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HOW TO IMPROVE EDUCATIONAL BEHAVIORS FOR CAREGIVERS AND PATIENTS HAVING CENTRAL VENOUS ACCESS DEVICE (CVAD): A SCOPING REVIEW

F. SOLLAZZO[1], G. LIQUORI[2], F. TROTTA[2], J. URBAN[2], E. DI SIMONE3, S. DIONISI[1], D. DE NUZZO[4], C. CAPPITELLA[5], M. DI NITTO[1], N. GIANNETTA[1,6], A. TAFURI[2], M. DI MUZIO[2]

[1]Department of Biomedicine and Prevention, Tor Vergata University of Rome, Rome, Italy
[2]Department of Clinical and Molecular Medicine, Sapienza University of Rome, Rome, Italy
[3]Nursing, Technical, Rehabilitation, Assistance and Research Department - IRCCS Istituti Fisioterapici Ospitalieri - IFO, Rome, Italy
[4]Emergency Department, Sant'Andrea Hospital, Sapienza University of Rome, Rome, Italy
[5]Department of health professions, Sant'Andrea Hospital, Sapienza University of Rome, Rome, Italy
[6]Vita-Salute San Raffaele University, Milan, Italy

Abstract – *Objective:* *Central venous access devices (CVADs) are essential to the modern management of patients with hematological malignancies and solid tumors. Educational programs play a crucial role in promoting appropriate patient actions to support patient safety during hospitalization and homecare. This review aimed to identify literature concerning educational interventions to promote patients' actions to overcome CVAD-related problems and improve self-monitoring and self-management.*

Materials and Methods: *Documentary evaluation of international databases, such as PubMed, CINAHL, Scopus and Cochrane. Searching for data on population, context and concept regarding CVAD self-management. The extracted data was subject to thematic analysis. The following scoping reviews were developed using the five-stage framework outlined by Arksey and O'Malley, and advanced by Levac and colleagues.*

Results: *Of the 2802 articles identified, 19 research articles were selected in this review. Educational programs have been shown to improve CVAD self-management, to decrease stress and anxiety related to their use, and to reduce the onset of complications. In addition, nurses have proven to be the professional reference figure for educational interventions.*

Conclusions: *The results of the study lead to the conclusion that programs aimed at improving selfcare and reducing the onset of complications in patients living with chronic and debilitating diseases should be made available to a larger portion of individuals. Both generic and specific programs are needed, in the different contexts of home and hospital, for the short and long term, in order to ameliorate participants' abilities. The results of this study should, therefore, encourage health professionals to plan, carry out, and evaluate the establishment of educational programs with patient participation.*

KEYWORDS: *Central Venous Access Device (CVAD), Patient education, CLABSI, Family-involved care, Caregivers' education, Self-care, Self-Management.*

Corresponding Author: Noemi Giannetta, Ph.D; e-mail: noemi.giannetta@uniroma1.it

INTRODUCTION

Central venous access devices (CVADs) are essential to the modern management of patients with hematological malignancies and solid tumors[1]. CVADs provide safe intravenous access to administer large amounts of blistering and irritant drugs with minimal risk of pain and damage to the blood vessel wall.

The Central Line-Associated Bloodstream Infection (CLABSI) and Catheter Related Bloodstream Infections (CRBSI) represent the main concern of healthcare systems. In fact, CLABSI and CRBSI result in thousands of deaths and clinical complications each year[2]. According to CDC guidelines (Atlanta, GA, USA), healthcare workers must follow protocols in order to ensure the line, adopting different strategies of prevention.

Education plays a pivotal role in promoting improved patient outcomes, ensuring patient safety in the healthcare environment and in homecare. Health information is an important resource for patients to manage their health problems and to reduce their anxiety, improving their wellbeing[3].

To prevent infection, healthcare workers should improve patients' ability to solve their problems and to adequately respond to CVADs-related emergency situations by fostering greater self-care ability. Additionally, providing information for CVC self-management in a gradual and continuous way resulted in significant results for patients. In addition, the involvement of family members in the care program may improve caregiver's abilities by receiving instructions on appropriate health care techniques[4,5].

