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
						Pharmacy Board of Australia (PBA) introducing the mandatory use of the NCS for self-assessment at annual re-registration in 2015. A better understanding of the CPD process and the use of the NCS and CPD framework is needed. Authors suggest an e-portfolio at undergraduate level with reference to the NCS to match and record learning. Additionally, they suggest formative assessment with feedback and summative assessment of students' ability to implement a CPD cycle. Self-assessment skills are complex and challenging and it cannot be assumed that students and pharmacists are automatically equipped to carry out this task and preparation to engage in meaningful lifelong learning should begin at undergraduate level.
16.	Nunes-Da-Cunha and Fernandez-Llimos (2019)[39]	Spain	This study analyses the quality of the competency allocation to courses in the pharmacy curricula of Spanish universities according to the CIN/2137/2008 Ministerial order.	The CIN/2137/2008 Ministerial order depicts the duration of the pharmacy degree, the requirements on the curriculum and the competencies for pharmacy practice in Spain. A list of all the CIN/2137/2008 competencies assigned to each course of the curriculum was compiled for pharmacy schools in Spain. The courses were classified into 7 knowledge areas according to the proportion of competencies from each area assigned to that course, or classified as non-specific in the event if a tie. Courses without online syllabi, elective courses and courses that specifically focus on the internship period or final dissertation were excluded.	Courses from Spanish pharmacy schools with online syllabi detailing description of objective, learning outcomes and educational teaching and assessment methods, n = 881 courses (44.7% private universities and 55.3% public universities)	57.5% of courses were paired to a general competency. 2 universities had no courses paired to general competencies. Two universities assigned 15 out of 15 general competencies. Competencies were frequently mismatched with no real alignment between them and the content of the course. The variation between competency and course pairings differed greatly between the universities. Despite similar course syllabi universities reported great variation between alignments with competencies, suggesting that competency pairings may not be accurate. The authors suggest that competency assignment was on the basis of course title rather than actual content and schools can simulate a curriculum that appears more clinically-orientated than it actually is. The authors call for pairings based on educational content and assessment methods and that competencies should be aggregated into EPAs to easily map why courses are in a particular curriculum and what competencies and activities the course are preparing the students with. The recommendation is for educational and professional bodies to create a common database to allow for this mapping.
17.	Paradis et al.[40]	Canada	To identify how the 2010 Association of Faculties of Pharmacy of Canada (AFPC) roles have been included in the curriculum at the Leslie Dan Faculty of Pharmacy (LDFP) Toronto.	Content analysis of interviews exploring understanding of the AFPC roles, their significance for teaching strategies, students, patients and the profession, and specific examples of how the roles are being addressed, their perspectives of the AFPC	Core members of the PharmD faculty who were instructors involved with curricular and course design for courses where AFPC 'non-expert' roles were identified as educational outcomes in the PharmD program.	All faculty members saw the AFPC roles as extremely important. They saw the roles as key for development of students in to 'well-rounded professionals' and that it was important for the profession as the roles help distinguish the place of the

Table 1 (*continued*)

	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
			AFPC roles are based on the CanMEDS competency framework.	outcomes and their import to the curriculum, and how they are perceived by their colleagues and students, and how they may contribute to interprofessional education		pharmacist within other healthcare disciplines. Underlying knowledge was deemed important by some (particularly those with social science and humanities background) as opposed to purely technical knowledge. For example there is a scholarly foundation to communication which can be taught as a discipline in itself. However, Most viewed them as informally Taught technical skills. Developing active or experiential learning was deemed more important than materials to impart knowledge when it came to developing skills. The authors suggest that the AFPC's Education Outcomes are a result of external pressures on the profession rather than a 'fully self-driven, internally motivated process'. Authors conclude that their findings reflect the different epistemological understandings of competency-based frameworks and the ambiguity about the relationship between the roles and competencies. They conclude that is important for educators to agree on and define how the will be teaching roles and competencies, including their nature in relation to skills and knowledge and the optimal way to teach them. Competency development should be explicitly embedded into the curriculum and not left to individual instructors.
18.	Reardon et al. (2016)[41]	Qatar	Qatar University's (QU) pharmacy program is accredited by the Canadian Council for Accreditation of Pharmacy Programs (CCAP). A new registration exam (known as a final cumulative assessment) based on the Canadian format was piloted with pharmacy graduates and a sample of practising pharmacists	Qualitative focus groups, with open and closed-ended questions, were held to examine the perceptions of the exam candidates on the competency-based exam format. The objective was to inform exam developers of barriers and facilitators to implementation of the new exam format and to identify the resources required to support future candidates.	All undergraduate pharmacy students in their final year at QU, practising pharmacist's that had taken the pilot exam, and a convenience sample of pharmacists involved with experiential training of graduates and undergraduates from QU. Three focus groups, n = 3, n = 5, and n = 8. (11 pharmacists and 5 students)	Participants commented that the current exam tested basic pharmaceutical sciences knowledge and did not assess clinical application. It was felt that a standardised exam would increase public trust and pharmacist's professional confidence by insuring that each practitioner has met requirements for minimal competence. Barriers to implementation were fear that the current pharmacists would not be able to pass a competency-based exam, would not have time to prepare and that community and hospital pharmacy cannot be assessed equitably with the same exam. Physicians might also feel a threat to their practice if they think pharmacists are expanding their roles. Facilitators included increased salaries and a new professional designation for those that pass the exam and training including preparation with mock OSCEs. Thorough dissemination of information to increase awareness and acceptance of the exam is recommended to alleviate anxiety

Table 1 (*continued*)

	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
19.	Rich (2019)[42]	Canada	Compare how professionals describe and represent competence. The study focuses on how core competencies are described and structurally organised and to what extent tensions between competing conceptions of competence are conveyed across frameworks.	Content and inductive thematic analysis of publicly accessible Canadian entry-to practice competence frameworks	Frameworks from 10 professions (medicine, nursing, occupational therapy, pharmacy, psychology, social work, teaching, engineering, law, and planning)	surrounding the new format. It is suggested that laws should be changed to allow the scope of pharmacy practice to be expanded. Six out of ten frameworks (including pharmacy) describe a relational architecture between meta-competencies (e.g. roles, competency categories, and competency blocks) and component key and enabling competencies. Those that had organisation into 'meta-competencies' describe competence as integrated, holistic, and equal to more than the sum of its components when compared to those without this organisational structure who describe competence as being equal to the sum of its components. This highlights the tensions between the different conceptions of competence. The author concludes that language and architecture of entry-to-practice competency frameworks that influence professional education stakeholders are important to consider. Particularly as this could affect the conceptualisation of competence. This requires some thought and agreement prior to creating CBE program and related teaching and assessment methods.
20.	Skowron et al. (2017)[43]	Poland	Determine whether the Jagiellonian University Medical College (FP-JUCM) Master Diploma in Pharmacy (MDPharm) undergraduate curriculum meets the criteria of the European Competence Framework (ECF)	Academics from FP-JUCM mapped the specific learning outcome (sLO) to the ECF which were then mapped to the courses of the MDPharm program. They also subjectively categorised the level of competence students' could acquire from these sLO according to the 5 levels of the Dutch Standard Framework	Four academics from the FP-JUCM, all had previously obtained their pharmacy education from the JUCM and had experience as community pharmacists.	Competencies were not found to be integrated across all years of the program. For instance, 'personal competencies' were mostly covered in the final years of study. The 'research and industrial pharmacy' competencies were the only ones found to be distributed across all years of study. Only one competency 'knowledge of design, synthesis, isolation, characterisation and biological evaluation of active substances' could be categorised at level 5 of the Dutch Standard Framework. The authors conclude that the curriculum at the time of writing did not adequately reflect the ECF and so recommend further research as the study was limited to analysing the 'intended curriculum' through documents only and suggest that students' perception of competencies achieved should also be measured. The authors acknowledge that national regulation would need to be changed for the curriculum to convert to a competency-based one and incorporate the ECF, which they recommend given the gaps and lack of balance of competencies across all years of study.

