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TITLE

Anaesthetic and perioperative considerations for extrapleural pneumonectomy: a scoping review protocol

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ABSTRACT

Introduction: Extrapleural pneumonectomy (EPP) is a prolonged and morbid procedure, with a high prevalence of postoperative complications. Despite publications focussing on surgical technique, a significant gap remains in the literature regarding the best approach to the challenges of perioperative anaesthesia for EPP. It is not known whether risk stratification processes are standardised or what methods of functional and dynamic cardiac and pulmonary function tests are routinely employed to stratify perioperative risk; further, it is unknown whether prehabilitation impacts outcomes and if so, what the best prehabilitation comprises. Further, it is unknown if the anaesthesia technique and analgesia techniques and the types of haemodynamic monitoring tools used impact outcomes. Finally, there is a dearth of evidence regarding postoperative monitoring and the most effective enhanced recovery after pneumonectomy protocols to mitigate postoperative complications and accelerate hospital discharge.

To increase our knowledge of the best perioperative and anaesthetic treatment for patients undergoing EPP, this scoping review attempts to synthesise the literature and define these knowledge gaps.

Methods and analysis: This scoping review will be conducted in accordance with the PRISMA-ScR methodology. Electronic databases: OVID Medline, Embase, and the Cochrane Library will be systematically searched for relevant literature corresponding to EPP and perioperative or anaesthetic management. Reference lists from eligible studies will be checked for additional articles. All studies reporting the preoperative, intraoperative, or postoperative outcomes or techniques for patients undergoing EPP or being considered for EPP will be included. Studies consistent with key search terms will be screened and extracted for data by two independent reviewers. Data will be analysed and summarised descriptively and organised according to the three perioperative stages: preoperative, intraoperative, and postoperative factors in clinical care.

Ethics and dissemination: Ethics approval will not be required. The findings will be disseminated through professional networks, conference presentations, and publications in scientific journals.

Keywords
perioperative, extrapleural, pneumonectomy, anaesthesia, complications, thoracics, surgery

Wordcount 3079

ARTICLE SUMMARY

STRENGTHS AND LIMITATIONS

Strengths

- There are no reviews that map the full spectrum of the anaesthetic factors pertinent to the management of patients undergoing EPP.
- The scoping review is unlimited in its search timeline.
- IT provides a detailed longitudinal perspective of the anaesthesia perioperative management of EPP.
- This scoping review will highlight opportunities to further guide more targeted research in patients being considered for or who undergo an EPP.
- Our findings may assist perioperative clinicians to reflect upon the risks of EPP and provide patients and their families with valuable outcome data to help guide informative discussions about the benefits and risks of EPP.

Limitations

- The quality of the evidence summarised may be heterogenous.
- Only articles in English will be reviewed.
- The quality of the evidence will not be evaluated as this is a scoping review and not a systematic review.

BACKGROUND AND RATIONALE

Extrapleural pneumonectomy (EPP), also known as pleuro-pneumonectomy, is a standardised procedure of en-bloc resection of the parietal and visceral pleura with the ipsilateral lung, pericardium, and hemidiaphragm(1, 2, 3, 4). This technique was first documented in 1949 for the treatment of adult pulmonary tuberculosis(5) and has more recently been considered as an option for surgical management of various pleural malignancies(6), primarily malignant pleural mesothelioma (MPM)(7, 8, 9). The current indications for EPP are controversial, however, the procedure is typically considered in select patients with early-stage mesothelioma (Stage 1- early tumour growth occurs along the mesothelial lining of one lung, and Stage 2: tumour spread to nearby lymph nodes)(10), or in patients with limited tumour involvement in complicated pleural malignancies, such as thymomas(11, 12, 13) or low-grade sarcomas(6, 14, 15) if complete resection of the tumour is feasible.

The decision to perform EPP should be made by a multidisciplinary team of specialists, including thoracic surgeons, medical oncologists, radiation oncologists, and pulmonologists, in consultation with the patient and their family(16). This radical surgery provides a potential curative option to control pleural lesions(6, 17). However, to improve tumour control and prevent recurrence, EPP is usually performed as part of a multimodality treatment program, consisting of hyperthermic intrathoracic chemotherapy (HIOC)(18, 19), and perioperative chemo/radiotherapy(20, 21, 22).