The purpose of this scoping review is to identify and evaluate the literature published on the educational interventions aimed at promoting patients' ability in solving CVAD-related problems by self-monitoring and self-management.

MATERIALS AND METHODS

The following scoping review was developed using the five-stage framework outlined by Arksey and O'Malley[6], and advanced by Levac et al[7] and Grant et al[8].

The framework includes the following steps: (1) identify the research question, (2) identify the relevant studies, (3) perform the study selection, (4) chart the data (5) collect summarize and report the results.

Identify the research question

The objectives of this review were to answer the following questions:

- How to define the characteristics of studies related to the self-care of patients that have a central venous catheter?
- How to define the educational contents, objectives and methods adopted
- How to identify the provider for the educational intervention (whom, where, when, why and how?)
- How to define the outcomes that need to be evaluated and how were they measured

Details on documentary research on research aspects such as population, context and concept are shown in Table 1.

Identifying relevant studies

A systematic search on the following electronic databases was conducted: PubMed, CINAHL, Scopus and Cochrane Library. The search strategy was adapted to the specific characteristics of each database ***(Supplementary File 1)***.

The studies on the evaluation and on the development of educational interventions were eligible for inclusion, according to the following criteria: date of publication between January 2002-July 2019; addressed to adult patients with CVAD and/or caregivers. This time frame was chosen since in August 2002 the guidelines of the Centres for Disease Control and Prevention on the prevention of infectious complications from central venous catheter were published (Atlanta, GA, USA)[9].

All observational, experimental, quasi-experimental, qualitative studies and theoretical and opinion papers in English, Spanish and Italian were included.

TABLE 1. PCCT methodology to identify search questions.

Population	Adult and pediatric patients undergoing central venous catheter (PICC or CICC) implantation and/or caregivers of this type of patients.
Concept	Educational interventions for the improvement of Selfcare, aimed at patients and/or caregivers, designed with the aim of encouraging and improving self-care (Self-maintenance, Self-monitoring and Self-management) in order to prevent infectious complications (CLABSI/CRBSI) and non-complications infectious (Obstruction, Breakage, secondary mal positioning).
Context	Medium/long-term CVC patients in hospital, outpatient or at home.
Types of studies	All methodologies and all studies with full text available, in English, French, Spanish, Italian.

Study selection

Following the execution of the search strategy, the first stage of the selection process was carried out so that titles and abstracts of publications were read independently by two members of the research team (GL, FT) and deemed eligible if inclusion and exclusion criteria were met. During the screening phase, the Zotero® reference manager software was used to indicate whether the citations were assessed as potentially relevant or not.

Studies that are duplicates, irrelevant or unrelated were removed from the study at this stage. If the relevancy of the article is unclear from the title or abstract, the reviewers will then read the article in full text to determine its eligibility.

Discrepancies were solved by discussion. The full text of articles deemed eligible was retrieved and assessed for the inclusion criteria by the same investigators. Any disagreement was resolved by discussion and consensus.

When the latter wasn't reached, the arbitration was sought from a third member of the team (FS).

Studies involving dialyzed patients were excluded, as they were subjected to different venous access positioning under study. The studies are focused on all the educational interventions for the improvement of selfcare core elements (self-maintenance, self-monitoring and self-management), aimed at patients and/or caregivers, designed with the aim of encouraging and improving selfcare in order to prevent infectious and non-infectious complications (accidental removal, occlusion, catheter damage and dislocation).

Charting the data

Duplicates were removed from the 2802 articles which were identified at the first glance, reducing the effective records to be examined to 1494; 27 articles were included for eligibility after title and abstract reading, 5 of which were excluded because they did not meet the criteria and 2 were screened as reviews. Finally, 19 records were included in the study, as reported (Figure 1). The reading of the complete texts allowed to classify and organize the data in an extraction table thanks to the Excel® software. A summary of the findings of the articles included in this scoping review are shown in Table 2.