Table 1 (*continued*)

	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
21.	Stupans et al. (2012)[44]	Australia	Develop a competency graduated descriptors tool to support developmental stages on experiential placements. The tool is intended to be used by all universities in Australia to enhance consistency of experiential placements and to facilitate students' self-assessments and discussions with preceptors.	a. Participatory action research to develop the tool, including a series of collaborative workshops and individual consultations. n = 201 b. The tool was the trialled at 2 universities by students on their final year placements where they were asked to give their opinion on the tool in a post-placement debrief session via a paper survey using a 5-point Likert scale (n = 162, 57% response rate)) Preceptors at one of the universities (university 2) were also given a similar survey (n = 30, 36% response rate)	a. Academics (n = 47), students (n = 102), professional/registration board representatives and preceptors (n = 52) in eight states and territories in Australia. b. Australian undergraduate pharmacy students that had trialled the tool while on placement in their final year (n = 117 students from university 1 and n = 45 students from university 2).	Negatives were associated with the tool potentially blurring the roles of university and the mandatory 12 month internship following graduation. Others felt that the tool should have some continuity with the internship particularly as they will have to repeat a similar thing during the internship year and it could help with a more seamless transition from undergraduate to postgraduate levels. Overall authors indicate that students were ambivalent towards the tool while preceptors were generally positive. Survey comments indicated that student engagement with the tool was not strong as some felt that they did not understand how it apples to them or how to use it, so more explanation prior to placements may be warranted. Some preceptors' comments were related to the tool being too complex or time-consuming, potentially linked to the short time they have available with students in practice. More work is needed to refine language and complexity of the tool and authors recommend that universities wishing to use the tool should ensure that competencies and competency standards are explained clearly within the curriculum and that students should have prior practice with self-assessment skills.
22.	Stupans et al. (2016)[45]	Australia, Canada, United Kingdom and United States of America	A comparison of the learning outcomes for pharmacy graduates from Australia, Canada, United Kingdom and United States through mapping to the International Pharmaceutical Federation (FIP) Global Competency Framework (GbCF)	Comparative document analysis to review the level of commonality and the differences between expectations of pharmacy graduates' learning outcomes from these countries aligning them to the global pharmacy workforce practice via the GbCF.	End of degree expectations from 4 pharmacy programs	There was overall alignment across the jurisdictions between the learning outcomes and the GbCF for the basic elements of public health, pharmaceutical care and personal attributes. Dispensing and compounding has less emphasis in Canada, UK and US compared to Australia. Which may be due to individual differences between countries with regards to the role of pharmacy technicians. Australian outcomes do not include organisation and management. Only the US outcomes specify innovation and entrepreneurship potentially preparing students for adaptability and responding to the unknown. Authors mention that teamwork and leadership is not referenced in the GbCF but that these are present in 3 out of the 4 countries' learning outcome statements. The GbCF was partly created using the practitioner development competency frameworks from these countries so similarities are not surprising.

Table 1 (*continued*)

	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
						Authors suggest that revisions be considered in the future regarding harmonisation of learning outcomes across these countries for transferability and thus mobility of pharmacists across the jurisdictions. Cross-border institutional networking is recommended to address a common assessment tool in pharmacy education. Despite the differences in degree title, the jurisdictions align with pharmacists as patient-orientated medicines experts and demonstrate a close relationship between the professional and university systems.
23.	Vitor et al. (2019)[46]	United Kingdom	Understand perceptions of pharmacist practitioners after completing the MSc in Advanced Pharmacy Practice (MScAPP) at the University College London (UCL) and how the program supports developmental progress towards advanced practice.	Semi-structured interviews analysed via an iterative process of thematic grouping and a matrix coding approach. Two independent variables; years since graduation of the MScAPP, and professional roles before enrolling on the program were chosen to see the impact on short-term career progression and adaptability of the program to different pharmacy specialisation areas. Dependent variables were current role, RPS Faculty engagement and general workplace representations. The MScAPP uses the Advanced Practice Framework (APF) for the Royal Pharmaceutical Society (RPS) to support competency-based education.	Pharmacists of any background that graduated from the program, n = 15, 14 were working in a clinical role and 1 in an academic setting. (Specialisations couldn't be compared because most participants had a clinical role.)	Participants found that the APF was a useful benchmark for their education and tool for identifying learning gaps. Students found the APF useful to facilitate their learning portfolios and one also used it to support carer progression suitability. Graduates continued to use the framework after graduation and found it relevant to continued carer development. There were no differences found between experience level and the research and evaluation skills and competencies, authors suggest that this area is not developed during professional practice and so experience does not equate to strength in research and evaluation. The APF supported practitioners in acquiring new skills or enhancing prior skills and competencies. Authors suggest that it can also assure quality and safety of professional services and conclude that the AFP is helpful for strengthening advanced level competencies.
24.	Volmer et al. (2017)[47]	Estonia	Evaluate the existing Masters of Pharmacy (MSc Pharm) undergraduate pharmacy program at the University or Tartu (UT), Estonia by using the European Pharmacy Competence Framework (EPCF). The EPCF was used as a mapping tool for the current curriculum and curriculum gaps were identified and the curriculum outcomes competency levels assessed.	Qualitative assessment of the pharmacy program was performed with a convenience sample of different pharmacy stakeholders. Both obligatory and elective subjects were included in the analysis. Subject areas were defined using predetermined subject groups. Competency levels to be achieved by the outcomes of the curriculum were identified according to the Dutch competency standards framework which has a 5-point scale based on increasing professional independence.	Pharmacy stakeholders from academia, wholesale and retail sale of medicines, hospital pharmacy, pharmaceutical industry and other fields (e.g. State Agency of Medicines). Recently graduated pharmacists were also included to analyse the program from the point of view of both students and pharmacists, n = 14.	Pharmacy sector representatives identified issues in the organisation and training methods of the program and called for: incorporating patient care competencies from the beginning of the program and linking this to practice; more detailed requirements for students and supervisors for internships, due to the important role of the internships in developing professional competencies; more practical implementation of theoretical knowledge; more interdisciplinary collaboration; and integration and novel methods for student self-reflection and identification of learning needs. The EPCF is designed primarily for community pharmacy so was not found ideal for evaluating this type of curriculum (without specialisation). Occupational qualification standards for

