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Effects of e-learning in a continuing education context on nursing care: an overview of systematic mixed studies reviews (protocol)

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Effects of e-learning in a continuing education context on nursing care: an overview of systematic mixed studies reviews (protocol)

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Abstract

Introduction: Continuing education (CE) is imperative to the future of professional nursing. The use of e-learning by registered nurses (RN) for CE is spreading. An overview of systematic mixed studies reviews (SMSRs) will be conducted to develop a broad picture of the effects of e-learning in a CE context on nursing care.

Methods and analysis: Quantitative, mixed studies, and qualitative reviews published in English, French, or Spanish from 1 January 2006 will be included. The outcomes of interest will be extracted and analyzed inductively and deductively from the Nursing Care Performance Framework (NCPF); some themes include nursing resources, nurses' practice environment, processes, professional satisfaction as well as nursing sensitive outcomes. Two reviewers will independently screen first the title and abstract of the papers and then the full texts in order to assess their eligibility. Two teams of two reviewers will extract the selected reviews' characteristics and data. The results from various types of reviews will be integrated using a data-based convergent synthesis design. We will conduct a thematic synthesis and transform all quantitative and mixed data into qualitative data.

Ethics and dissemination: Ethics approval is not required for overviews of SMSRs. We will summarize evidence concerning the negative, neutral and positive effects of various forms of e-learning on different aspects of nursing care. If we find gaps in the literature, we will highlight them and suggest ideas for further research. We will also focus on positive effects and present, if possible, the components and characteristics of e-learning interventions that were found to be successful. We will present this protocol and results in international conference in Nursing and in Medical and Health Informatics domains. We will also submit the results of our work for peer-review publication in a journal indexed in the international bibliographic database of biomedical information. **(297 words)**

Keywords

e-learning; nursing care; overview, systematic mixed studies review; continuing education, nurses

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Strengths and limitations of this study

- The realization of an overview of systematic mixed studies reviews (SMSRs) is justified by the use of multiple methodological approaches and a diversity of data in order to broaden the repertoire of effects of e-learning on nursing care.
- To the best of our knowledge, this is the first overview of SMSRs that uses the Nursing Care Performance Framework to draw a broad, multidimensional and system-based perspectives on the dimensions and indicators of nursing care that can be impacted by e-learning interventions.
- The quality of overviews of SMSRs is still in its infancy regarding the reporting, the assessment of methodological quality, and the risks of bias and quality of evidence.
- One of the limits of overviews of SMSRs is the lack of granularity of information provided by the review authors.

INTRODUCTION

Continuing education (CE), a term often used interchangeably with continuing professional development (CPD), lifelong learning, and staff development [1], is an imperative for the future of professional nursing [2]. In many countries CE is mandated by professional or regulatory bodies, which encourages nurses to participate in these activities [3]. CE is an opportunity to acquire knowledge, to improve performance, to support growth and development as a nursing profession, to expand the nursing role, and to introduce, develop, and advance professional competencies/skills [3,4]. Ultimately, CE is intended to improve quality of care and patients' health status due to changes in healthcare provider practice [5].

Nurses who are looking for CE activities face many barriers in terms of work schedule/commitments, lack of support (from co-workers, employers, organization), geographic distance, time away from work, and activity cost [6–8]. The use of electronic (i.e. computer and web-based) and mobile devices (i.e. smartphone, tablets) to support learning (i.e. e-learning and m-learning) is a promising avenue to face these challenges.

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E-learning is an umbrella term that encompasses various concepts and technologies related to learning, such as distance, digital, electronic, online, Web-based and mobile learning [9]. For this work, we will use "e-learning" as the terminology entailing a variety of electronic, digital or mobile devices used to support learning. E-learning has many advantages: it reduces travel time, is flexible and accessible, can be cost-effective, and can allow learners to learn at their own pace and from the place of their choice [10,11]. Furthermore, e-learning has the potential to provide tailored content and instructional methods based on individual needs of the learners and can present a variety of multimedia components to support acquisition of knowledge and skills such as text, audio, still and motion visuals [10]. Even if there is no strong evidence to prove that e-learning is superior to traditional learning, results of systematic reviews support that this is an effective alternative way to learn [11–13]. Moreover, it has positive impacts on nurses' knowledge, skills, level of self-efficacy and satisfaction [13,14].

However, e-learning is not a panacea [15]. Learners can encounter barriers, like skill requirement for using a particular device, low level of technological literacy, loss of time when the system/device doesn't work properly, or the reduction of social contact compared to face-to-face learning [16,17]. Clark and Mayer [10] summarized drawbacks surrounding e-learning, such as too many multimedia components interacting at the same time, lack of features that promote learning, and the loss of an exploratory learning environments learners can lack of guidance. The authors highlighted an interesting point: learning is better supported by effective instructional methods than by delivery medium (i.e. virtual classroom, face-to-face classroom).

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E-learning technologies have been studied extensively in nursing, especially for students in an academic educational context, as supported in an overview of systematic reviews (n=22) [9,12]. The results of this overview didn't lead to robust evidence on the superiority of e-learning over traditional learning, nor did they conclude which technology or medium of e-learning was best to influence the acquisition of skills and knowledge for nursing students at undergraduate and postgraduate levels. However, e-learning was shown to reduce the cost related to education and save time for students and lecturers. To the best of our knowledge, there is no overview of reviews that focuses on e-learning in a CE context – such as a healthcare and/or professional setting – for registered nurses (RN).

Objective

The objective of this overview of systematic mixed studies review (SMSRs) is to systematically summarize the best evidence that comes from qualitative, quantitative and mixed studies reviews regarding the effects of e-learning in a nursing CE context on nursing care (i.e resources, services and patients' outcomes).

To meet this objective, we will use a process of data conceptualization by mobilizing both inductive (data-driven) and deductive (theory-driven) approaches iteratively or simultaneously to guide all the methods and analysis processes. We will be open-minded to allow the emergence of new concepts, but we will also use concepts from existing framework, ie, the Nursing Care Performance Framework (NCPF)[18] as a tool to extract, synthesize and interpret data. The NCPF is useful to define an important concept of this overview, namely, "nursing care".

NURSING CARE PERFORMANCE FRAMEWORK

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The NCPF [18] will be used to conceptualize how e-learning interventions could influence nursing care and impact health outcomes. This is an organizational model, originally composed of three subsystems, 14 dimensions and 51 indicators, from which we have integrating elements of the actual scope of nursing practice [19] as well as findings from our previous work [20] (figure 1) carrying out the impact of information and communication technologies on nursing care. Figure 1 presents the range of possible outcomes for which data will be sought.

Insert Figure 1 here

The NCPF shows how the interplay of three nursing subsystems (structure, services, and patients' outcomes) can operate to achieve three key functions: (1) acquiring, deploying, and maintaining nursing resources (structure); (2) transforming nursing resources into nursing services (processes); and (3) producing changes in patients' conditions in response to the nursing services provided ("nursing-sensitive outcomes" or patients' outcomes).

The first function refers to the human and material resources needed to provide effective nursing care, such as nursing staff supply, working conditions, staff maintenance, and economic sustainability. The first way e-learning could influence nursing care is by considering it as part of the structure (as a resource, in the first function of the model). We could pay attention to these elements when we extract data from systematic reviews: exploring whether the availability of e-learning in healthcare settings impacts the quality of life at work for nurses and if e-learning acts as facilitator/motivator to enhance nurses' working conditions, or serve a barrier that inhibits them. Another question could be: to what extent can e-learning create favourable conditions that attracts nurses and reinforces stability in the workforce?

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The second function encompasses nursing services, which are defined in various dimensions: nurses' practice environments (i.e. nurse autonomy; collaboration), nursing processes (i.e. assessment, care planning, and evaluation; problems and symptom management), nurses' professional satisfaction and patient experience. E-learning can be viewed as a resource that has the potential to influence all dimensions of nursing services at different levels. E-learning can be seen as way to support nursing work and create a professional practice environment for nurses, for example, by allowing collaborative practice. E-learning could impact what nurses do, i.e. nursing interventions (processes) or the ability of nurses in using their competencies to provide healthcare. Resulting from these two dimensions, e-learning could influence nurses' professional satisfaction, in terms of quality of care provided, satisfaction or dissatisfaction of nurses using e-learning, and/or patient experience.

The desirable end result of the interactions between nursing resources (structure) and nursing services is to improve patients' conditions. The third function is then described as the positive changes that can be detected among patients (also called "nursing-sensitive outcomes"). As other models used in the learning [5,21] domain, we could speculate that if e-learning changes nursing resources and nursing services, patients' outcomes could be potentially affected. Examples of indicators in the NCPF are: patient comfort and quality of life, risk outcomes and safety, empowerment and functional status.

METHODS

This protocol of this overview has been registered on International prospective register of systematic reviews (PROSPERO), registration number: (CRD42016050714). We used the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocol

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(PRISMA-P) checklist to guide the elaboration of this protocol (see online supplementary appendix 1) [22].

Insert PRISMA-P here

Design

We will conduct an overview of SMSRs. The inclusion of reviews using multiple methodological approaches is justified by the possibility of broadening the repertoires of effects of e-learning on nursing care. An overview of systematic reviews (SRs) is a good way to derive the best available knowledge in a single document to afford broad, cumulative statements that summarize the existing evidence on the effectiveness of interventions [23].

As underlined by Lunny et al. [24], methods to conduct, interpret and report overviews are in their infancy. To the best of our knowledge, no unified and integrated tool allows a comprehensive reporting of overview of quantitative SRs, even less for SMSRs. We will follow the general methods for Cochrane reviews [25] and other relevant works in this domain [23,24,26] to conduct and report the overview.

Eligibility criteria

The scope in this overview is formulated using PICOS (participants, interventions, comparisons, outcomes, study design) [27,28].

Type of reviews

We will include all types of qualitative, quantitative and mixed studies reviews that evaluate the influence of e-learning used by nurses on nursing care in a CE context, that have been published in French, English, or Spanish from January 1, 2006.