RESULTS

The data extraction information was collated and summarized, and the results were reported using the same framework we had established for the purpose and research questions and for the data extraction form.

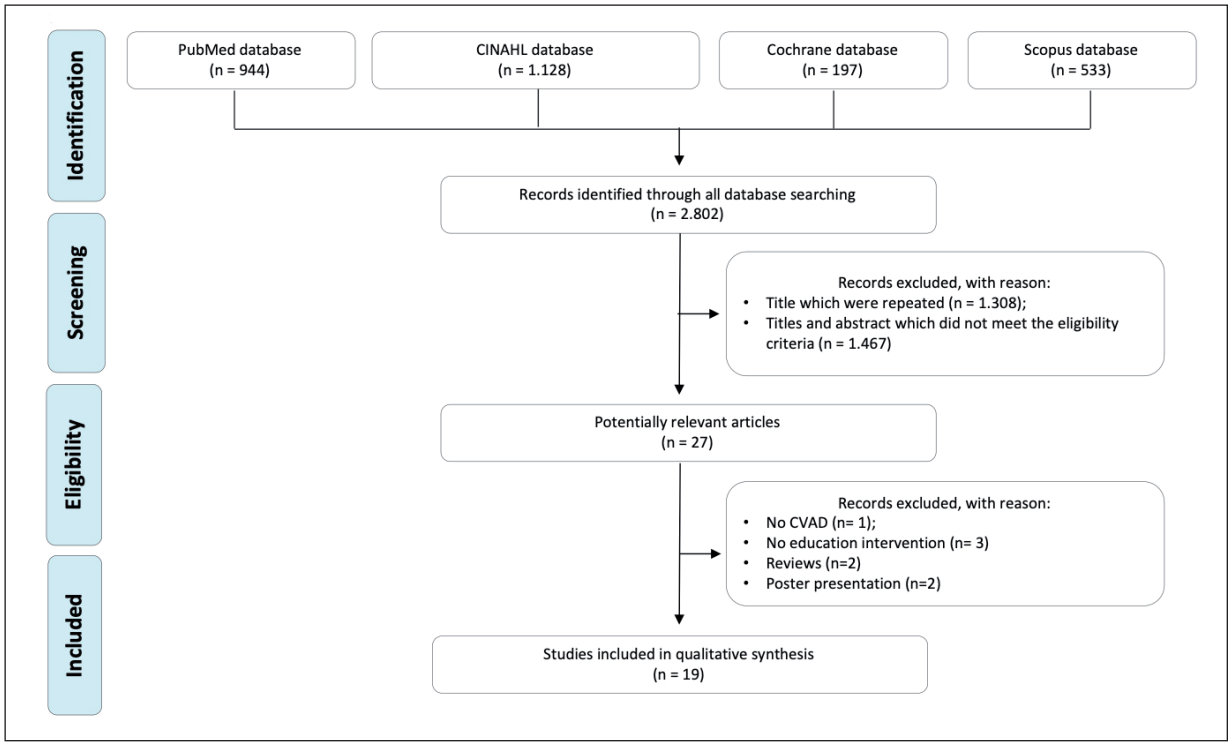

Fig. 1. PRISMA flow diagram of study selection.

TABLE 2. Summary of findings.