Table 1 (*continued*)

16

	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
						pharmacists were approved in Estonia in 2016 which include detailed descriptions of required competencies and this information can support pharmacy education in the future. Previously, practice-linked training was not well supported in Estonia. Patient care competencies had specific subjects listed to support them whereas personal competencies were identified as being covered by the whole program and less specific and so the differences in the level of competency achieved could be due to speculative evaluation of the personal competencies which scored higher. The development of professional competency is a continuous process involving both under- and post-graduate education. Evaluators were not curriculum development experts, it would be advised in the future to consult with curriculum development specialists and education scientists.
25.	Walter et al. (2018)[48]	Canada	Recommendations for establishing core competencies for preceptors were made by The Canadian Experiential Education (CanExEd) project to facilitate preceptor development and ensure effective training for pharmacy undergraduates. A list of desired qualities of preceptors was made in 2007 by the Pharmacy Experiential Programs of Canada (PEP-C) special interest group and this work builds on that to identify preceptor competencies and define performance indicators for each one.	A list of competencies and performance indicators was developed and plotted against the PEP-C list of desired qualities of a preceptor. Themes from the literature were adapted by the authors based on professional experience and a list of competencies were created which were compared against the AFPC Educational Outcomes for First Professional Degree Programs (2017) and NAPRA's Professional Competencies for Canadian Pharmacist at Entry to Practice (2014) and then reviewed against the Canadian Interprofessional Health Collaborative (CIHC) National Interprofessional Competency Framework. Feedback was then obtained from a steering committee of PEP-C members, the Executive Director of AFPC, and one experiential education expert in the US for feedback and the final framework was prepared.	Eight articles from pharmacy, medicine, nursing, and higher education.	The measure of competency and minimum requirements for preceptors is increasingly critical following the increased time spent in experiential training as the BPharm program in Canada transitions to the PharmD. Although accreditation and licensing bodies stipulate pharmacists' professional responsibility for providing training it is often not valued by pharmacists and employers in actual practice and therefore development is not prioritised. Thus impacting the quality of undergraduate training. Three themes emerged from the literature review: commitment to teaching, role modelling, and encouraging self-directed learning. The final framework defines nine competencies: commitment to teaching; create practice-based learning opportunities; engage in continuous reflection, self-assessment and lifelong learning; communication skills, professional relationships with students; adapt to students learning needs; model best educational and clinical practices to facilitate development of skills; facilitate student development of critical thinking, problem solving and decision making skills; and assess and document student pharmacist performance. Stakeholder feedback was limited and consulting preceptors, residency program directors and regulatory authorities could

Table 1 (*continued*)

	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
						help further refine the competencies. Cross-section of stakeholders and Delphi process would increase validity. It is imperative that the framework is endorsed by all stakeholders as it influences downstream support of the preceptors developing the competencies and engaging with the national PDP.
26.	Waterfield (2017)[49]	United Kingdom	To gain insight in to the perceptions of pharmacy educators on the term 'competence'. The perspective of educators from different schools of pharmacy were gathered and contrasts were made between science-based and practice-based educators. Reflexive links between definitions and theoretical perspectives of competence were constructed.	Semi-structured interviews analysed by a reflexive framework analysis. Participants were selected from 29 volunteers to reflect a balance of gender, experience and areas of specialism. (representing two groups—science-based and practice-based)	n = 12 (4 academic members of staff from 3 different pharmacy schools in England, including a school with a long established MPharm program and one that was relatively new).	Four major themes emerged: (1) 'Competence as defined by a group of peers' - Both groups referred to competence as being socially defined (2) 'Competence is about the present rather than the future' - concerns were raised about it being based on a snapshot of time which means it does not reflect future competence or lack of competence in changing practice settings. (3) 'Competence-based assessment: hesitation from practitioners compared to scientists' - Science-based educators had a more positive view of competence compared to practice-based (4) 'The contrasting view of competence' - Differences between the two groups emerged when discussing assessment in detail moving from an absolute to a more relative definition. A formulaic or overly structured approach to objective outcomes is not be sufficient to prepare pharmacists that can structure and develop understanding of a clinical problem. A holistic approach, where students align knowledge within a clinical environment in combination with a CBE approach is suggested. A narrow interpretation of CBE approach can lead to a fragmentation of pharmacy knowledge. There is a tension between perceived objective science and subjective clinical practice.
27.	Westein et al. (2019)[50]	Netherlands	Implement, evaluate and revise a two-year workplace-based postgraduate CBE curriculum introduced for community pharmacist specialists in the Netherlands in 2012.	Development of the CBE postgraduate education program for community pharmacy. Evaluation of workplace-based learning and assessment using surveys of trainees and supervisors which were used to define 3 themes to evaluate in more depth via 2 focus group discussions focusing on ways of improving the curriculum. The results of the focus groups were then discussed by a review committee	Stakeholders – community pharmacists, teachers, policy advisors, stakeholder organisations e.g. the Young Pharmacists' Association, a total of 100 community pharmacists contributed to the defining task areas. Eighty-two trainees enrolled in the first year of the course in 2012. Details of the survey and focus group participants were not provided.	A list of 10 task areas were compiled by the program director.[51] The CanMEDS model was used to define the required competencies which had already been adopted for the education of medical specialists in the Netherlands in 2006. Themes identified by the survey: (1) trainees and supervisor workload, (2) learning opportunities in the pharmacy workplace, (3) utility of the assessment system. Focus groups felt that the program improved the capabilities of community pharmacists to work as high-standard healthcare professional. Concerns were: (1) heavy workload, (2) insufficient insight into what is expected of

Table 1 (*continued*)

	Author (year)	Location	Description	Methods	Sample	CBE related conclusions
						both trainees and supervisors, (3) difficulties in using the assessment instruments and portfolio. The review committee recommendations following the evaluation include: decreasing the number of assessments, clarifying the assessments instruments, improving the look and feel of the portfolio, make supervisor training more instructive, and additional evaluations of impact and relevance of classroom courses. In 2016 the MPharm program in the Netherlands also adopted the CanMEDS model thereby creating an education continuum for pharmacists.[52] Pharmacists must combine the roles of educator and judge on a daily basis when leading their pharmacy team but bringing in other highly qualified supervisors, such as mentors for example, is often not feasible in current practice. The CanMEDS framework was well accepted but further research and improvements still need to be made. Similar workplace-based curricula can be developed for other specialisations around the globe.
28	Zeind et al. (2012)[53]	United States of America	Determine the level of inclusion of the 5 core competencies outlined by the Institute of Medicine (IOM), to improve the quality and safety of health care in the US. These competencies have been acknowledged by The Accreditation Council for Pharmacy Education (ACPE) and included in their standards.	An electronic survey using IOM language to explore the extent of the desire to incorporate the IOM competencies, and the extent to which each competency was included in the PharmD curriculum as well as how the competency was incorporated.	Pharmacy practice chairs (or designated individuals) from US colleges and schools of pharmacy, n = 91 (79.1% response rate). Public universities made up 58%, and private universities made up 42% of the total respondents which was representative of the distribution of public and private schools of pharmacy in the US.	Evidence-based practice and patient-centred care competencies were well integrated in the PharmD curricula. The competencies with the least inclusion were related to informatics, interdisciplinary learning and quality improvement. This is thought to be due to potential challenges with the design and implementation of educational experiences and assessments in these competency areas. This study did not investigate the barriers to incorporation of the IOM competencies but noted that although the desire to include these competencies was high the actual inclusion rates were much lower. This study asked respondents to judge the extent of inclusion of the competencies throughout the whole PharmD program but does not address whether the competencies are included in the curriculum appropriately and as such recommend that this is assessed in future research. Different approaches to incorporation were found and this study highlights which areas require more work. The authors call for a more unified incorporation of the competencies due the variation in findings and the potential benefit of further national guidance on the integration of IOM competencies.