Publication type

To be included, the reviews have to be "systematic" [29] :

- clear and unambiguous

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- include a type of research and one or a combination of method(s)
- have specific research question(s), precise inclusion criteria, a comprehensive search strategy, a quality appraisal process, and a rigorous synthesis.

The SMSRs must be published in peer-reviewed journal. Reports that state systematic methodology are included. We will exclude grey literature (i.e. conference proceedings, trial registries, dissertations) and non SMSRs such as literature reviews.

Population

We will include RNs according to the professional legislation of each country. Reviews that target RNs and other health professionals (i.e. physicians) will be included, as long as it is possible to differentiate nurses and to extract these relevant participants' data. Patients receiving care from qualified RNs through the medium of e-learning will be part of this work, as long as nursing-related outcomes are discussed. We will exclude undergraduate nursing students in an academic context.

Intervention

All types of e-learning delivered through different devices are targeted. Blended learning interventions will be included as long as they have an "electronic" or "digital" component. Any types of simulation, including with a "physical" mannequin (i.e. high-fidelity simulation, technology-enhanced simulation) will be excluded.

Comparisons

We will include these type of comparisons: face-to-face learning, any other e-learning intervention and blended learning.

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Outcomes

The outcomes will include but are not limited to the three subsystems (i.e. nursing resources, nursing services and nursing sensitive outcomes), dimensions (i.e. working conditions, time and efficiency, nurses' practice environment, nursing processes, professional satisfaction, nursing sensitive outcome) and indicators (i.e. learning, nurse-patient relationship, knowledge access) showed in the adapted version of the NCPF in Figure 1. Definitions and/or examples of components are presented (see online supplementary appendix 2) related to each outcome of interest. The purpose is not to provide "standardized" definitions but to offer a guidance for the data extraction process. No "standardized" definition is available for the outcome of interest based on the fact that reviews included in this overview may have: diversity in terms of nature of data (quantitative, qualitative and mixed), heterogeneity in e-learning interventions, and various possible outcomes. Furthermore, the data synthesis approach is abductive. This means that we will use the NCPF as a starting point to extract the data and analyze them, but we will let new data emerge from the reviews. If stable and fixed definitions are provided, the inductive part can be compromised.

The main outcomes of interests are those targeting the effects of e-learning on nursing resources and services. Then, if the outcomes belonging to these dimensions are found in the reviews, patients' outcomes will be extracted.

We will exclude reviews that focus only on patients' outcomes without discussing nursing resources or services. Determinants of e-learning use (i.e. intended use) without reporting "actual use" of e-learning will also be excluded.

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Search methods for the identification of reviews

Publications will be searched through general health sciences (PubMed), nursing (CINAHL), education electronic databases (Education Source and ERIC) as well as those containing systematic reviews publications (Cochrane Database of Systematic Reviews). Structured search strategies will be developed using the thesaurus terms of each database and using free text, targeting the "title" and "abstract" fields. The strategies will be adapted to the other databases. The search strategy will be developed by the research team and validated by a health information specialist. The results of each database search will be collected in a single reference database, and duplicate citations will be removed. An example of the search strategy in PubMed is presented (see online supplementary appendix 3). This strategy will be adapted and refined according to the specificities of the databases. Furthermore, to obtain additional reviews, we will contact authors to find other relevant works in this domain and will consult reference lists of included reviews.

DATA COLLECTION AND ANALYSIS

Selection of reviews

The research team will use Distiller SR software from Evidence Partners (Ottawa, Canada) to perform the overall overview. Citations retrieved from the searches will be imported into a reference management software such as Endnote. The database containing all the references will then be imported in Distiller SR. Three reviewers (GR, JPG, EH) will independently screen the title and abstract of the papers in order to assess their eligibility. Each paper will be reviewed twice. The reviewers will compare their results, and discuss them in case of discrepancies. If a consensus cannot be reached, arbitration with a third review author will be required. After the first round of screening, full text copies of publications that meet the pre-established inclusion criteria will be retrieved. In cases when

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the information regarding the eligibility of a review is limited or incomplete (i.e.when only an abstract is available), we will contact authors to request the full text or further details. We will use the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram to show the overall process of reviews selection [30].

Data extraction and management

The coding process will be done by four independent reviewers (GR, JPG, EH, JBP). We will use the NCPF to code, organize and classify the data according to the three subsystems (i.e. resources/structure, services, outcomes), the dimensions and the indicators. This is the deductive part of the synthesis. Additional codes will be generated inductively by the four reviewers from the text of the articles without fitting them into the existing model. The four reviewers will begin by coding a set of the same three articles independently in order to ensure consistency during the coding and data extraction process. The independently developed frameworks or "coding plan" will then be compared and combined into a single integrated framework [24]. Any conflict arising through this extraction process will be discussed between the four reviewers. After a general agreement on coding and data extraction, the remaining articles will be divided equally between two teams of two reviewers.

The four reviewers will summarize general characteristics about reviews: purpose, type of review (qualitative, quantitative, mixed), examples of topics covered, number of studies included, target populations, search dates and context (i.e. mandatory CE, workplace). Details about e-learning interventions, comparisons and outcomes will also be extracted as follow: examples of e-learning intervention, devices or media used, examples of educational strategies and material, theory used to develop and evaluate interventions (i.e. learning theory, behavioural change), examples of comparison interventions, dimensions and

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indicators based on adapted version of NCPF, effects of e-learning as reported by authors, and nature of the effects (quantitative, qualitative or mixed). Any disagreements arising during the data extraction process will be resolved by discussion and consensus involving the two reviewers, or will involve a third review author if needed.

Methodological quality assessment of included reviews

In this overview we will include different types of SRs. The array of underlying types of SRs combining qualitative and quantitative evidence can render reporting and the assessing the quality of overviews more complex. At the time of this overview, we found no reporting guidelines on assessing methodological quality of mixed studies and qualitative reviews.

One of the most commonly used tools for authors of SRs and overviews of quantitative SRs using a randomized controlled trial (RCT) design is the Assessment of Multiple Systematic Reviews (AMSTAR) [31,32]. AMSTAR is an 11-item checklist from which reviewers assign one point when the criterion is met. Quality is characterized at three levels: 8 to 11 is high quality (i.e. minor or no methodological limitations), 4 to 7 is medium quality (i.e. moderate methodological limitations), and 0 to 3 is low quality (i.e. major methodological limitations) [33]. AMSTAR items provide an assessment of methodological criteria such as the comprehensiveness of the search strategy and whether the quality of included studies was evaluated and accounted for [34]. Although AMSTAR has limitations (i.e. inappropriateness of applying some criteria to mixed-method and qualitative reviews), as underlined in previous work [20], the four reviewers (GR, JPG, EH, JBP) will apply the tool to all reviews in order to use the same criteria for quality assessment.

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Risks of bias and quality of evidence

Others challenges encountered for authors of overviews are the assessment of limitations (risk of bias) as well as the quality of evidence in systematic reviews [24,31]. We found no tool or guidance to perform these tasks for authors of overviews of SMSRs. The Grades of Recommendation, Assessment, Development and Evaluation (GRADE) has been largely adopted as a tool to judge the overall quality of evidence for each individual outcome (i.e. consideration of within-study risk of bias, directness of evidence, heterogeneity, precision of effect estimates and risk of publication bias) in the context of quantitative primary studies, especially those using experimental or quasi-experimental designs [35,36]. When the unit of analysis is SRs (and not primary studies), it is not always possible to extract GRADE ratings because data can be missing, not reported adequately or reported in different ways across the SRs. The use of a tool to assess the quality of evidence has to be modified for use in overviews [37]. Recently, two tools have been published to assess both the confidence in qualitative review findings (methodological quality or dependability) and the potential influence of study quality on the review findings: Confidence of synthesized qualitative findings, named ConQual [38], and Confidence in the Evidence from Reviews of Qualitative research, called CERQual [39]. They both aim to provide a qualitative equivalent to the GRADE approach and they both present a final ranking [40], but they are not currently considered as gold standard. We found no tool to assess the quality of evidence in mixed studies reviews. In this overview, we will report the assessment of quality of evidence and risk of bias performed by original SMSRs authors who used GRADE, ConQUAL, CerQUAL or other approaches.

Finally, another element to consider in an overview is the risk of biased results caused by the repetition of primary studies that are included more than once (i.e. overlaps) across the

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reviews [41]. It is important to calculate the actual degree of overlap in overviews with the corrected covered area (CCA) method in order to report these overlaps properly [41]. As suggested by Studzinski *et al* [42], one reviewer will generate a matrix that will cross-link SMSRs (columns) with primary studies included in SMSRs (rows), and a second reviewer will check the matrix.

Data synthesis

An important challenge of data synthesis is the integration of the quantitative, qualitative and mixed studies reviews [43]. In order to integrate the results from various types of reviews, we will perform a qualitative thematic synthesis using a data-based based convergent synthesis design [44,45], which is an approach used by authors conducting MSRs. We will qualify quantitative data, as we did in our previous work [20]. Qualifying the quantitative data means that we will use a textual and narrative approach to name and qualify the effect. For instance, if the results of the review show that e-learning leads to significant increase of knowledge, instead of reporting the *p* value, we will qualify the result: positive effect of e-learning on knowledge level. Frantzen & Fetters [43] call this approach "transformation", in which quantitative data are transformed into qualitative ones. We will also organize the results into themes and sub-themes according the specific dimensions of nursing care (i.e. practice environment, nursing processes, professional satisfaction, and nursing-sensitive outcomes) and their corresponding indicators. Even if this is an uncommon approach (using a convergent synthesis by qualifying quantitative data), we do believe that this way of synthetizing will allow us keeping the richness of the results.

In order to transform all quantitative and mixed data into qualitative, we will use Thomas and Harden's [46] approach. We will follow these three steps: (1) coding relevant extracts of each SR line by line; (2) developing descriptive themes; and (3) generating

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analytical themes. This might lead to an adapted version of the NCPF cited earlier. The thematic synthesis will be done in an inductive and deductive way (i.e. abductive), which means that some themes will be organized based on the NCPF [20,21,47] while others will emerge inductively.