Surgery for EPP is a morbid and prolonged procedure involving the mediastinum, resulting in significant perturbations in cardio-pulmonary haemostasis(4), and other complications such as supraventricular arrythmia(23, 24, 25, 26, 27, 28), cardiac failure(23, 27), thromboembolism(23, 26), respiratory failure(23, 27), renal failure(23), pneumonia(24, 25, 27), empyema and bronchopleural fistula(23, 27). Consequently, a 2018 systematic review found perioperative mortality from EPP to be as high as 11.8%, with complications occurring in 82.6% of patients(2) – a reflection of the many challenges that may arise throughout the perioperative period. This has major impacts on quality of life and long-term survival, in addition to implications for health resource management.

While EPP has been comprehensively investigated from a surgical perspective(29, 30), there is minimal research dedicated to mapping the perioperative anaesthetic care of such patients(31, 32, 33), despite the vital role anaesthetists have in preventing and treating the physiological and metabolic derangements that occur in the perioperative setting(34, 35). This contrasts with the literature pertaining to the anaesthesia management of the standard pneumonectomy patient(36, 37). However, there are several "EPP-specific" anaesthetic challenges that need to be considered to ensure safe delivery of anaesthesia and operation success(33).

These include greater risks of blood loss, arrythmias, impediments to venous return, haemodynamic instability, pulmonary dysfunction, fluid shifts in the early post operative period, diaphragm dysfunction and postoperative pain compared to standard pneumonectomy – owing to greater disruptions to mediastinal anatomy and procedural complexity(32). Moreover, the assessment of postoperative complications is poorly described. Additionally, EPP for treatment of MPM is now commonly performed with intra-operative administration of "intracavitary heated chemotherapeutics" to reduce any residual tumour cells in the empty hemithorax, which also needs to be factored into the anaesthetic plan(31, 32). There is little research into the anaesthesia-related considerations specific to these advanced therapies that

occur in combination with EPP. Therefore, increasing this knowledge base is necessary to improve perioperative outcomes and reduce acute and longer-term complications.

To date, there have been no scoping or systematic reviews charting the available literature relating to anaesthetic and perioperative practices for patients undergoing EPP. Additionally, a review published in 2008 by Ng and Hartigan did not detail the anaesthetic management specific to each intra-operative surgical stage of the EPP procedure(32). As such, a significant knowledge gap remains regarding how to approach the perioperative anaesthesia challenges. It is unknown if the perioperative risk stratification processes for EPP are standardised across the speciality units, what types of functional and dynamic cardiac and pulmonary tests are necessary, and whether they impact on postoperative outcomes; further, it is also unknown whether different types of prehabilitation programs impact on outcomes, and if so, what the prehabilitation program specifically incorporates. Importantly, it is unknown if the types of anaesthesia (volatile, intravenous, combination) and analgesia techniques (epidural vs. extrapleural catheter vs. systemic opioid based analgesia), and the types of perioperative haemodynamic monitoring tools used (e.g., transesophageal echocardiography, pulmonary artery catheters) impact on outcomes. It is also unknown if individualised haemodynamic protocols are used to guide the rational use of fluids, vasoactive drugs, and inotropes. Finally, there is a dearth of evidence regarding how to best monitor this patient group postoperatively or what the most effective enhanced-recovery-after-EPP protocols are to best mitigate postoperative complications and accelerate hospital discharge.

To address this research gap, we propose to undertake a scoping review of the peer-reviewed and academic grey literature relating to “anaesthetic” and “perioperative” considerations of “extrapleural pneumonectomy”. A scoping review is appropriate for this topic due to the limited quantity of published studies, allowing for more flexible and dynamic concept mapping. Additionally, the identification of key gaps in knowledge may be better assessed through a scoping review methodology(38). Subsequently, this review aims to provide an updated understanding of perioperative care and anaesthetic treatments for patient cohorts undergoing EPP, including step-by-step considerations for each of the intraoperative stages unique to this procedure.