were collated and categorised into overarching themes. The data extraction and analysis followed an inductive approach of gathering detailed information, forming themes and comparing these with the literature and personal experiences.[21] Because the review contained a broad spectrum of research methods and contexts, a degree of interpretation was required for categorising data into features. Therefore, these features and themes were further refined and compared to those of Frank et al.,[6] and any discrepancies were resolved with the whole research team in group discussions, with assistance from collaborators from around the globe with experience in the field of CBE in pharmacy (see acknowledgements).

2.4. Quality analysis

The Mixed Methods appraisal Tool (MMAT)[22] was selected for quality analysis of the studies in the review as a tool with established reliability and validity suitable for a number of different research designs.[23]

3. Results

3.1. Study characteristics

The search identified 1178 studies. After the removal of duplicates and screening of the titles and abstracts for relevance, 103 studies remained. Eligibility of the remaining studies against the inclusion and exclusion criteria was performed, resulting in the selection of 28 studies for review (Fig. 1). The locations of the research from the studies, according to the WHO regions, and the level of education or training referenced as the focus of the study are presented in Fig. 2. Most research was based in high-income countries, none of the studies relate to CBE activity in the African or South-East Asian regions, and one study was cross-regional. The majority of the studies focused on initial education (18 (64%)), followed by post-qualification training (7 (25%)), and then postgraduate education (3 (11%)).

3.2. Features of CBE

The studies and their methods, sample size, participants, and main CBE related findings and conclusions relevant to the review are displayed in Table 1. This provides an overview of the current picture of CBE related activity for pharmacy across the globe according to the available relevant literature. In Table 2 the features identified are summarised and compared to the themes (see Appendix 2) defined by Frank et al.,[6] supporting components of these CBE features are also outlined. Specific benefits, challenges, or recommendations mentioned

by the authors with respect to these features or components are summarised and may be useful for institutions that are wishing to implement or develop their own CBE activities. The majority of these studies could not be classed as 'true CBE', in terms of a fully CBE integrated curriculum design, but instead discuss separate elements that are related to the core concepts of CBE. These features however show many of the elements of CBE that are being used and developed for pharmacy and provides an idea of what supporting components are commonly employed.

3.3. Design

The studies often referred to a patient-centred[35,40,41,45,47,50] and needs-based approach[28,29] to CBE program design that incorporates generic skills.[38,40,42,46–48] In one study, focus group participants identified that the supporting abilities students develop during a CBE program are important as they align with the demands of pharmacists to work as high-standard healthcare professionals.[50] Several studies referred to a recent change in the accreditation standards from pharmacy education regulators, often following reform of professional standards, which guided their CBE design,[25,32,41] or were used to identify gaps in an existing curriculum.[30,43,53] Other features are less related to content and associated with the progressive process of competency development, including the sequence of competency development[34,37,44,53] and the extent to which competencies are integrated throughout the curriculum.[37,40,43,50] Stupans et al. describe an overall alignment of the learning outcomes for pharmacy graduates across the four selected jurisdictions in their study when mapped against the GbCF, but note that the GbCF is missing competencies related to teamwork and leadership.[41]

Endorsement of CBE by all stakeholders also contributes to ensuring that learners are supported throughout their education or training.[48] Working groups,[25] steering committees,[28,48] retreats,[32] and workshops[28,44] are examples from the review studies of ways in which organisations can begin to prepare and outline their visions for CBE. Establishment of a shared vision, together with strong leadership for the conversion to CBE process, is therefore important to address when considering the features of CBE identified during this study and can help mitigate potential challenges.[50]

3.4. Systems of instruction and learning methods

Several features were identified relating to teaching and learning approaches, the most common of which was the need to provide training on the concept of competency itself.[36–38,40–42,44] Studies mentioned familiarising students with the competencies, frameworks, and
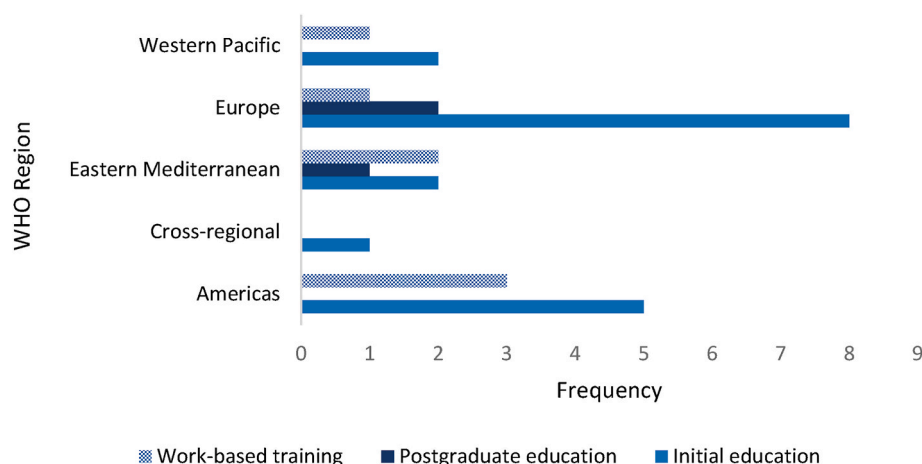

Fig. 2. Locations of review studies according to WHO regions and level of pharmacy education or training.

Table 2
Features of CBE in pharmacy and related supporting components.