CONCLUSION

Results of this overview could be used to understand the dimensions of nursing care that have the potential to be supported, enhanced or constrained by the use of e-learning to sustain CE activities among nurses. This overview is in continuity with previous work that has been done about the impacts of various types of ICTs (excluding e-learning interventions) on nursing care [20]. Some reviews on e-learning used by nurses or nursing students target specific outcomes, especially knowledge, attitudes, barriers and facilitators, skills and satisfaction regarding the use of e-learning [13,14,48,49]. By using the NCPF to organize, extract and analyze the data, this overview could provide a good starting point to deepen our understanding regarding the dimensions and indicators of nursing care that can be impacted by e-learning. With the growing presence of digital devices in nursing care systems, we think it is important to document the interaction of e-learning and nursing care dimensions and indicators. We believe that if we better understand the effects of these e-learning interventions, we could deploy strategies to facilitate their implementation and their integration in nursing care, nursing research, management and education. Consequently, we could overcome negative effects and optimize positive ones in order to use them to their full potential as a tool to support nursing practice and, ultimately, improve patient outcomes.

Authors' contributions

GR is the guarantor, supervised by MPG and JC. GR drafted the manuscript with input from MPG and JC. GR, MPG, JC, JPG and EH contributed to the development of the selection

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criteria, the quality assessment strategy and data extraction criteria. GR and MPG participated in the development of the search strategy. CAD provided expertise on the application of the NCPF as the first author of the framework. JBP contributed to integrate relevant references in e-learning and in methodological quality assessment. GR and JPG were involved in the screening of titles and abstracts. GR, JPG and EH are responsible for screening full texts. GR, JPG, EH and JBP will be responsible of data extraction. All authors read, provided feedback and approved the final manuscript.

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Competing interests statement

The authors declare that they have no competing interests.

Provenance and peer review

Not commissioned; externally peer reviewed.

Data sharing statement

The authors will submit the results of the study for peer-review publication in a journal indexed in the international bibliographic database of biomedical information.

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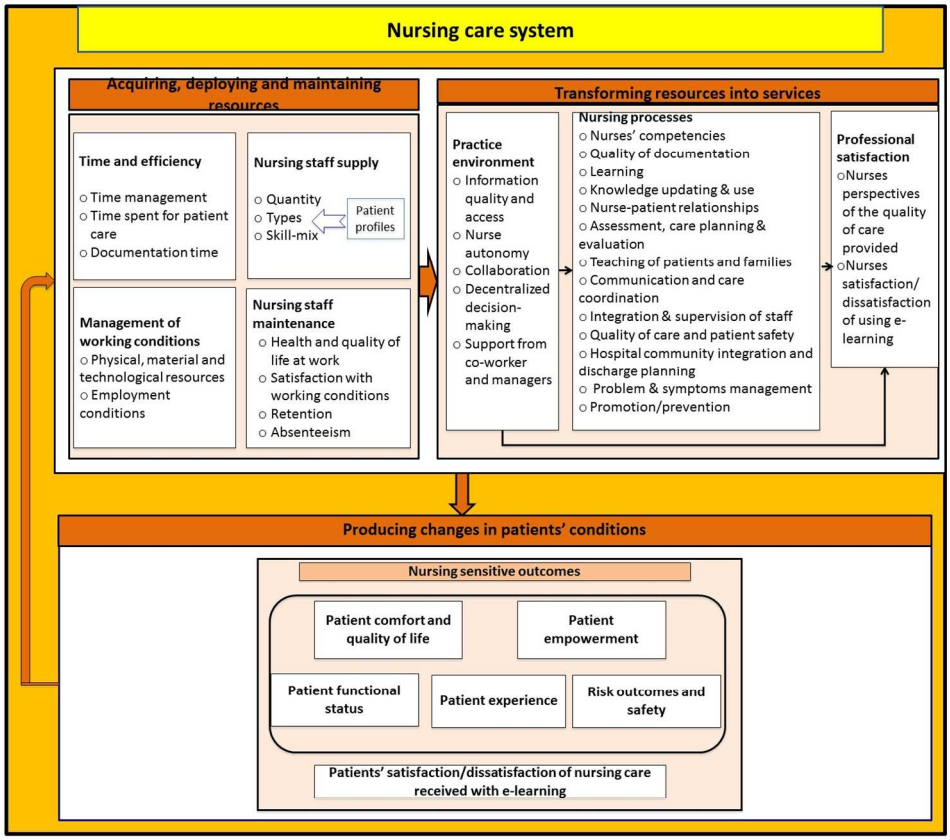

Figure 1. Nursing Care Performance Framework adapted from previous works

420x450mm (96 x 96 DPI)

Appendix 1: PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol

Title: Effects of e-learning interventions in continuing education context on nursing care: an overview of systematic mixed studies reviews (protocol)

Section and topic	Item No	Checklist item	Reported on page #
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	1
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	n/a
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	8
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	17
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	n/a
Support:			
Sources	5a	Indicate sources of financial or other support for the review	17
Sponsor	5b	Provide name for the review funder and/or sponsor	n/a
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	n/a
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	5
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	5
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	8-10
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey	11

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		literature sources) with planned dates of coverage	
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Appendix 3
Study records:			
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	11
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	11
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	12-13
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	8-10
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	Appendix 2
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	13-15
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	-
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	-
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	-
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	15-16
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	n/a
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	14-15

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.

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Appendix 2: Definitions and/or examples of components regarding outcomes of interest

Nursing subsystems	**Dimensions/***Indicators*	**Definition and/or examples of components**	**References**
Nursing resources (structure)	Nursing staff supply	The effectiveness of diverse activities that govern nursing staff intake (planning, recruitment, selection) and deployment; must ensure an adequate balance with the demand for nursing services.	[1]Dubois et al. 2013
	Quantity	Total number of workers in defined occupational groups; nurse-patient ratios.	[2]Dubois et al. 2009
	Quality	Professional backgrounds, skills, job title, qualifications, expertise and experience in order to achieve optimal patient care.	[1,2]Dubois et al. 2013; 2009
	Skill mix	Role enhancement (e.g expanding scope of practice, developing new competencies and assuming new responsibilities), role enlargement (e.g diversification and expansion of nurses' skill repertoires), role substitution and role delegation.	[2]Dubois et al. 2009
	Time and efficiency	Time devoted to perform general and specific tasks related to direct or indirect care.	[3]Rouleau et al. 2017
	Time management	Time devoted to perform a task (in general). For instance, using e-learning intervention could be "time consuming" or "time saving".	[3]Rouleau et al. 2017
	Time spent with patient care	Time allocated to patient care discussed with the use of e-learning interventions.	[3]Rouleau et al. 2017
	Documentation time	Time allocated to document nurses' activities.	[3]Rouleau et al. 2017
	Management of working conditions	Depends on resources and employment characteristics.	[1]Dubois et al. 2013

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Nursing resources (structure)	*Physical, material and technological resources*	Different types of material resources (e.g. physical facilities, technologies, financial resources, organizational configurations) that are required to support nurses in the performance of their roles.	[1]Dubois et al. 2013
	Employment conditions	Employment characteristics such as workload, scheduling, overtime, employment status, labour relationships.	[1]Dubois et al. 2013
	Nursing staff maintenance	Depends on various factors such as quality of life at work and satisfaction or dissatisfaction with working conditions.	[1]Dubois et al. 2013
	Health and quality of life at work	E.g. Work-related accidents, illnesses, injuries	[1]Dubois et al. 2013
	Satisfaction with working conditions	E.g. Job satisfaction or dissatisfaction related to working conditions	[1]Dubois et al. 2013
	Absenteeism	Can be caused by many factors	[1]Dubois et al.2013
	Retention/Turnover	Capacity to recruit new nurses and retain those already employed.	[1]Dubois et al. 2013
Nursing services	Nurse practice environment	E-learning can be seen as way to support nursing work and create a professional practice environment for nurses.	[4]Lake, 2002
	Information quality and access	The use of e-learning interventions could improve or alter information quality and access regarding for example patient issues, clinical data, medication information/profile, and other information (policies, guidelines, drug resources, patient files).	[3]Rouleau et al. 2017
	Nurse autonomy in their role	Shared governance, nursing responsibility, authority, accountability.	[5]Currie et al. 2005
	Intra and interprofessional collaboration	Communication and collaboration among nursing staff; collegiality between nurses and other professional groups.	[1]Dubois et al. 2013
	Decentralization of decision-making	Decentralization of decision-making with responsibilities for nursing services devoted to the nursing unit.	[1]Dubois et al. 2013
	Support from co-workers and managers	E.g. A supervisory staff that is supportive (or not) of the nurses.	[4]Lake, 2002

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Nursing services	Nursing processes	Are linked to what nurses do (nursing interventions).	[1]Dubois et al. 2013
	Quality of documentation	The extent to which e-learning interventions could improve or alter the quality of documentation regarding, for example, patient care and nursing activities.	[3]Rouleau et al. 2017
	Learning	Acquisition of declarative (knows) and procedural knowledge (knows how), described in a general way.	[5]Moore et al. 2009
	Nurses competencies and skills	E.g. Decision support/decision-making, observation skills, clinical judgment, critical thinking.	[3]Rouleau et al. 2017
	Nurse-patient relationship	E.g. The use of e-learning interventions to create pathways for communication, new types of bonds between nurses and patients, establish trust, create a sense of connection.	[3]Rouleau et al. 2017
	Assessment, care planning and evaluation	Assess patient's physical and mental condition, taking biopsychosocial aspects into consideration. Evaluate and update, in writing, information about the patient's condition and the care provided in the therapeutic nursing plan, nurses' notes, etc. Plan interventions using healthcare assessment tools (pain scale, wound assessment tool). Involve the patient and the patient's family in care planning. The nurse participates in designing, applying, and updating patient care programs.	[6]D'Amour et al. 2012
	Teaching of patients and families	Assess the specific information and education needs of each patient and his/her family. Verify that the patient and family have understood the teaching provided. Use teaching strategies that are adapted to each patient and family in accordance with the patient's level of autonomy. Check the quality of patient education provided on the unit.	[6]D'Amour et al. 2012