OBJECTIVES

The objective of this scoping review will be to appraise and map the current understandings of perioperative and anaesthetic management for patients undergoing EPP. This review will add to the current evidence base with the goal of improving medical practices and guiding future research. Specifically, this review will aim to:

- Identify the current indications for EPP
- Evaluate and describe preoperative risk stratification tools to guide patient-focused discussions regarding the risks and benefits of anaesthesia and surgery
- Evaluate the types of perioperative prehabilitation programs that are being employed to optimise fitness for surgery
- Explore the types of anaesthesia and analgesia techniques being used to care for patients undergoing EPP
- Evaluate what types of haemodynamic monitoring devices (e.g., transoesophageal echocardiography, pulmonary artery catheter) are being used intraoperatively to guide the rational use of fluid and vasoactive medications

- Evaluate and describe the intraoperative complications (e.g., arrythmias, bleeding, cardiac dysfunction), and what strategies are employed to prevent or treat these
- Evaluate postoperative analgesia techniques (e.g., epidural, extrapleural catheter, patients controlled opioid analgesia) and whether this impact postoperative outcomes.
- Evaluate and describe postoperative complication rates (e.g., acute respiratory distress syndrome, bronchopleural fistula, acute kidney injury, stroke, bleeding, cardiac failure, deep vein thrombosis, pulmonary embolus, pneumonia, and need for prolonged mechanical ventilation)
- Identify risk factors that may predict complications and mortality
- Summarise the duration of the intensive care and the hospital length of stay
- Identify in-patient 30-day, 1-year, 5-year, and 10-year mortality rates
- Identify gaps in the socio-demographic and health status of patients undergoing EPP and determine how these differ across various health domains, countries, ethnicities, and sexes
- Identify the impact of EPP on the patient's quality of life

METHODS AND ANALYSIS

The scoping review will be conducted following the relevant aspects of the Preferred Reporting Items for Systematic Review and Meta-Analysis Extension for Scoping Review Protocols (PRISMA-ScR) guidelines, allowing for a systematic review of the existing literature to ensure rigor and replicability. Additionally, the methodological framework described by Arskey and O'Malley (2005)(39) and furthered by Levac et al. (2010)(40) will be utilised.

Protocol and Registration

Following discussions with perioperative thoracic surgeons, intensivists, respiratory physicians, anaesthetists, and physiotherapists working in thoracic surgery, this protocol was developed with the broad research question of describing the anaesthesia considerations in managing patients undergoing EPP. Outcomes of interest will focus on preoperative risk stratification techniques, pre-rehabilitation strategies, intraoperative anaesthesia and analgesic techniques, and the prevention and management of perioperative complications, including mortality. Finally, the impact of EPP on quality of life will be explored. In order to guarantee the protocol's dissemination, public accessibility, transparency, and opportunity for feedback from other significant stakeholders, including patients and their carers or families, it has been submitted to an open-access peer-reviewed journal.

Patient and Public Involvement

No patients were involved in the protocol or scoping review process, as this work analyses pre-existing research.

Search Strategy

Literature search strategies will be developed using medical subject headings (MeSH) and text words related to EPP quality indicators. MeSH terms and keywords relating to the "extrapleural pneumonectomy" procedure, "anaesthesia" techniques, "intraoperative" techniques and strategies, and "perioperative" care will be used. Studies will be identified by searching Medline (OVID interface), CINAHL (EBSCO interface), EMBASE (OVID interface), and the Cochrane Central Register of Controlled Trials (Cochrane Library).

Finally, experts in the field of EPP will be contacted and consulted to ensure that all relevant data is obtained.

Types of Studies

Primary empirical research studies will be eligible for inclusion, while editorials, protocols for planned studies, abstracts, and dissertations will be excluded.

Eligibility Criteria

Publications reporting on medical care related to perioperative or anaesthetic medicine on patients undergoing EPP will be included. For this review, "perioperative medicine" will be defined according to the Australian and New Zealand College of Anaesthetist (ANZCA), comprising a broad, multidisciplinary science and practice prioritising patient optimisation throughout the operative period to mitigate risk and manage perioperative complications(41). This encapsulates the three broad stages of the perioperative period: preoperative (risk assessment, decision for surgery, patient selection, optimisation), intraoperative (stages of anaesthesia), and postoperative (recovery and complication management, monitoring, rehabilitation) care(41). The focus of this scoping review will be the role of the anaesthetist or anaesthesiologist in providing perioperative care for patients undergoing EPP.

As the primary aim of this review is to provide a broad overview of all the perioperative anaesthesia considerations for EPP, the search and inclusion of studies will not be restricted to any specific period of the perioperative timeline. Similarly, there will be no restrictions placed on the age of the human patients studied (i.e., both adult and paediatric populations will be included). Additionally, there will be no restrictions to the types and modes of anaesthesia administered for EPP included in the review.