Overarching Theme	Features of CBE identified from the studies	Corresponding studies cited in this review	Related CBE definition theme as summarised by Frank et al.[6]	Supporting components relevant to CBE related activity of the features identified	Corresponding studies cited in this review
A. Design	Curriculum/program development using competency framework mapping	24,25,37,40,43	1.a	*Based on accreditation standards from regulatory bodies*	29,33,38,40,41,45,48,53
	Competencies integrated throughout curriculum	37,40,43,50	1.b		
	Emphasis on abilities	50	1.c	*Use of meta-competencies in conjunction with enabling competencies*	42,46,48
				Include generic Skills	38,40,42,46–48
	Scaffolded development (attention to sequencing of learning)	34,37,44,53	1.d		
	Needs-based approach	28,29	2.b		
	Patient-centred approach	35,40,41,45,47,50			
B. Systems of instruction and learning methods	Learner-centred pedagogy	36,46,47	2.a		
	Translate learning to practice	29,37,40,46,47,50		*Interdisciplinary learning*	53
				Experiential learning	40,44,47,48,50
				Use of teacher-practitioners/ practice preceptors	40,44,47,48,50
	Prepare students for adaptability and resilience (for changing healthcare landscape)	45,46			
	Lifelong learning preparation	44,46–48		*Education and training on the concept of competence/competency frameworks*	36–38,40–42,44
	Learner flexibility (self- directed and/or self-pacing)	44,46,50	2.a and 3		
C. Feedback and assessment	Criterion-based assessment	32	1.d	*Official methods for recognising excellence*	32
				Standardised form for assessment	25,36,41
				Entrustable Professional Activities (EPAs)	50
				Objective Structured Clinical Examinations (OSCEs)	25,27,34,41
				Portfolios	36,38,46,50
	Learner self-assessment	24,26,27,33,36–38,46–48	2.a		
	Continuous Feedback	24,27,33,50		*Longitudinal assessment of competencies in various scenarios/ contexts*	33,42,50
				Combination of formative and summative assessment	33,38,50
D. Faculty	Inform and involve the whole faculty with CBE activities	40	4		
	Department acceptance and participation	40,50			
	Training on the use of CBE related teaching & learning practices and assessment methods	40,47,50		*Scholarly approach to teaching and learning*	25,42
E. Resources	Intensive implementation process	32,47,53	4	*Use of IT for teaching & learning/ course planning/tracking student progress*	32,37
				Additional staff with expertise in instructional design/teaching & learning/curriculum development	47,48
				Designated course or curriculum coordinators	40,50
F. Internal & External Factors	Formal institutional and departmental support for CBE	38,48	4		
	Support from higher authorities/ policies/regulators	24,26,29,43,47,50		*Coordination of education quality assurance efforts across national and/or international borders*	29,40,41,45,48,50,53
				Collaboration with schools outside of the pharmacy school.	42,50
				Collaboration with other HEIs.	42,44,45

definitions of competency. This is namely to connect competencies in relation to the learning outcomes[40,42] but also so that students can engage with a continuum of competence relevant to the standards of the profession appropriate to the level at which they will be working in practice.[37,38] This is particularly important when it is the first time that the concept of competency has been introduced to the learners,[41,54] to

faculty,[42] or preceptors.[44] Tensions between the applications of different interpretations of the concept of competence were highlighted by Rich.[42] Integrated meta-competencies (supporting roles, categories, or blocks of competencies) were found in the framework structure for medicine, nursing, and pharmacy, where the language used to describe competence in these frameworks reflected a holistic approach to

competency development. Conversely, professions such as engineering, law, and clinical psychology organised their frameworks without supporting meta-competencies, in the format of a list of performances or behaviours. Rich argues that the differences in conceptualisation of the notion of competence in this way influences the teaching and learning approaches that are used in the curricula.[42]

Studies referred to preparation for lifelong learning,[44,46–48] which is related to self-directed learning,[44,46,50] and resilience and adaptability.[45,46] Lifelong learning and continuing professional development (CPD) were denoted as interchangeable concepts to equip learners, not only to successfully complete their current education and training but also to continue learning in an environment where expanding scopes of practice and uncertainty for the future skills of pharmacists reinforces the need for adaptability.[38] Reference was made to self-directed learning helping to encourage motivation and autonomy which could also be utilised when pharmacists advance their practice.[46] Self-directed learning is also closely linked to a learner-centred approach,[19] where students identify their own learning gaps using self-reflection and choose their own research projects or topics of interests. Learners expressed this flexibility and opportunity to individually tailor a program to their own needs as a benefit of the CBE approach.[36,46] Flexible learning was another feature identified from the studies associated with the CBE approach.[44,46,50]

Experiential learning strategies were perceived as important and superior for translating learning to practice and supporting acquisition of skill compared to teaching materials designed to impart knowledge.[40] However, underpinning knowledge is still important and appropriate balance between academic content and technical skill development needs attention in the curriculum. An integrated approach from the faculty can enable this as individual instructors, depending on background, i.e., pharmacy, humanities, or social sciences, tend to favour one approach over the other; therefore, a unified strategy would promote consistency.[40] In countries where the PharmD professional program is dominant, experiential learning time is a significant proportion of the curriculum. In Canada, US, and Australia particular attention is dedicated to assuring the quality of experiential education, which relies on the quality of preceptors and so developing their competencies is increasingly important.[44,48] In a community pharmacist specialisation program, trainees felt that supervisor feedback was insufficient and authors note that using the same supervisor for the majority of education and assessment can be strenuous and lack objectivity.[50] In some locations there is not such a longstanding practice of experiential learning, during assessment of the undergraduate pharmacy curriculum, a need for more support to improve experiential learning opportunities was identified in Estonia.[47] Similarly, more practice-partnerships with educational institutions are called for in Portugal.[28] Case studies, simulations, and workplace-based learning can also contribute to achieving authentic and integrated teaching and learning across different contexts.[42]

In addition to experiential learning, interdisciplinary learning is also advocated for inclusion in the PharmD CBE curriculum as outlined by Zeind et al.[53] In this study, despite the inclusion of interdisciplinary competencies in the Accreditation Council for Pharmacy Education (ACPE) standards, a low proportion of US pharmacy schools (34%) indicated that these competencies were well covered by the curriculum. Although the study does not capture data on the reasons for this, interdisciplinary learning and associated competencies are recognised as a key component of education for healthcare professionals, and thus the authors suggest that this area requires improvement in the US.[53]

3.5. Feedback and assessment

Portfolios, as an assessment tool, were used in four of the studies,[36,38,46,50] and two made specific reference to these being in an online format.[36,38] The use of a portfolio can facilitate the reduction of interrater variability when used in conjunction with other assessment

methods.[36] Portfolios are also used in conjunction with competency frameworks, which help to structure the documentation of the learner's development.[36,50] Development of all patient care competencies were found to be significant in a longitudinal study of community pharmacists, before and after completing a tailored education program, which included a mandatory competency-based portfolio of learner's contributions to patient care.[36] Furthermore, portfolios were found to contribute to learner's motivations to enrol on a MSc in Advanced Pharmacy Practice in the UK and utilised as an instrument to consolidate learning activities for career development and professional recognition (credentialing).[46] However, feedback on portfolios revealed they could be difficult to use and so attention to their user-friendliness is recommended to ensure they are clear and efficient to employ, thus improving their acceptance and usability.[36,38]

Another common CBE assessment method identified from the studies was the Objective Structured Clinical Examination (OSCE). Recommendations for improving the experience and performance during OSCEs include performing prior formative OSCEs, which helps to allay any anxieties particularly for students and pharmacists that are new to this method, in preparation for summative or registration OSCE assessments.[25,41] Kirton and Kravitz describe that there is a weak correlation between performance in OSCEs and more traditional assessments as the different formats examine different skills. They recommended that OSCEs should be used in conjunction with a variety of assessment formats and that performance may be related to external factors rather than ability. Therefore, attention should be paid to the examination environment, structure, timing, and the amount of weight they carry towards any final summative grade.[34]