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Nursing services	*Communication and care coordination*	Communicate to members of the team all information that could affect the coordination of care. Coordinate the work of the nursing team to meet the needs of the patient and family as well as the interventions of the interprofessional team. Convey all relevant information to healthcare professionals in other institutions in order to ensure continuity of care. Participate in interprofessional team meetings or activities. Ensure continuity of care.	[6]D'Amour et al. 2012
	Knowledge updating and utilization	Keep knowledge up-to-date. Improve nursing practice based on new knowledge derived from best practices and research in nursing science or in health. Knowledge exchange with the nursing team knowledge emerging from research. Different types of knowledge exist, such as declarative knowledge (know), procedural knowledge (know how to do something) and competence (know how).	[5,6] D'Amour et al. 2012; Moore et al., 2009
	Integration and supervision of staff	Participate in identifying in-service education needs in workplace. Being involved in the orientation and training of nursing students or of newly hired staff. Act as a mentor or educator for newly hired staff. Develop and conduct training activities for the care team, in accordance with nurses skills.	[6]D'Amour et al. 2012
	Quality of care and patient safety	Report clinical situations in which deficiencies in quality and safety of care are identified, and propose courses of action to improve them. Improve the quality and safety of care by updating practices. Be a part in the evaluation of quality and safety of care and in developing nursing practice.	[6]D'Amour et al. 2012
	Problem and symptoms management	Nursing interventions intended to have effect on symptoms management, such as pain and fatigue (e.g. evaluation, use of non pharmacological approaches, patients' education)	[7]Dubois et al. 2015

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Nursing services	*Promotion/prevention*	Nursing interventions intended to promote health-related behaviours in order to prevent disease or the apparition of complications. For example: interventions for preventing falls among elderly people, for preventing pressure ulcers, vaccination, smoking cessation interventions, etc.	[7]Dubois et al. 2015
	Hospital community integration and discharge planning	Care organization, resources planning depending of patients' health status when they leave the hospitals	[7]Dubois et al. 2015
	Professional satisfaction	Resulting from nursing processes and from specific aspects that influence their perception of their ability to accomplish their daily assignments and enjoy the work itself.	[1]Dubois et al. 2013
	Nurses perspectives of the quality of care provided	According the nurses' perspectives, the way they evaluate the quality of care they provided. For example: improvement (or not) of quality of care and patient safety, nurses' perceptions that technologies reduce medication errors and improve medication administration processes, the provision of comprehensive and adaptive care related to the patients' needs.	[3]Rouleau et al. 2017
	Nurses satisfaction or dissatisfaction using e-learning	Overall acceptance of e-learning interventions, and their satisfaction with them described in general way (e.g. their degree of satisfaction or dissatisfaction). Other elements to consider: system navigability (e.g. complexity, ease of use, user-friendliness, and flexibility), nurses' attitudes, concerns about patients' privacy, and perceived benefits or inconveniences.	[3]Rouleau et al. 2017
	Nursing sensitive outcomes	The desirable end result of the interactions between nursing resources (structure) and nursing services (processes) is to improve patients' conditions.	[1]Dubois et al. 2013
	Patient experience	Patients' perspectives about care received, for example, in terms on care continuity, engagement in care, respect of their preferences, quality of communication with healthcare professionals, etc.	[1]Dubois et al. 2013

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Change in patients' outcomes	*Patient comfort and quality of life related to care*	Nursing system performance reflects the extent to which patients' needs in relation to personal hygiene, nutrition, management of symptoms (pain, dyspnea), and continence are met, unnecessary interventions (physical or chemical restraints, nasogastric tubes, prolonged use of urinary catheters) are avoided, and patients' respect is ensured throughout the episode of care.	[1]Dubois et al. 2013
	Patient empowerment	Ability to achieve appropriate self-care. Adoption of health-promoting behaviours.	[1]Dubois et al. 2013
	Patient functional status	This category of indicators covers essential end results and benefits that reflect what happens in people's lives as a result of nursing care interventions. In the models examined, these indicators encompass diverse aspects of patients' general functional status and conditions, including physical, psychosocial and cognitive status, as well as recovery of initial health status and nutritional status.	[1]Dubois et al. 2013
	Risk outcomes and safety	Safety-related outcomes considered potentially sensitive to nursing: patient falls, injuries, medication errors, pulmonary infections, pressure ulcers, urinary tract infections, intravenous infections, abuses, and failure to rescue.	[1]Dubois et al. 2013
	Patient satisfaction or dissatisfaction of using e-learning	Patient results indicated their degree of satisfaction/dissatisfaction with e-learning interventions, their acceptance, acceptability, and receptiveness of their usage of interventions. Usefulness (or uselessness), perceived and actual benefits/advantages, such as accessibility and flexibility, ease of use, usability, complexity, level of confidence in using e-learning interventions, the confidentiality.	[3]Rouleau et al. 2017

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Appendix 3: Search strategy planned for PubMed

From January 1, 2006 to January 26, 2017

"registered nurse" [TIAB] OR nurse's role [MeSH] OR nursing practice [TIAB] OR nurs* [TIAB] OR nursing [MeSH] OR "nursing diagnostics" [MeSH] or nursing care [MeSH] or Evidence-based nursing [MeSH] or "advanced practice nursing" [MeSH] or "nursing assessment" [MeSH] OR "practice patterns, nurses" [MeSH] OR "education, nursing, continuing" [MeSH] OR "health care profession*"[TIAB] OR "health profession" [TIAB] OR "health-care professional" [TIAB] OR "healthcare education" [TIAB]

AND

"mLearning" [TIAB] OR "m-learning" [TIAB] OR "mobile learning" [TIAB] or "web-based learning" [TIAB] or "web based learning" [TIAB] OR "internet based learning" [TIAB] OR "internet-based learning" [TIAB] or "eLearning" [TIAB] or "e-learning" [TIAB] or "electronic learning"[TIAB] OR "health, education" [MeSH] OR "eLearning in health" [TIAB] or "multi-media learning tool*" [TIAB] or "multimedia learning tool*" [TIAB] OR "multimedia instruction" [TIAB] OR "interactive learning" [TIAB] OR "online learning" [TIAB] or "online discussion board*" [TIAB] OR "exchange portal" [TIAB] or electronic mail [MeSH] OR smartphone [MeSH] OR cellular phone [MeSH] OR "computers, handheld" [MeSH] "internet-mediated videoconferencing" [TIAB] or "virtual learning environment" [TIAB] OR "learning management system" [TIAB] OR "education, distance" [MeSH] OR "distance learning" [TIAB] OR "distance education" [TIAB] OR Self Directed Learning [MeSH] OR "blended learning"[TIAB]

OR

"Life-long learning" [TIAB] OR "lifelong learning" [TIAB] OR "continuing, education" [MeSH] OR "continuing professional development" [TIAB] OR "education, professional" [MeSH] OR "Professional Development" [MeSH]

AND

(systematic[sb] OR meta-analysis[pt] OR meta-analysis as topic[mh] OR meta-analysis[mh] OR meta analy*[tw] OR metanaly*[tw] OR metaanaly*[tw] OR met analy*[tw] OR integrative research[tiab] OR integrative review*[tiab] OR integrative overview*[tiab] OR research integration*[tiab] OR research overview*[tiab] OR collaborative review*[tiab] OR collaborative overview*[tiab] OR systematic review*[tiab] OR technology assessment*[tiab] OR technology overview*[tiab] OR "Technology Assessment, Biomedical"[mh] OR HTA[tiab] OR HTAs[tiab] OR comparative efficacy[tiab] OR comparative effectiveness[tiab] OR outcomes research[tiab] OR indirect comparison*[tiab] OR ((indirect treatment[tiab] OR mixed-treatment[tiab]) AND comparison*[tiab]) OR Embase*[tiab] OR Cinahl*[tiab] OR

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Effects of e-learning in a continuing education context on nursing care: a review of systematic qualitative, quantitative and mixed studies reviews (protocol)

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Manuscripts

Effects of e-learning in a continuing education context on nursing care: a review of systematic qualitative, quantitative and mixed studies reviews (protocol)

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Abstract

Introduction: Continuing education (CE) is imperative to the future of professional nursing. The use of e-learning by registered nurses (RN) for CE is spreading. A review of systematic reviews will be conducted to develop a broad picture of the effects of e-learning in a CE context on nursing care.

Methods and analysis: Systematic qualitative, quantitative and mixed studies reviews published in English, French, or Spanish from 1 January 2006 will be included. The outcomes of interest will be extracted and analyzed inductively and deductively from the Nursing Care Performance Framework (NCPF); some themes include nursing resources, nurses' practice environment, processes, professional satisfaction, and nursing sensitive outcomes. Two reviewers will independently screen first the title and abstract of the papers, and then the full texts in order to assess eligibility. Two teams of two reviewers will extract the selected reviews' characteristics and data. The results from various types of reviews will be integrated using a data-based convergent synthesis design. We will conduct a thematic synthesis and transform all quantitative and mixed data into qualitative data.

Ethics and dissemination: Ethics approval is not required for review of systematic reviews. We will summarize evidence concerning the negative, neutral and positive effects of various forms of e-learning on different aspects of nursing care. If we find gaps in the literature, we will highlight them and suggest ideas for further research. We will also focus on positive effects and present, if possible, the components and characteristics of e-learning interventions that were found to be successful. We will present this protocol and results in international conference in Nursing and in Medical and Health Informatics domains. We will also submit the results of our work for peer-review publication in a journal indexed in the international bibliographic database of biomedical information. **(293 words)**

Keywords

e-learning; nursing care; nurses, review; review of review ; continuing education;

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Strengths and limitations of this study

- Review of systematic qualitative, quantitative and mixed studies reviews is an innovative and emerging type of research synthesis. The inclusion of reviews using multiple research designs and a diversity of data is justified by the possibility of broadening the repertoires of effects of e-learning on nursing care.
- To the best of our knowledge, this is the first review of systematic reviews that uses the Nursing Care Performance Framework to draw a broad, multidimensional and systems-based perspective on the dimensions and indicators of nursing care that can be impacted by e-learning interventions.
- Review of systematic reviews is still in its infancy regarding reporting, assessment of methodological quality, risks of bias, and quality of evidence, especially for the qualitative and mixed studies reviews.
- One of the limits of reviews of systematic reviews is the lack of granularity of information provided by the review authors.