Authors (year)	*Education methods*	*Education method's aim*
Hicks et al[17]	Evaluation method based on the appropriate response to the questions asked during the lessons and on the demonstration of the acquired skills. The GLAD method used multimodal tools such as teaching, demonstrations, short videos, lecture notes, practical and verbal exercises. The lessons lasted about 2 hours, 4 times a week, on different days and times.	The goal was to acquire general skills in managing the CVC; being able to recognize the emerging signs of CLABSI; know how to properly wash the CVC; place the cap and the dressing; cover the device during the shower. All this had to be found at home.
Lura et al[10]	Three different videos were applied based on a 44-step guide, divided into three sections: 1. Description of the material, in which the devices used are described; 2. Educational part, in which the correct execution of the procedure is shown; 3. Support part, in which the patient can interrupt the video and repeat the procedure step by step.	The goal was to train patients in CVC self-management, during blood sample collection; make them understand the importance of safety in the maneuver and the high risk of infection to which one is facing.
Petroulias et al[16]	The educational method included educational lessons provided through an electronic iPad device to which both patients and their caregivers were subjected.	The goal of the educational intervention was to assess whether the patient, subjected to an educational program, implemented a self-management technique to reduce complications related to the PICC.
Smith et al [20]	IVEI program envisaged infection prevention through a CVC education based on CDC recommendations for hand washing; the treatment of depression instead included daily diary writing by the patient and relaxing massages.	Educate the patient on the correct management of the CVC, teaching them to recognize signs and symptoms of possible infectious complications.
Park et al[14]	The method is based on 4 educational sessions and one post-discharge: 1. Introduction to the management of the CVC; 2. Description of dressing change, CVC washing and expression of emotions; 3. Practical demonstrations with use of a model under the supervision of the nurse; 4. Feedback and self-management of complications.	The goal is to promote these patients' ability to solve CVC-related problems; increasing the capacity for self-management in the decision-making process, using resources and creating partnerships with nursing operators.
Tan et al[15]	Nurses and caregivers were involved in a Focus Group through which information was collected about the feedback received through videos and brochures. The method consisted in completing a test before and after receiving the educational intervention.	The goal of the educational intervention includes the implementation of the knowledge of caregivers about related CVC infections.
Sebbens et al[25]	On the DVD, the nurse demonstrated the following skills: proper hand washing and the procedures for applying sterile gloves, flushing catheters, changing a running IV to a heplock, changing the cap, changing the dressing, and managing complications.	Creative educational strategies, such as delivering education by DVD, may increase knowledge while improving satisfaction, increasing compliance, and ultimately improving outcomes.
Møller et al21	The patient's education was individually organized and, if desired, could involve relatives. Theory and practice were performed in 3 sections: general information on CVC, hygiene, risk factors, dressing change and cvc washing. The practical ability of the patients was tested.	The aim of the educational intervention is to make patients able to manage their device, without risking complications.

Continued

TABLE 2 (Continued). Summary of findings.

Authors (year)	*Education methods*	*Education method's aim*
Gordon et al[26]	The educational method is based on coping strategies: adaptation to CVC management; observation of nurses during nursing practices; reading information; interview with other families.	The educational goal is to increase awareness among health professionals about the impact of this problem on children and families, to allow them to fully appreciate the psychological, emotional and practical needs associated with the child.
Rinke et al[22]	The educational method is based on written brochures, about the management of the central line and informative surveys in which the patients were invited to participate. Questions were asked after administering the survey to understand understanding.	The educational objective aims to make families aware of the correct management of CVC.
Drews et al[11]	The educational method is based on the use of DVDs given to family members of children in which there is a practical demonstration that the nurse performs in the management of CVC.	The aim of the educational intervention is to analyze what the knowledge deficits are in the caregivers of these children and make them independent in the management of the central device.
Han et al[23]	The study did not implement a real educational method, as it observed some variables that may or may not influence the incidence of related CVC infections, including family support.	The aim of the study is to investigate how certain variables can influence CVC Self-care.
Møller et al[27]	The two educational modules used (modules 1 and 2) describe the focus, actions and objectives for each of four levels incorporated in each module. Module 1 focused on the sterile change of catheter dressing and requires 30-40 practical continuous actions to achieve the right clinical procedure. Module 2 described the flushing techniques and manipulation of the catheter (including the possibility of drawing central blood samples) and requires 70–80 continuous actions.	Aim of becoming patients independently responsible for their own catheter care.
Steiner[24]	The educational method has seen the use of: information brochures written during hospitalization and an informative video for discharge.	The aim of the educational intervention is to implement patient knowledge, skills and attitudes in CVC management.
Fusco et al[18]	T1. The first stage of the educational intervention, that is the interview, lasting 10 minutes provides standardized information of a general nature on the unit. T2. The second stage is only for groups of treatment. The duration is made variable by the characteristics of the instruments through which the information has been chosen and influenced by subjective factors, the actual fruition is carried out by the patient at home.	The patient must be educated to a proper home management of the PICC through targeted education.
Gallotto et al[12]	The educational method is explained through 5 explanatory and demonstrative teaching sessions before the patient is discharged home. Each session, lasting 1 hour, is carried out in the patient's bed. The caregiver is viewed if he has acquired good skills.	The aim of the intervention is to facilitate the transition between hospital and home and to promote education by avoiding the risk of CVC-related complications.
Álvarez-Moreno et al[13]	Bundle for CLABSI prevention developed by the Institute for Healthcare Improvement: (1) hand hygiene, (2) skin antisepsis with chlorhexidine, (3) maximal barriers, (4) insertion in sub-clavian vein, and (5) timely central line (CL) removal were associated with a reduction in the incidence density of CLABI in developed countries.	The goals of the INICC include the development of a dynamic global hospital network that applies systematic surveillance of HAIs with standardized definitions and methodologies of the CDC-NHSN, promotes evidence-based infection control practices, and performs applied infection control research to reduce rates of HAI, associated mortality, excess LOSs, costs, and bacterial resistance.