The final specific assessment activity identified are Entrustable Professional Activities (EPAs). Westein et al. describe the process of a thorough evaluation of a CBE program for community pharmacists and conclude that EPAs are an assessment method for postgraduate pharmacy education that is adaptable to changes in pharmacy practice without needing to change the underlying competency framework. However, care must be taken to limit the amount of EPAs to avoid administrative burden and assessment trivialisation.[50]

Learner self-assessment was a salient feature employed in pharmacy education both at undergraduate level,[27,37] post-qualification,[24,26,33,36,38,46] and for the development of pharmacy education preceptors.[48] Competency frameworks provide standards which learners can assess themselves against and use to plan future learning.[24,26,33,36,38,46,48] Self-assessment is referred to as a skill that needs to be developed at an early (undergraduate) level as pre-career habits influence the performance of the future pharmacist and their lifelong learning, reflected by the mandatory self-assessment CPD requirement for pharmacists in Australia.[38] Furthermore, Nash et al. describe that asking students to self-assess on their performance using Miller's pyramid can contribute to a program's assurance of learning by providing data reflective of the actual "learnt" curriculum as experienced by students.[37] In the UK, one study utilised video self-observation of student's performance, participants reported this to be more valuable than third party feedback as it enabled them to see themselves in the eyes of others and acknowledge things about themselves that they may not have otherwise accepted.[27] Allen et al. argue that this approach of self-observation improves learning in accordance with Bigg's theory of constructive alignment—enabling 'learning through choice and engagement with relevant learning activities' where the learner is at the centre of their own learning experience which encourages active self-reflection.[27] As with EPAs and OSCEs, it is noted that learner self-assessment should not be used in isolation but as part of a profile of varied CBE feedback and assessment strategies.[33]

A number of studies referred to providing regular feedback, particularly soon after completing assessments[27,33,50] and learning activities.[24] The combined use of formative and summative assessment, can aid the regulation of learner's competency development to engage in a continual learning process.[38,42] The individualised nature of CBE assessment and feedback also requires attention in relation to the way

assessment grading is referenced. Bray et al. argue that traditional relative grading scales (e.g., alphabetical) are reliant on the performance of other students in the cohort and this does not lend itself well to the absolute and individualised nature of the attainment of competence.[32] In this study, a criterion-referenced grading model was implemented which allowed students to demonstrate competency for all outcomes measured whilst still allowing for the demonstration of excellence, deemed necessary for purposes such as applying for residency or scholarship.[32]

Feedback in CBE can be given in a variety of ways and digital platforms are often utilised. Al-Haqan et al. reported an improvement in CPD and associated documentation after a 6-month period of continuous feedback through a variety of online platforms.[24] An online feedback tool was found to be helpful for students following OSCEs, especially as their performance was colour-coded (red, amber, green) which enabled them to visualise their progress.[27] Allen et al. report that students found detailed, individualised, immediate feedback useful for contributing to learning and suggest that tracking performance in this way increases students' motivation, enabling them to identify and target particular areas for development to define and redefine their own learning goals.[27] Feedback should be specific and meaningful and come from a variety of sources, including other healthcare professionals and even patients, which contributes to objectivity.[33]

In Canada, the majority of assessments for pharmacy resident programs (75%) were longitudinal,[33] where one of the few assessment stipulations of the accreditation standards of the Canadian Pharmacy Residency Board (CPRB) is the requirement for longitudinal assessments.[55] Rich suggests that measuring competence in this manner as a pattern of performance overtime is more useful than measuring competencies in isolation.[42] Using competency frameworks to develop standardised forms for the demonstration of competence can reduce variability between pharmacists' self-assessment in practice[36] and application of a standardised entry-to practice assessment may also contribute towards improved public, and other professionals' perceptions of pharmacists as well as enhanced self-perception.[41]

3.6. Faculty

The involvement of practice-based trainers is often fundamental, as better translation of learning to practice is a desirable feature of CBE facilitated through experiential educational activities.[47] These trainers are often pharmacists, and occasionally other healthcare professionals, who are involved in teaching and supervision of a substantial portion of CBE and training. In some cases this can be whole years of study,[40] entire programs,[50] and significant periods of supervised practice prior to licensure as a pharmacist.[44] However, they are not necessarily trained educators and may not have much knowledge of CBE and related assessments. A graduated descriptors tool, developed in Australia for pharmacy graduates pre-licensure, provides a rubric for learner's to self-assess and identify learning gaps according to competency standards, which preceptors found useful for their role in supporting learners.[44] In recognition of the crucial role of preceptors in CBE, a preceptor competency framework has been developed in Canada to enhance the quality of practice-based learning experiences.[48] In addition to CBE training for practice-based trainers, support, and familiarisation with the concept of competence and related teaching are also essential for academic faculty members.[40] Different epistemological understandings of CBE within faculty members can lead to disjointed approaches to teaching, therefore a unified approach is recommended.[40] Additionally, involvement of all faculty members, and other higher education stakeholders, in the design and evaluation of CBE programs helps to facilitate faculty buy-in and acceptance for the considerable changes needed to adapt to a CBE curriculum.[40,47,50]

3.7. Resources

CBE is widely endorsed by the profession, but implementation can be an intensive process requiring considerable change and disruption.[32,47] To help alleviate this, recommendations include collaboration within the pharmacy sector and with other healthcare professions to share experiences and improve the success of curricular CBE integration.[47,53]

Information Technology (IT) and web-based systems are utilised in CBE to aid feedback, organisation, and evaluation. Allen et al. describe a web-based tool (individualised Skills Evaluation and Development, iSED®) specifically designed for formative feedback with OSCEs that facilitates self-regulated learning.[56] Similarly, Bray et al. describe using the Examsoft® computer software to aid students with self-assessment and the provision of timely feedback, but also for question coding and rubrics.[32] Nash et al. found that educators' perspectives of the 'assessed' curriculum and the students' perspectives of the 'learnt' curriculum were not always consistent. The authors describe using a database of information from educators' and students' perspectives for curriculum mapping and the co-creation of rubrics as a useful process for highlighting issues with scaffolding of learning and the integration of professional standards.[37]

Paradis et al. found that the differences in approaches to teaching in CBE, and the difficulties faculty have in articulating these approaches, calls for better coordination of the curriculum, which can be facilitated by specific leadership with curriculum mapping.[40] Westein et al. describe a process of careful curriculum design, coordination, and evaluation of a CBE post-graduate education program through the use of a program director and a Director of Education responsible for overall management. On a similar note, Volmer et al. recognise the limitations of using evaluators without expertise in curriculum development and suggest that consultation with curriculum specialists is required to progress further with CBE in Estonia.[47] Furthermore, the engagement of additional staff with expertise in CBE related features, such as experiential education, is recognised as a strength by Walter et al. in their approach with the design of a competency framework for preceptor development that has relevance internationally, both for pharmacy and across other health disciplines.[48]