INTRODUCTION

Continuing education (CE), a term often used interchangeably with continuing professional development (CPD), lifelong learning, and staff development [1], is an imperative for the future of professional nursing [2]. In many countries CE is mandated by professional or regulatory bodies, which encourages nurses to participate in these activities [3]. CE is an opportunity to acquire knowledge, improve performance, support growth and development as a nursing profession, expand the nursing role, and introduce, develop, and advance professional competencies/skills [3,4]. Ultimately, CE is intended to improve quality of care and patients' health status due to changes in healthcare provider practice [5].

Nurses may engage in CE activities for myriad reasons; some seek opportunities voluntarily whereas others complete CE credits for specialization or licensure. While there is a breadth of nursing-specific CE activities, nurses searching for CE may face many barriers in terms of work schedule/commitments, lack of support (from co-workers, employers, organization), geographic distance, time away from work, and activity cost [6–8]. The use of

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electronic (e.g. computer and web-based) and mobile devices (e.g. smartphone, tablets) to support learning (i.e. e-learning and m-learning) is a promising avenue to face these challenges.

E-learning is an umbrella term that encompasses various concepts and technologies related to learning, such as distance, digital, electronic, online, Web-based and mobile learning [9]. For this work, we will use "e-learning" as the terminology entailing a variety of electronic, digital or mobile devices used to support learning. E-learning has many advantages: it reduces travel time, is flexible and accessible, can be cost-effective, and can allow learners to learn at their own pace and from the place of their choice [10,11]. Furthermore, e-learning has the potential to provide tailored content and instructional methods based on the individual needs of learners, and can present a variety of multimedia components such as text, audio, still and motion visuals to support acquisition of knowledge and skills [10]. Even if there is no strong evidence to prove that e-learning is superior to traditional learning, results of systematic reviews support that this is an effective alternative way to learn [11–13]. Moreover, it has positive impacts on nurses' knowledge, skills, level of self-efficacy and satisfaction [13,14].

However, e-learning is not a panacea [15]. Learners can encounter barriers, like skill requirement for using a particular device, low level of technological literacy, loss of time when the system/device doesn't work properly, or the reduction of social contact compared to face-to-face learning [16,17]. Clark and Mayer [10] summarized drawbacks surrounding e-learning, including too many multimedia components interacting at the same time, a lack of features that promote learning, a loss of an exploratory learning environment, and a lack of guidance for learners. The authors highlighted an interesting point: learning is better

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supported by effective instructional methods than by delivery medium (e.g. virtual classroom, face-to-face classroom). Furthermore, we have to keep in mind that the process of knowledge translation into clinical practice is embedded in a complex and challenging phenomenon, which can be influenced by various elements such as: the nature of knowledge to be transferred, the expected outcomes of the educational intervention, the way the knowledge is transferred (e.g. the instructional methods/implementation strategies, the use of tailored and individualized educational approaches, the medium) and the target audience [18].

E-learning technologies have been studied extensively in nursing, especially for students in an academic context, as supported in a review of systematic reviews (n=22) [9,12]. The results of this review did not lead to robust evidence of the superiority of e-learning over traditional learning, nor did they conclude which technology or medium of e-learning best influenced the acquisition of skills and knowledge for nursing students at undergraduate and postgraduate levels. However, e-learning was shown to reduce the cost related to education and save time for students and lecturers. To the best of our knowledge, there is no review of reviews that focuses on e-learning in a CE context for registered nurses (RN).

Objective

The objective of this review of systematic reviews (SRs) is to systematically summarize the best evidence that comes from systematic qualitative, quantitative and mixed studies reviews (MSRs) regarding the effects of e-learning in a nursing CE context on nursing care (i.e resources, services and patients' outcomes). We used the terminology "review of systematic reviews" because it describes the concept in a simple and specific manner. Other terms are less specific, such as 'overview', which can be used in a generic way [19].

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To meet this objective, we will use a process of data conceptualization by mobilizing both inductive (data-driven) and deductive (theory-driven) approaches iteratively or simultaneously to guide all the methods and analysis processes. We will be open-minded to allow the emergence of new concepts, but we will also use concepts from an existing framework, the Nursing Care Performance Framework (NCPF)[20], as a tool to extract, synthesize and interpret data. The NCPF is useful to define an important concept of this review, namely, "nursing care".

Why it is important to do this review of systematic reviews

- The context of nursing education in an academic setting versus in a workplace setting as a CE opportunity is different. Undergraduate students engage in the process of learning a large repertoire of clinical competencies, whereas practicing nurses in a CE context maintain and reinforce their clinical expertise.
- Knowledge synthesis at the third level of research (i.e. review of SRs) about the effects of e-learning already exists in an academic context, but there is no one exclusively on nursing workplace and CE.
- To complement existing nursing knowledge, we believe that it could be useful to use a review of SRs with an exploratory lens, as suggested by Caird et al.[21]. The synthesis it provides is ideal for identifying existing e-learning interventions used by RN in their workplace settings, and possible outcomes of interest (based on the NCPF) and their effects (i.e. positive, no effect, or negative effects). NCPF has never been used as a framework to extract and analyze data for educational interventions among nurses.

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NURSING CARE PERFORMANCE FRAMEWORK

The NCPF [20] will be used to conceptualize how e-learning interventions could influence nursing care and impact health outcomes. This is an organizational model, originally composed of three subsystems, 14 dimensions and 51 indicators, from which we have juxtaposing elements of the actual scope of nursing practice [22] as well as findings from our previous work [23] carrying out the impact of information and communication technologies (ICTs) on nursing care. Figure 1 presents the adapted version of the NCPF, which represents the range of possible outcomes for which data will be sought in this review of SRs.

Insert Figure 1 here

The NCPF demonstrates how the interplay of three nursing subsystems (structure, services, and patients' outcomes) can operate to achieve three key functions: (1) acquiring, deploying, and maintaining nursing resources (structure); (2) transforming nursing resources into nursing services (processes); and (3) producing changes in patients' conditions in response to the nursing services provided ("nursing-sensitive outcomes" or patients' outcomes).

The first function refers to the human and material resources needed to provide effective nursing care, such as nursing staff supply, working conditions, staff maintenance, and economic sustainability. The first way e-learning could influence nursing care is by considering it as a resource (i.e. the first subsystem of the NCPF). We could pay attention to these elements when we extract data from SRs: exploring whether the availability of e-learning in healthcare settings impacts the quality of life at work for nurses, and if e-learning acts as facilitator/motivator to enhance nurses' working conditions, or serve as a barrier that

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inhibits them. Another question could be: to what extent can e-learning create favourable conditions that attracts nurses and reinforces stability in the workforce?

The second function encompasses nursing services (i.e. the second subsystem of the NCPF), which are defined in various dimensions: nurses' practice environments (e.g. nurse autonomy; collaboration), nursing processes (e.g. assessment, care planning, and evaluation; problems and symptom management), nurses' professional satisfaction and patient experience. E-learning can be viewed as a resource that has the potential to influence all dimensions of nursing services at different levels. E-learning can be seen as way to support nursing work and create a professional practice environment for nurses by, for instance, facilitating collaborative practice. E-learning could impact what nurses do, for instance nursing interventions (processes), or the ability of nurses in using their competencies to provide healthcare. Resulting from these two dimensions, e-learning could influence nurses' professional satisfaction in terms of quality of care provided, satisfaction or dissatisfaction of nurses using e-learning, and/or patient experience.

The desirable end result of the interactions between nursing resources and nursing services is to improve patients' conditions. The third function is then described as the positive changes that can be detected among patients (also called "nursing-sensitive outcomes", i.e. the third subsystem of the NCPF). As other models used in the learning [5,24] domain, we could speculate that if e-learning changes nursing resources and nursing services, patients' outcomes could be potentially affected. Examples of indicators in the NCPF are: patient comfort and quality of life, risk outcomes and safety, empowerment and functional status.

The NCPF has been chosen to fit in the scope of this review for many reasons: 1) it was useful as an extraction and analytical tool in previous work [23]; 2) it offers a broad,

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multidimensional and system-based perspective on the dimensions and indicators of nursing care that can be impacted by e-learning interventions; 3) it can highlight many indicators that could be relevant to document and measure ways in which nursing care performance is impacted by CE.

METHODS

The protocol of this review of SRs has been registered at the International prospective register of systematic reviews (PROSPERO), registration number CRD42016050714. We used the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocol (PRISMA-P) checklist to guide the elaboration of this protocol (see online supplementary appendix 1) [25].

Insert PRISMA-P here

Design

We will conduct a review of systematic qualitative, quantitative and MSRs, which is, to the best of our knowledge, an innovative and emerging type of research synthesis. The inclusion of reviews using multiple research designs is justified by the possibility of broadening the repertoires of effects of e-learning on nursing care.

As underlined by Lunny et al. [26], methods to conduct, interpret and report review of SRs are in their infancy. To the best of our knowledge, no unified and integrated tool allows a comprehensive reporting of a review of systematic qualitative, quantitative and MSRs. We will follow the general methods for Cochrane reviews [27] and other relevant works in this domain [26,28,29] to conduct and report the review of SRs.

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Eligibility criteria

The scope in this review of SRs is formulated using PICOS (participants, interventions, comparisons, outcomes, study design) [30,31].

Type of reviews

We will include all types of systematic qualitative, quantitative and MSRs that evaluate the influence of e-learning used by nurses on nursing care in a CE context that have been published in French, English, or Spanish from January 1, 2006.