Continued

TABLE 2 (Continued). Summary of findings.

Authors (year)	*Education methods*	*Education method's aim*
Barrell et al[19]	The educational method is explained through a bundle strategies to reduce CLABSIs in the pediatric intensive care unit (PICU).	To reduce CLABSIs in the pediatric intensive care unit (PICU).
Polzien[28]	The educational method is explained through written instruction about what to do in emergency situations such as: • Air embolism • Signs and symptoms of infection • Clotting • Breakage Instructions included the importance of proper hand hygiene before and after touching the central catheter during any care to prevent infection.	The aim of the educational method include the management of Sally's catheter.

Studies' general characteristics

19 studies were selected: 4 descriptive studies[10-13]; 3 quasi-experimental[14-16]; 3 non-experimental analytical[17-19], 2 RCTs[20,21], 2 surveys[22,23]; 2 educational projects[24,25]; 1 mix-method study[26]; 1 pilot study[27] and 1 case report[28].

11 studies were conducted in the USA, 3 in Denmark, 2 in Korea, 1 in Taiwan, 1 in the United Kingdom and 1 in Italy.

Among the 3968 participants in the 19 selected research studies, 3972 (82%) were adults[10,12-20,22,23,26-28], 358 (18%) pediatric patients[11,21,25] supported by their caregivers.

56% of the studies were carried out in a hospital setting[10-15,17,19,21,22], 19% were conducted as outpatient (19%)[18,22,24-27], 13% as inpatient and home setting[16,20,28]. Nurses emerge as the professional figure most involved in educational programs (87%).

Education topics

The selected studies have common objectives in the educational methods used: implementing procedural security in the management of CVAD at home[10,17]; improving the dressing adherence[17]; educating patients on making themselves able to acquire general skills in managing the CVC[10,20]; being able to recognize the emerging signs of CLABSI[10,15,17,20]; knowing how to properly flush the CVC[17]; placing the cap and the dressing; safely covering the device during showers[17].

The patient's education was conducted individually and in a group with relatives and caregivers that were involved in all educational programs. The educational programs included the use of interactive videos, brochures and training lessons conducted by nurses in hospital, at home and in the clinic[17,24].

Two studies showed the use of information brochures written during hospitalization and an informative video about the management of the central line and informative surveys in which the patients were invited to participate[22,24]. Other studies have used technological tools such as tablets or interactive DVDs as educational methods[16,20,25].