3.8. Internal and external factors

In addition to specific aspects of CBE already discussed, there are further features which augment successful CBE implementation and ongoing use. Formal support from both inside and outside of educational institutions is valuable for CBE. For example, in a study of undergraduate curricula and the use of the Spanish competency framework, alignment was found to be insufficient despite legal enforcement since 2008. Consequently, the authors suggest that professional regulatory bodies should work with educational bodies to support improvements in pairing of competencies with curricula.[39] One of the keys to success, reported by Bray et al. regarding the implementation and ongoing use of a competency-based assessment model, was a supportive academic leadership team understanding of the disruption necessary to enact change.[32] Similarly, Volmer et al. recognise that considerable change requires understanding from both educational and governmental institutions.[47] Walter et al. highlight the importance of endorsement from all stakeholders when integrating a competency framework for preceptors, as this in turn influences the support for them to complete a competency-based development program.[48] Workplace organisational support for learning is also emphasised, as the educational environment of the learner can influence effective experiential learning[50] and a CPD approach in the workplace.[24] Higher support from regulation, practice, and policy is correspondingly required to expand the scope of pharmacy practice, in line with educational developments, to promote excellence and achieve higher quality patient-orientated care, which is ultimately the aim of CBE for pharmacy.[26,29,43]

Quality assurance of education in CBE is highlighted by the studies

from the description of the processes involved in defining and selecting competencies and competency frameworks according to national standards. The Canadian Medical Education Directives for Specialists (CanMEDS)[57] framework was applied in both postgraduate curriculum development in the Netherlands[50] and in program development for preceptors in Canada.[48] In addition, Canadian pharmacy education standards were applied in exploring the perceptions of pharmacists surrounding a national licensing exam by the college of Pharmacy at Qatar University—due to the accreditation of their pharmacy program being granted by the Canadian Council for Accreditation of Pharmacy Programs (CCAPP).[41] Bajis et al. also state that Western accreditation standards have been acquired by other pharmacy schools in the Eastern Mediterranean Region (EMR), reportedly enhancing credibility of their programs and influencing integration of competency standards. However, context- and needs-based specificity is still advised for CBE initiatives due to heterogeneity between countries in the EMR.[29] A common theme from the studies is that CBE efforts should be coordinated to strengthen the consensus on optimal standards of practice and education for pharmacists, which was recommended on interprofessional,[40,50,53] national,[29,41,48,53] and international levels.[45,48] Stupans et al. reported that high-income countries with similar health needs (Australia, Canada, United Kingdom, and United States) displayed good alignment between their undergraduate learning outcomes and the FIP GbCF. Additionally, there was agreement on the role of pharmacists as 'patient focused medicines experts' irrespective of degree title.[45] The authors suggest that their findings support the feasibility of a common assessment tool for pharmacy education that would support transferability of skill, and thus mobilisation of the workforce across these jurisdictions.[45]

CBE for pharmacy should feature collaboration with other professions as demonstrated by the acceptability of a postgraduate program for community pharmacists designed to align pharmacy competencies with other health professions in the Netherlands.[50] In a content analysis of 10 entry-to-practice competency frameworks in Canada, results suggest that supporting, or intrinsic, competency domains are quite similar across a variety of professions. The author draws attention to the importance of integrating these competencies (often referred to as 'soft skills', i.e., communication, ethics, and professionalism) with discipline-specific technical knowledge and skills for competency development, suggesting that partnerships and collaborations across institutions may be beneficial to all professions when overcoming common challenges in related competency assessment.[42]

4. Discussion

This review was designed to establish a broad overview of CBE related activity for pharmacy over recent years. The aim being to document and increase the understanding of what CBE and training entails for the current pharmacy profession; in order to drive CBE forward, it is prudent to exam its existing state. It is evident from the previous literature that despite progression and increasing popularity, the operationalisation of CBE is not straight forward. Additionally, as in agreement with the findings of this review, there is a great deal of heterogeneity across the globe in both the interpretation of CBE and the extent of its use.

There is no universally accepted approach to adopting the CBE model currently, and geographical, socio-political, and cultural contextual differences mean it is unlikely that a one-size-fits all approach would be appropriate. This review does, however, bring together some generic features of CBE for pharmacy in relation to those already identified in the closely linked field of medical education whilst highlighting some of the more general elements of education which can typically support a CBE approach. This review is the first to collate a broad cross-section of CBE related activity across the pharmacy professions, capturing information and lessons to be learnt from all stages of competency development. We suggest that there is valuable information from all the stages of pharmacy education and training that can be used to inform CBE programs and curricula for initial (pre-registration undergraduate) education, and as such the intention was to not only examine initial education but all parts of the professional development journey. By including this diversity in level of education and training, this review illustrates that there are some features of CBE related activity common to more than one level of education. Furthermore, this allowed for the inclusion of a wealth of detail on factors that are contributory to the CBE approach, such as the quality and development of preceptors or basic training on the concept of competency or use of competency frameworks, enriching the description of the overall picture of CBE related activity for pharmacy whist also recognising the importance of a continuum of competency development which extends beyond initial education.

In concordance with similar findings in pharmacy CBE related literature, this review revealed a paucity of literature originating from South-East Asia and Africa. This suggests that CBE development, or at least research and publication, is confined to a select few countries predominately in the global North. Further work is therefore recommended in the Global South, where there is a particular need to improve health outcomes, and where the principles of CBE are likely to be beneficial due to the global shortage of adequately trained healthcare professionals acutely affecting the lower-income countries.[58] Research on the development of CBE in resource limited settings would therefore be of value, including how to overcome the challenges of the resource intensive nature of CBE implementation in these settings. For example, strategies for beginning to adopt particularly useful features of the CBE approach, such as local health-needs based education which could still be advantageous even when a fully comprehensive and integrated overhaul of the whole curriculum is not feasible.

Applicability and validity of the FIP GbCF to serve as a blueprint for CBE has previously been noted, with adaptation to the national context where needed.[11] This is in keeping with the Stupans et al. study in this review.[45] However, it is worth mentioning that in 2016, Stupans et al. stated that 3 of the 4 jurisdictions in their study make reference to teamwork and leadership but that the GbCF did not.[45] Yet, on examination the FIP GbCF 2012 (Version 1) does in fact include behavioural standards; *"3.2.5 Recognise the value of the pharmacy team and of a multidisciplinary team"*, and *"4.6.2 Demonstrate leadership and practice management skills, initiative and efficiency"*.[9] Moreover, the revised GbCF (Version 2), released in 2020, has further expanded these topics and now includes behavioural standards specifically addressing flexibility, adaptability, resilience, and interprofessional collaboration.[12] Notably, this flexibility in the workplace parallels the flexible learning approach identified as a feature of CBE in this review and is a welcomed addition to the GbCF, as students are expected to manage their own work and learning which translates to preparation for flexible working and learning as practitioners.[59]

The conceptualisation and associated definitions and terminology associated with CBE requires harmonisation, as illustrated by several of the studies explicitly referring to a need for CBE to include training of both staff and students on the concept of competency itself. This need for a consensus in CBE components has previously been noted elsewhere[11] and permeates through all 6 overarching themes of the CBE features identified in this review, particularly as the approach to CBE can have an impact on whether it is viewed as a 'state of being' or reduced to a list of tasks that may have limited applicability to the dynamics of actual practice.[42] Change at the regulatory level is often required for successful CBE implementation but also to expand the scope of practice so that pharmacists can put their competencies to use effectively and develop them further towards the ultimate goal of CBE, which is to translate education and training in to improved patient and population health outcomes. Without a unified approach and understanding, the outcomes may not reflect the holistic and integrated approach that is required for CBE and its intended application towards the development of the healthcare workforce and subsequent improvements in health outcomes

and patient care.[60] Therefore, further tools or guidance on adopting CBE for pharmacy is warranted which is also reflected by the scarcity of studies available that are truly reflective of a fully integrated CBE design.