Publication type

To be included, the reviews have to be "systematic" [32] :

- clear and unambiguous
- include a type of research and one or a combination of method(s)
- have specific research question(s), precise inclusion criteria, a comprehensive search strategy, a quality appraisal process, and a rigorous synthesis.

The systematic qualitative, quantitative and MSRs must be published in peer-reviewed journals. Reports that outline a systematic methodology are included. We will exclude grey literature (e.g. conference proceedings, trial registries, dissertations) and non-SRs such as literature reviews.

Population

We will include RNs according to the professional legislation of each country. Reviews that target RNs and other health professionals (e.g. physicians) will be included as long as it is possible to differentiate nurses and to extract these participants' data. Patients receiving care from qualified RNs through the medium of e-learning will be part of this work, as long as nursing-related outcomes are discussed. We will exclude undergraduate nursing students in an academic context.

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Intervention

All types of e-learning delivered through different devices are targeted. Blended learning interventions will be included as long as they have an "electronic" or "digital" component. Any types of simulation, including with a "physical" mannequin (e.g. high-fidelity simulation, technology-enhanced simulation) will be excluded. However, simulation could be included if it is done through virtual reality (i.e. in an electronic learning environment).

Comparisons

We will include these types of comparisons: face-to-face learning, any other e-learning intervention, and blended learning.

Outcomes

The outcomes will include but are not limited to the three subsystems (i.e. nursing resources, nursing services and nursing sensitive outcomes), dimensions (e.g. working conditions, time and efficiency, nurses' practice environment, nursing processes, professional satisfaction, nursing sensitive outcome) and indicators (e.g. learning, nurse-patient relationship, knowledge access) showed in the adapted version of the NCPF in Figure 1. Definitions and/or examples of components are presented (see online supplementary appendix 2) related to each outcome of interest. The purpose is not to provide "standardized" definitions but to offer a guidance for the data extraction process. No "standardized" definition is available for the outcome of interest based on the fact that reviews included in this review of SRs may have: diversity in terms of nature of data (qualitative, quantitative and mixed), heterogeneity in e-learning interventions, and various possible outcomes. Furthermore, the data synthesis approach is abductive. This means that we will use the NCPF

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as a starting point to extract the data and analyze them, but we will let new data emerge from the reviews. If stable and fixed definitions are provided, the inductive part can be compromised.

The main outcomes of interests are those targeting the effects of e-learning on nursing resources and services. Then, if the outcomes belonging to these dimensions are found in the reviews, patients' outcomes will be extracted.

We will exclude reviews that focus only on patients' outcomes without discussing nursing resources or services. At least one nurse-related outcome need to be present in order to include a publication. Determinants of e-learning use (e.g. intended use) without reporting "actual use" of e-learning will also be excluded.

Search methods for the identification of reviews

Publications will be searched through general health sciences (PubMed, Embase), nursing (CINAHL) and Joanna Briggs Institute electronic databases. Structured search strategies will be developed using the thesaurus terms of each database and using free text, targeting the "title" and "abstract" fields. The strategies will be adapted to the other databases. The search strategy will be developed by the research team and validated by a health information specialist. The results of each database search will be collected in a single reference database, and duplicate citations will be removed. An example of the search strategy in PubMed is presented (see online supplementary appendix 3). This strategy will be adapted and refined according to the specificities of the databases. Furthermore, to obtain additional reviews, we will hand search for relevant reviews, contact authors to find other relevant works in this domain, and will consult reference lists of included reviews.

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DATA COLLECTION AND ANALYSIS

Selection of reviews

The research team will use DistillerSR, a web-based SR software from Evidence Partners (Ottawa, Canada), to perform the overall tasks related to the realization of a review of SRs. Citations retrieved from the searches will be imported into a reference management software such as Endnote. The database containing all the references will then be imported in DistillerSR. Three reviewers (GR, JPG, EH) will independently screen the title and abstract of the papers in order to assess their eligibility. Each paper will be reviewed twice. The reviewers will compare their results, and discuss them in case of discrepancies. If a consensus cannot be reached, arbitration with a third review author will be required. After the first round of screening, full text copies of publications that meet the pre-established inclusion criteria will be retrieved. In cases when the information regarding the eligibility of a review is limited or incomplete (e.g. when only an abstract is available), we will contact authors to request the full text or further details. We will use the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram to show the overall process of reviews selection [33].

Data extraction and management

The coding process will be done by four independent reviewers (GR, JPG, EH, JBP). We will use the NCPF to code, organize and classify the data according to the three subsystems (i.e. resources, services, outcomes), the dimensions and the indicators. This is the deductive part of the synthesis. Additional codes will be generated inductively by the four reviewers from the text of the articles without fitting them into the existing model. The four reviewers will begin by coding a set of the same three articles independently in order to ensure consistency during the coding and data extraction process. The independently

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developed frameworks or "coding plan" will then be compared and combined into a single integrated framework [26]. Any conflict arising through this extraction process will be discussed between the four reviewers. After a general agreement on coding and data extraction, the remaining articles will be divided equally between two teams of two reviewers.

The four reviewers will summarize general characteristics about reviews: purpose, type of review (qualitative, quantitative or mixed), examples of topics covered, number of studies included, target populations, search dates and context (e.g. mandatory CE, workplace). Details about e-learning interventions, comparisons and outcomes will also be extracted as follows: examples of e-learning interventions, devices or media used, examples of educational strategies and material, theory used to develop and evaluate interventions (e.g. learning theory, behavioural change), examples of comparison interventions, dimensions and indicators based on adapted version of NCPF, effects of e-learning as reported by authors, and nature of the effects (qualitative, quantitative or mixed). Any disagreements arising during the data extraction process will be resolved by discussion and consensus involving the two reviewers, or will involve a third review author if needed.

Methodological quality assessment of included reviews

In this review of SRs, we will include different designs. The array of underlying types of SRs combining qualitative, quantitative and mixed-method evidence can render reporting and assessing the quality of reviews of SRs more complex. At the time of this review of SRs, we found no reporting guidelines on assessing methodological quality of qualitative and MSRs.

One of the most commonly used tools for authors of quantitative SRs using a randomized controlled trial (RCT) design is the Assessment of Multiple Systematic Reviews

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(AMSTAR) [34,35]. AMSTAR is an 11-item checklist from which reviewers assign one point when the criterion is met. Quality is characterized at three levels: 8 to 11 is high quality (i.e. minor or no methodological limitations), 4 to 7 is medium quality (i.e. moderate methodological limitations), and 0 to 3 is low quality (i.e. major methodological limitations) [36]. AMSTAR items provide an assessment of methodological criteria such as the comprehensiveness of the search strategy and whether the quality of included studies was evaluated and accounted for [37]. Although AMSTAR has limitations (e.g. inappropriateness of applying some criteria to mixed-method and qualitative reviews), as underlined in previous work [23], the four reviewers (GR, JPG, EH, JBP) will apply the tool to all reviews in order to use the same criteria for quality assessment.

Risks of bias and quality of evidence

Others challenges encountered for authors of reviews of SRs are the assessment of limitations (risk of bias) as well as the quality of evidence in SRs [24, 31]. A tool has been recently published, named ROBIS, to assess or avoid the risk of bias in SRs [38]. It has been developed for guideline developers and authors of reviews of SRs. Three steps can be fill in when using the tool: (1) assessment of relevance (optional) between a review question and its fit/match with the review of reviews question, (2) identification of research steps where bias may be introduced into the SR process (i.e. eligibility criteria, identification and selection of reviews; data collection and review appraisal; and synthesis and findings) and (3) overall judgement of risk of bias. Bias appears if limitations in the design, conduct or analysis of a review alter the results. Two reviewers will then assess independently the risk of bias with ROBIS tool and will compare their results.

We found no tool or guidance to perform the quality of evidence assessment for authors of reviews of SRs. The Grades of Recommendation, Assessment, Development and

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Evaluation (GRADE) has been largely adopted as a tool to judge the overall quality of evidence for each individual outcome (i.e. consideration of within-study risk of bias, directness of evidence, heterogeneity, precision of effect estimates and risk of publication bias) in the context of quantitative primary studies, especially those using experimental or quasi-experimental designs [39,40]. When the unit of analysis is SRs and not primary studies, it is not always possible to extract GRADE ratings because data can be missing, not reported adequately, or reported in different ways across the SRs. The use of a tool to assess the quality of evidence has to be modified for use in reviews of SRs [41]. Recently, two tools have been published to assess both the confidence in qualitative review findings (methodological quality or dependability) and the potential influence of study quality on the review findings: Confidence of synthesized qualitative findings, named ConQual [42], and Confidence in the Evidence from Reviews of Qualitative research, called CERQual [43]. They both aim to provide a qualitative equivalent to the GRADE approach and both present a final ranking [44], but they are not currently considered as gold standard. We found no tool to assess the quality of evidence in mixed studies reviews. In this review of SRs, we will report the assessment of quality of evidence and risk of bias performed by original systematic quantitative, qualitative and MSRs authors who used GRADE, ConQUAL, CerQUAL or other approaches. In other words, only the quality indicators used by the authors of the original reviews will be reported, and no additional evaluation will be done.

Finally, another element to consider in a review of SRs is the risk of biased results caused by the repetition of primary studies that are included more than once (i.e. overlaps) across the reviews [45]. It is important to calculate the actual degree of overlap in reviews of SRs with the corrected covered area method in order to report these overlaps properly [45].

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As suggested by Studzinski *et al* [46], one reviewer will generate a matrix that will cross-link the SRs (columns) with primary studies included in the reviews (rows), and a second reviewer will check the matrix.