From the literature it emerged that each educational method is often linked to a demonstration of the skills acquired by the patient or caregiver[17,14].

The outcomes that were measured were: CRBSI incidence; hospitalizations; quality of life; patient's attitude in device management.

Smith et al[20] have shown that in an educational program with interactive videos, a small number of CRBSIs, recurrences of depressions and re-hospitalizations were found, but it was not found in patients educated by a method based on demonstrative teaching lessons. The Interactive Educational Videotaped Interventions (IEVI) program has reduced patients' hospitalization rates and has improved their quality of life in USA (Lenexa).

The educational intervention showed benefits in patient adherence and CRBSI incidence reduced to 1.4 x 1000 days catheter (p <0.001). The patients demonstrated an adherence to the bundle in CVAD management, and stress and anxiety reduction[26].

DISCUSSION

This scoping review, based on 19 studies published between 2002 and 2019, is to our knowledge the first comprehensive review that includes studies that have investigated Educational interventions to improve self-care behavior in patients with Central Venous Access Device (CVAD) and their caregivers. These devices are essential to the modern management of patients with hematological malignan-

cies and solid tumors. Several studies focused on their prevalence[29-31]. The studies were mostly carried out in developed countries throughout Europe and the USA. A large variety of methodological approaches was used, whilst few studies assessed the educational interventions using an experimental or quasi-experimental approach.

The studies concluded that caregivers and patients benefited from the educational interventions empowering their skills, knowledge, and comfort of CVAD care. The patient self-management of the CVC allow them to improve their quality of life; furthermore, the patients' education leads to the adherence of a good CVAD management practice in the follow-up.

Family caregivers can participate in the CVAD care, which can offer patients a superior quality of life. While receiving needed CVC education, caregivers were able to collaborate, encourage and learn together. Nurses emerged in the literature as the main professional reference figure on the technical management of the CVADs. Nurses are responsible for proper device and therapy management. Knowledge, attitude and behavior are very important in medication management and to prevent medication errors[32]. Moreover, a study has shown that the use of self-reporting systems of adverse events to drugs, such as chemotherapy, together with the work and clinical judgment of an expert, can contribute to improvement in the patient quality of life[33].

CONCLUSIONS

The results of the study lead to the conclusion that educational programs, aimed at improving self-care and self-management behavior, in order to reduce the onset of complications in this patient population, should be made available even in a hospital setting. Both generic and specific programs are needed, in different contexts such as home and hospital, for the short and long term, in order to enhance participants' knowledge, behavior and skills.

The evidence-based practices that prevent CRBSI and implementing those measures requires a strategic and organized education program to directly target and reduce the incidence of CRBSI, a highly preventable adverse event[5].

The implementation of an educational approach as a strategy to reduce CVAD related complications and promotes safety. Moreover, it could improve the adherence of CVADs dressing and reduces anxiety, fear and stress.

A good educational program should be addressed based on the knowledge concerning catheter flushing, connector cap change, sterile dressing change, complications associated with CVADs and their management, including who to contact in case of need and the information concerning the PICC Team service that supports them in the CVAD management after the discharge.

As educators, nurses are on the front line of the care process and hence hold a great responsibility for improving patient safety and standards of patient care.

Authors' contribution:
Concept/design: FS; GL; FT; MDN
Data collection: GL; FT
Data analysis/interpretation: MDN; FS; DDN
Drafting article: UEO; JU; EDS; SD
Critical revision of article: AT; MDM; NG
Approval of article: NG, MDM; FS

Conflict of Interest Statement:
The authors declare that they have no conflict of interests and that the article has not been published previously and has not been forwarded to another journal.

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Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	1
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	2
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	2
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	-
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	2-3
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	2-3
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Supplementary File 1
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	2-3
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	3
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	3
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	-
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	3

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	3-6
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	6
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	-
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	3-6
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	3-6
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	6-7
Limitations	20	Discuss the limitations of the scoping review process.	6-7
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	6-7
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	None

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.

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