5. Limitations

This review does have some limitations as only studies published in English were included. Some studies from the original search were also not accessible to the researchers, including one study from India. This may have restricted the scope of the review in terms of capturing data from a greater variety of countries. Secondly, identification of features took a certain level of interpretation and although the authors worked in collaboration with experts, best judgement decisions had to be made within the context of the individual studies which may have resulted in certain misinterpretations or unintentional omissions. Lastly, the heterogeneity of study designs limited direct comparisons of the results although commonality across CBE features was demonstrated between different study sizes as well as locations and educational levels.

6. Conclusions

The list of features identified in this review is not intended to be exhaustive, but rather a reflection of just over a decade of the most recent research in this area within the timeframe of the publication of a global competency framework for pharmacy. The GbCF has relevance across a variety of contexts and has been shown to facilitate harmonisation of CBE efforts transnationally. However, there are disparities in the way that CBE is conceptualised and the variations in terminology and definitions can have an impact on all of the features of CBE identified from this review. It is, therefore, imperative that a consensus and shared vision for all stakeholders is reached to bridge any gaps between intended curricula and that which is experienced by the learner to enable them to engage in a lifelong learning and adaptation process that is in alignment with the realities of contemporary pharmacy practice. The review provides a timely summary of the features of CBE in pharmacy, given the recent advancements in this area, and provides a valuable resource for those considering implementing or improving CBE by building on what has already been learnt. Advancements are not however uniformly distributed around the globe, therefore we call for further research in regions, such as Africa and Southeast Asia, which can aid the application of CBE in contexts with different needs and resources.

Author Contribution

This review was conceptualised by JM, NA and CA. JM planned and conducted the search strategy, analysed and interpreted the studies, curated the findings and wrote the manuscript with assistance and editing from NA, CA and SM. LP acted as a second reviewer for the selection of papers and features of CBE and for the MMAT analysis, CA acted as the third reviewer to resolve any discrepancies.

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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Appendix 1

Table A1
Database Search Strategy

Database*	Search Terms	Results
ERIC	(pharmacy or pharmacies or pharmacist or pharmacists) AND (competenc* or outcome*) AND (educat* or school or curricul* or training or learning or teaching or classroom or education system)	91
Embase/Medline	ID Search Term 1 exp Pharmacy/ 2 exp Pharmacists/ 3 (pharmacy or pharmacist*).mp. 4 1 or 2 or 3 5 exp Education, Pharmacy/ 6 exp Education/ 7 (competenc* adj3 educat*).mp. 8 (outcome* adj3 educat*).mp. 9 ("competenc* based educat*" or "outcome* based educat*").mp. 10 exp Competency-Based Education/ 12 7 or 8 or 9 or 10 12 4 and 11 13 (educat* or training or curricul*).mp. 14 5 or 6 or 13 15 12 and 14 16 limit 15 to (English language and last 11 years)	572
Scopus	(TITLE-ABS-KEY (pharmac*) AND (TITLE (competenc* OR "CBE" OR "OBE" OR {outcome-based} OR {competency-based} OR {outcome based} OR {competency based})) AND TITLE-ABS-KEY (education* OR training OR curricul*)) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEAR, 2016) OR LIMIT-TO (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2014) OR LIMIT-TO (PUBYEAR, 2013) OR LIMIT-TO (PUBYEAR, 2012) OR LIMIT-TO (PUBYEAR, 2011) OR LIMIT-TO (PUBYEAR, 2010)) AND (LIMIT-TO (LANGUAGE, "English"))	307
Web of Science	TOPIC:((pharmacy OR pharmacist* OR pharmacies)) *AN* TITLE: (("competenc* based educat*" OR "outcome* based educat*" OR competenc*)) *AND* TOPIC: ((educat* OR training OR curricul*))	206

*All searches completed on the January 29, 2021.

Appendix 2

Theme (major)/Sub-themes	Definition	Records, *n*
Table 2. Definitions of themes.		
1. Organizing framework	All descriptions of competency-based education (CBE) as an approach to education explicitly oriented to graduate outcomes.	165
a. Defined outcomes and milestones	Refers to the identification of specific competencies that are aligned to the outcomes of a training program. These outcomes are derived from the abilities required of physicians for practice or to meet the standards of the profession. Competencies may also be described in terms of milestones or benchmarks that indicate progression of competence in one domain.	144
b. Curriculum of competencies	Includes all references that describe how curricula are organized around the identified competencies. The curriculum node includes references to learning strategies, teaching methods, and instructional design.	50
c. Demonstrable abilities	Includes all references that articulate the need for the components of competency-based education to be observable and comparable to objective criteria for all learners.	20
d. Assessment of competencies	Contains all citations that refer to the assessment of pre-defined standards or milestones that indicate progress toward the defined outcomes of a curriculum. Assessment is criterion-referenced, in that learners are measured against set standards and not other learners. Assessment may also involve threshold standards that must be achieved before further progression of the learner through the curriculum.	73
2 Rationale	Includes all arguments as to the rationale for employing competency-based education as an approach to medical education. This may include how patient needs are a driver to use CBE, how physicians are better prepared for practice or the next stage of training, how it is better for learners, or how it can increase educational efficiency.	53
a. Learner-centred	Includes all discussion of the use of CBE to ensure curricula are aligned with the learning needs of diverse medical learners. It includes all references to organizing teaching and learning around facilitating the progression of trainee competence toward the defined outcome abilities for a program. This involves active engagement of learners in managing their learning, in regular self-assessment, and in ongoing frequent assessment of progress. This thread includes discussion of learner awareness of transparent goals, curriculum design, and assessment methods. It also includes mention of the self-directed continuing professional development of physicians in practice, and flexibility of curriculum processes to meet learners' needs.	29
b. Societal needs	Includes all discussions of the need for CBE to ensure that graduates have the essential abilities to effectively serve patients and populations once in practice. It also encompasses references to CBE as a mechanism to align curriculum goals with patient needs and optimal health care delivery.	26
3. Contrast with time	Includes all discussions that contrast time- or process-based medical education designs with CBE. All references to the pace of learning being tied to the acquisition of competence by a learner are incorporated. In this thread, training time is seen as a resource for instruction and not the organizing framework for medical education and credentialing.	35
4. Implementing CBE	Includes all discussions of CBE implementation designs, components, and ingredients.	20

Themes and frequency count of the definitions of CBE in medical education as identified by Frank et al.*

*Reproduced with permission from Frank JR, Mungroo R, Ahmad Y, Wang M, De Rossi S, Horsley T. Toward a definition of competency-based education in medicine: a systematic review of published definitions. *Medical Teacher.* 2010; 32(8).

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