Data synthesis

An important challenge of data synthesis is the integration of the systematic qualitative, quantitative and MSRs [47]. In order to integrate the results from various types of reviews, we will perform a qualitative thematic synthesis using a data-based convergent synthesis design [48,49]. We will qualify quantitative data, as we did in our previous work [23]. Qualifying the quantitative data means that we will use a textual and narrative approach to name and qualify the effect. We will then categorize the quantitative effect under a specific theme (e.g. knowledge use). Within this theme, subthemes may be created, to make a distinction between qualitative, quantitative and mixed studies reviews' findings. Aromataris et al. [50] suggest to present overall effect estimates, numerical data, and overall synthetized qualitative findings extracted from each review in a tabular presentation of findings. Under a theme, subthemes could be divided by type of review (i.e. qualitative, quantitative or MSRs) to keep the details, and then, an integrated synthesis could be conducted to summarize the effects.

However, if the results of the review demonstrate that e-learning leads to a significant increase in knowledge, instead of reporting the *p* value, we will qualify the result: positive effect of e-learning on knowledge level. Frantzen & Fetters [47] call this approach "transformation", in which quantitative data are transformed into qualitative data. We will also organize the results into themes and sub-themes according to the specific dimensions of nursing care (e.g. practice environment, nursing processes, professional satisfaction, and nursing-sensitive outcomes) and their corresponding indicators. Even if this is an uncommon

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approach, we do believe that this way of synthetizing will allow us to keep the richness of the results.

In order to transform all quantitative and mixed data into qualitative data we will employ Thomas and Harden's [51] approach. We will follow these three steps: (1) coding relevant extracts of each SR line by line; (2) developing descriptive themes; and (3) generating analytical themes. This might lead to an adapted version of the NCPF cited earlier. The thematic synthesis will be done in an inductive and deductive way (i.e. abductive), which means that some themes will be organized based on the NCPF [23,24,52] while others will emerge inductively.

CONCLUSION

Results of this review of SRs could be used to understand the dimensions of nursing care that have the potential to be supported, enhanced or constrained by the use of e-learning to sustain CE activities among nurses. This review is a continuation of previous work that has been done about the impacts of various types of ICTs (excluding e-learning interventions) on nursing care [23]. Some reviews on e-learning used by nurses or nursing students target specific outcomes, especially knowledge, attitudes, barriers and facilitators, skills and satisfaction regarding the use of e-learning [13,14,53,54]. By using the NCPF to organize, extract and analyze the data, this review of SRs could provide a good starting point to deepen our understanding regarding the dimensions and indicators of nursing care that can be impacted by e-learning. With the growing presence of digital devices in nursing care systems, we think it is important to document the interaction of e-learning and nursing care dimensions and indicators. We believe that if we better understand the effects of these e-learning interventions, we could deploy strategies to facilitate their implementation and

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integration in nursing care, nursing research, management and education. Consequently, we could overcome their negative effects and optimize positive ones in order to use them to their full potential as tools to support nursing practice and, ultimately, improve patient outcomes.

Authors' contributions

GR is the guarantor, supervised by MPG and JC. GR drafted the manuscript with input from MPG and JC. GR, MPG, JC, JPG and EH contributed to the development of the selection criteria, the quality assessment strategy and data extraction criteria. GR and MPG participated in the development of the search strategy. CAD provided expertise on the application of the NCPF as the first author of the framework. JBP contributed to integrate relevant references in e-learning and in methodological quality assessment. GR and JPG were involved in the screening of titles and abstracts. GR, JPG and EH are responsible for screening full texts. GR, JPG, EH and JBP will be responsible of data extraction. All authors read, provided feedback and approved the final manuscript.

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Competing interests statement

The authors declare that they have no competing interests.

Provenance and peer review

Not commissioned; externally peer reviewed.

Data sharing statement

The authors will submit the results of the study for peer-review publication in a journal indexed in the international bibliographic database of biomedical information.

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Figure legends

Figure 1. Adapted version of the Nursing Care Performance Framework, which represents the range of possible outcomes for which data will be sought in this review of SRs.

Figure 1 Caption

Adapted version of the Nursing Care Performance Framework - Range of possible outcomes of interest

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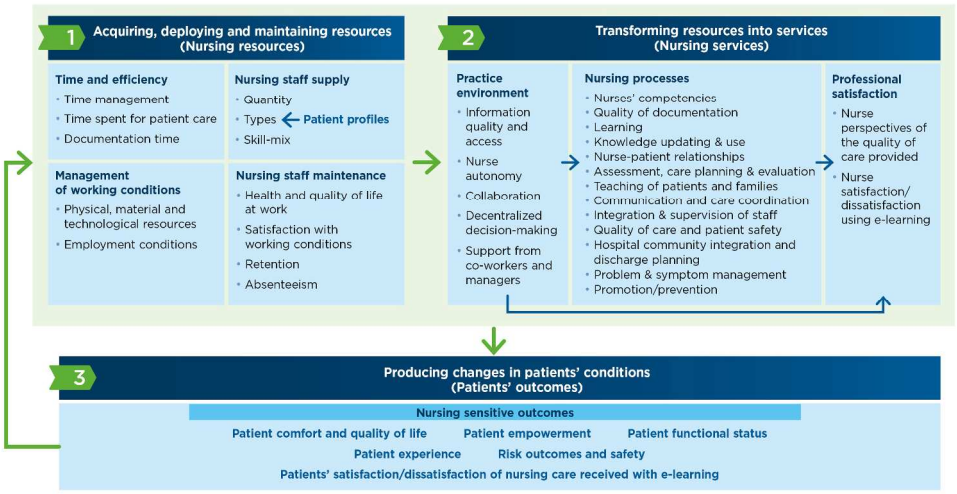

Figure 1. Adapted version of the Nursing Care Performance Framework - Range of possible outcomes of interest

269x135mm (300 x 300 DPI)

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Appendix 1: PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol

Title: Effects of e-learning interventions in continuing education context on nursing care: an overview of systematic mixed studies reviews (protocol)

Section and topic	Item No	Checklist item	Reported on page #
ADMINISTRATIVE INFORMATION			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	1
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	n/a
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	9
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	19
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	n/a
Support:			
Sources	5a	Indicate sources of financial or other support for the review	19
Sponsor	5b	Provide name for the review funder and/or sponsor	n/a
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	n/a
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	5-6
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	5-6
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	10-12
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey	12

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		literature sources) with planned dates of coverage	
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Appendix 3
Study records:			
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	13
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	13
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	13-14
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	13-14
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	Appendix 2
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	15-17
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	-
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	-
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	-
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	17-18
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	n/a
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	16-17

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.

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Appendix 2: Definitions and/or examples of components regarding outcomes of interest

Nursing subsystems	**Dimensions/***Indicators*	**Definition and/or examples of components**	**References**
Nursing resources (structure)	Nursing staff supply	The effectiveness of diverse activities that govern nursing staff intake (planning, recruitment, selection) and deployment; must ensure an adequate balance with the demand for nursing services.	[1]Dubois et al. 2013
	Quantity	Total number of workers in defined occupational groups; nurse-patient ratios.	[2]Dubois et al. 2009
	Quality	Professional backgrounds, skills, job title, qualifications, expertise and experience in order to achieve optimal patient care.	[1,2]Dubois et al. 2013; 2009
	Skill mix	Role enhancement (e.g expanding scope of practice, developing new competencies and assuming new responsibilities), role enlargement (e.g diversification and expansion of nurses' skill repertoires), role substitution and role delegation.	[2]Dubois et al. 2009
	Time and efficiency	Time devoted to perform general and specific tasks related to direct or indirect care.	[3]Rouleau et al. 2017
	Time management	Time devoted to perform a task (in general). For instance, using e-learning intervention could be "time consuming" or "time saving".	[3]Rouleau et al. 2017
	Time spent with patient care	Time allocated to patient care discussed with the use of e-learning interventions.	[3]Rouleau et al. 2017
	Documentation time	Time allocated to document nurses' activities.	[3]Rouleau et al. 2017
	Management of working conditions	Depends on resources and employment characteristics.	[1]Dubois et al. 2013

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Nursing resources (structure)	*Physical, material and technological resources*	Different types of material resources (e.g. physical facilities, technologies, financial resources, organizational configurations) that are required to support nurses in the performance of their roles.	[1]Dubois et al. 2013
	Employment conditions	Employment characteristics such as workload, scheduling, overtime, employment status, labour relationships.	[1]Dubois et al. 2013
	Nursing staff maintenance	Depends on various factors such as quality of life at work and satisfaction or dissatisfaction with working conditions.	[1]Dubois et al. 2013
	Health and quality of life at work	E.g. Work-related accidents, illnesses, injuries	[1]Dubois et al. 2013
	Satisfaction with working conditions	E.g. Job satisfaction or dissatisfaction related to working conditions	[1]Dubois et al. 2013
	Absenteeism	Can be caused by many factors	[1]Dubois et al.2013
	Retention/Turnover	Capacity to recruit new nurses and retain those already employed.	[1]Dubois et al. 2013
Nursing services	Nurse practice environment	E-learning can be seen as way to support nursing work and create a professional practice environment for nurses.	[4]Lake, 2002
	Information quality and access	The use of e-learning interventions could improve or alter information quality and access regarding for example patient issues, clinical data, medication information/profile, and other information (policies, guidelines, drug resources, patient files).	[3]Rouleau et al. 2017
	Nurse autonomy in their role	Shared governance, nursing responsibility, authority, accountability.	[5]Currie et al. 2005
	Intra and interprofessional collaboration	Communication and collaboration among nursing staff; collegiality between nurses and other professional groups.	[1]Dubois et al. 2013
	Decentralization of decision-making	Decentralization of decision-making with responsibilities for nursing services devoted to the nursing unit.	[1]Dubois et al. 2013
	Support from co-workers and managers	E.g. A supervisory staff that is supportive (or not) of the nurses.	[4]Lake, 2002

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Nursing services	Nursing processes	Are linked to what nurses do (nursing interventions).	[1]Dubois et al. 2013
	Quality of documentation	The extent to which e-learning interventions could improve or alter the quality of documentation regarding, for example, patient care and nursing activities.	[3]Rouleau et al. 2017
	Learning	Acquisition of declarative (knows) and procedural knowledge (knows how), described in a general way.	[5]Moore et al. 2009
	Nurses competencies and skills	E.g. Decision support/decision-making, observation skills, clinical judgment, critical thinking.	[3]Rouleau et al. 2017
	Nurse-patient relationship	E.g. The use of e-learning interventions to create pathways for communication, new types of bonds between nurses and patients, establish trust, create a sense of connection.	[3]Rouleau et al. 2017
	Assessment, care planning and evaluation	Assess patient's physical and mental condition, taking biopsychosocial aspects into consideration. Evaluate and update, in writing, information about the patient's condition and the care provided in the therapeutic nursing plan, nurses' notes, etc. Plan interventions using healthcare assessment tools (pain scale, wound assessment tool). Involve the patient and the patient's family in care planning. The nurse participates in designing, applying, and updating patient care programs.	[6]D'Amour et al. 2012
	Teaching of patients and families	Assess the specific information and education needs of each patient and his/her family. Verify that the patient and family have understood the teaching provided. Use teaching strategies that are adapted to each patient and family in accordance with the patient's level of autonomy. Check the quality of patient education provided on the unit.	[6]D'Amour et al. 2012

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Nursing services	*Communication and care coordination*	Communicate to members of the team all information that could affect the coordination of care. Coordinate the work of the nursing team to meet the needs of the patient and family as well as the interventions of the interprofessional team. Convey all relevant information to healthcare professionals in other institutions in order to ensure continuity of care. Participate in interprofessional team meetings or activities. Ensure continuity of care.	[6]D'Amour et al. 2012
	Knowledge updating and utilization	Keep knowledge up-to-date. Improve nursing practice based on new knowledge derived from best practices and research in nursing science or in health. Knowledge exchange with the nursing team knowledge emerging from research. Different types of knowledge exist, such as declarative knowledge (know), procedural knowledge (know how to do something) and competence (know how).	[5,6] D'Amour et al. 2012; Moore et al., 2009
	Integration and supervision of staff	Participate in identifying in-service education needs in workplace. Being involved in the orientation and training of nursing students or of newly hired staff. Act as a mentor or educator for newly hired staff. Develop and conduct training activities for the care team, in accordance with nurses skills.	[6]D'Amour et al. 2012
	Quality of care and patient safety	Report clinical situations in which deficiencies in quality and safety of care are identified, and propose courses of action to improve them. Improve the quality and safety of care by updating practices. Be a part in the evaluation of quality and safety of care and in developing nursing practice.	[6]D'Amour et al. 2012
	Problem and symptoms management	Nursing interventions intended to have effect on symptoms management, such as pain and fatigue (e.g. evaluation, use of non pharmacological approaches, patients' education)	[7]Dubois et al. 2015

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Nursing services	*Promotion/prevention*	Nursing interventions intended to promote health-related behaviours in order to prevent disease or the apparition of complications. For example: interventions for preventing falls among elderly people, for preventing pressure ulcers, vaccination, smoking cessation interventions, etc.	[7]Dubois et al. 2015
	Hospital community integration and discharge planning	Care organization, resources planning depending of patients' health status when they leave the hospitals	[7]Dubois et al. 2015
	Professional satisfaction	Resulting from nursing processes and from specific aspects that influence their perception of their ability to accomplish their daily assignments and enjoy the work itself.	[1]Dubois et al. 2013
	Nurses perspectives of the quality of care provided	According the nurses' perspectives, the way they evaluate the quality of care they provided. For example: improvement (or not) of quality of care and patient safety, nurses' perceptions that technologies reduce medication errors and improve medication administration processes, the provision of comprehensive and adaptive care related to the patients' needs.	[3]Rouleau et al. 2017
	Nurses satisfaction or dissatisfaction using e-learning	Overall acceptance of e-learning interventions, and their satisfaction with them described in general way (e.g. their degree of satisfaction or dissatisfaction). Other elements to consider: system navigability (e.g. complexity, ease of use, user-friendliness, and flexibility), nurses' attitudes, concerns about patients' privacy, and perceived benefits or inconveniences.	[3]Rouleau et al. 2017
	Nursing sensitive outcomes	The desirable end result of the interactions between nursing resources (structure) and nursing services (processes) is to improve patients' conditions.	[1]Dubois et al. 2013
	Patient experience	Patients' perspectives about care received, for example, in terms on care continuity, engagement in care, respect of their preferences, quality of communication with healthcare professionals, etc.	[1]Dubois et al. 2013

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Change in patients' outcomes	*Patient comfort and quality of life related to care*	Nursing system performance reflects the extent to which patients' needs in relation to personal hygiene, nutrition, management of symptoms (pain, dyspnea), and continence are met, unnecessary interventions (physical or chemical restraints, nasogastric tubes, prolonged use of urinary catheters) are avoided, and patients' respect is ensured throughout the episode of care.	[1]Dubois et al. 2013
	Patient empowerment	Ability to achieve appropriate self-care. Adoption of health-promoting behaviours.	[1]Dubois et al. 2013
	Patient functional status	This category of indicators covers essential end results and benefits that reflect what happens in people's lives as a result of nursing care interventions. In the models examined, these indicators encompass diverse aspects of patients' general functional status and conditions, including physical, psychosocial and cognitive status, as well as recovery of initial health status and nutritional status.	[1]Dubois et al. 2013
	Risk outcomes and safety	Safety-related outcomes considered potentially sensitive to nursing: patient falls, injuries, medication errors, pulmonary infections, pressure ulcers, urinary tract infections, intravenous infections, abuses, and failure to rescue.	[1]Dubois et al. 2013
	Patient satisfaction or dissatisfaction of using e-learning	Patient results indicated their degree of satisfaction/dissatisfaction with e-learning interventions, their acceptance, acceptability, and receptiveness of their usage of interventions. Usefulness (or uselessness), perceived and actual benefits/advantages, such as accessibility and flexibility, ease of use, usability, complexity, level of confidence in using e-learning interventions, the confidentiality.	[3]Rouleau et al. 2017

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Appendix 3: Search strategy planned for PubMed

From January 1, 2006 to January 26, 2017

"registered nurse" [TIAB] OR nurse's role [MeSH] OR nursing practice [TIAB] OR nurs* [TIAB] OR nursing [MeSH] OR "nursing diagnostics" [MeSH] or nursing care [MeSH] or Evidence-based nursing [MeSH] or "advanced practice nursing" [MeSH] or "nursing assessment" [MeSH] OR "practice patterns, nurses" [MeSH] OR "education, nursing, continuing" [MeSH] OR "health care profession*"[TIAB] OR "health profession" [TIAB] OR "health-care professional" [TIAB] OR "healthcare education" [TIAB]

AND

"mLearning" [TIAB] OR "m-learning" [TIAB] OR "mobile learning" [TIAB] or "web-based learning" [TIAB] or "web based learning" [TIAB] OR "internet based learning" [TIAB] OR "internet-based learning" [TIAB] or "eLearning" [TIAB] or "e-learning" [TIAB] or "electronic learning"[TIAB] OR "health, education" [MeSH] OR "eLearning in health" [TIAB] or "multi-media learning tool*" [TIAB] or "multimedia learning tool*" [TIAB] OR "multimedia instruction" [TIAB] OR "interactive learning" [TIAB] OR "online learning" [TIAB] or "online discussion board*" [TIAB] OR "exchange portal" [TIAB] or electronic mail [MeSH] OR smartphone [MeSH] OR cellular phone [MeSH] OR "computers, handheld" [MeSH] "internet-mediated videoconferencing" [TIAB] or "virtual learning environment" [TIAB] OR "learning management system" [TIAB] OR "education, distance" [MeSH] OR "distance learning" [TIAB] OR "distance education" [TIAB] OR Self Directed Learning [MeSH] OR "blended learning"[TIAB]

OR

"Life-long learning" [TIAB] OR "lifelong learning" [TIAB] OR "continuing, education" [MeSH] OR "continuing professional development" [TIAB] OR "education, professional" [MeSH] OR "Professional Development" [MeSH]

AND

(systematic[sb] OR meta-analysis[pt] OR meta-analysis as topic[mh] OR meta-analysis[mh] OR meta analy*[tw] OR metanaly*[tw] OR metaanaly*[tw] OR met analy*[tw] OR integrative research[tiab] OR integrative review*[tiab] OR integrative overview*[tiab] OR research integration*[tiab] OR research overview*[tiab] OR collaborative review*[tiab] OR collaborative overview*[tiab] OR systematic review*[tiab] OR technology assessment*[tiab] OR technology overview*[tiab] OR "Technology Assessment, Biomedical"[mh] OR HTA[tiab] OR HTAs[tiab] OR comparative efficacy[tiab] OR comparative effectiveness[tiab] OR outcomes research[tiab] OR indirect comparison*[tiab] OR ((indirect treatment[tiab] OR mixed-

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treatment[tiab]) AND comparison*[tiab]) OR Embase*[tiab] OR Cinahl*[tiab] OR systematic overview*[tiab] OR methodological overview*[tiab] OR methodologic overview*[tiab] OR methodological review*[tiab] OR methodologic review*[tiab] OR quantitative review*[tiab] OR quantitative overview*[tiab] OR quantitative synthes*[tiab] OR pooled analy*[tiab] OR Cochrane[tiab] OR Medline[tiab] OR Pubmed[tiab] OR Medlars[tiab] OR handsearch*[tiab] OR hand search*[tiab] OR meta-regression*[tiab] OR metaregression*[tiab] OR data synthes*[tiab] OR data extraction[tiab] OR data abstraction*[tiab] OR mantel haenszel[tiab] OR peto[tiab] OR der-simonian[tiab] OR dersimonian[tiab] OR fixed effect*[tiab] OR "Cochrane Database Syst Rev"[Journal:__jrid21711] OR "health technology assessment winchester, england"[Journal] OR "Evid Rep Technol Assess (Full Rep)"[Journal] OR "Evid Rep Technol Assess (Summ)"[Journal] OR "Int J Technol Assess Health Care"[Journal] OR "GMS Health Technol Assess"[Journal] OR "Health Technol Assess (Rockv)"[Journal] OR "Health Technol Assess Rep"[Journal])

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