A proposed list of preoperative, intraoperative, and postoperative considerations will be included (Table 1). This may be subject to adjustments during the conduct of the review and will be guided by what parameters and considerations have been studied and documented in the available peer-reviewed literature.

Table 1. *Summary of proposed perioperative (preoperative, intraoperative and postoperative) considerations to be included in the scoping review*

Perioperative period	Clinical Practice Considerations
Preoperative	• Patient selection • Risk assessment • Investigations (e.g., blood studies, echocardiography, respiratory function tests, cardiopulmonary exercise testing, radiological studies) • Malignancy staging • Pre-rehabilitation programs
Intraoperative	• Preoperative patient preparation (e.g., monitoring, lines) • Choice of double lumen tube (type and size) or bronchial blocker to achieve lung separation • Choice of anaesthetic agents (induction, maintenance, emergence) • Use of brain function monitoring and cerebral oximetry

	• Analgesia techniques • Lung isolation and one-lung anaesthesia techniques • Use of lung recruitment manoeuvres or strategies • Anaesthetic considerations during each major stage of the procedure (e.g., during tumour dissection, dissection of great pulmonary vessels) • Anaesthetic considerations of adjuvant therapy during the EPP procedure (e.g., intraoperative intracavity hyperthermic chemotherapy) • Use of vasoactive medications or inotropes • Use of haemodynamic algorithms to guide fluid therapy and use of vasoactive agents • Fluid therapy (type and amount) • Frequency and management of arterial blood gas derangements • Cardiac complication management, e.g., arrythmia management • Other intraoperative complication considerations
Postoperative	• ICU admission and length of stay in hospital • Cardiac complications including assessment of cardiac function • Incidence and management of right ventricular dysfunction • Respiratory complications and management • Renal complications and management • Surgical site complications • Pain management considerations • Tumour-related complications • Rehabilitation • Morbidity and mortality

Only publications or abstracts in English will be included to ensure their relevance to the studied healthcare contexts and feasibility of implementation. However, limiting the search to English-specific studies may result in a degree of bias towards countries that primarily communicate in English. The types of evidence that will ultimately be included for analysis in the review will comprise primary empirical research studies (prospective or retrospective) and other full-text publications (e.g., reviews). Conversely, editorial pieces (e.g., position statements), protocol studies, abstracts, posters, and articles that cannot be retrieved with a full-text version will be excluded. No limitations will be placed on the time frame, setting, or publication date of the study.

Screening Procedure

Publications will be reviewed and screened via the web-based systematic review application Covidence. A three-step screening process of the title, abstract, and full-text review will be undertaken. First, two study reviewers will independently screen titles and abstracts obtained from the database search in accordance with the inclusion and exclusion criteria. Abstracts not available in English will be excluded. If the abstract is available in English and fulfils the eligibility criteria, but the main manuscript is not in English, then the full manuscript will be translated into English and included. Limiting the search to the English language may result

in bias in the results of English-language speaking countries and reduce generalisability to non-English-speaking countries, but it is accepted by the authors given the scoping nature of the review rather than inform evidence-based practice.

To enhance the reliability of the screening by the two reviewers, a random sample of 50 publications will undergo a pilot test of the initial screening based on the eligibility criteria described above. The kappa statistic will then be computed to ascertain the inter-rater agreement for inclusion in the study(42). The kappa result will be interpreted as follows: values less than zero indicate no agreement, 0.01 to 0.20 indicate none to slight agreement, 0.21 to 0.40 indicate moderate agreement, 0.41 to 0.60 indicate considerable agreement, and 0.81 to 1.00 indicate nearly perfect agreement. A kappa value between 0.80 and 0.90 (representing a high level of agreement) will serve as the acceptance criterion. Any disagreement will be discussed and resolved by a third reviewer of the study. The data-charting form will be revised, if necessary, in response to any discrepancies discovered by the third reviewer of the study.

Then, the full-text publications of all relevant and potentially relevant studies will be retrieved and independently screened by two reviewers, with any discrepancies resolved by a third reviewer, and all studies that do not satisfy the inclusion criteria will be excluded. In addition, summary tables and reference lists will be manually combed for additional publications that qualify. Prior to implementing the full scoping review, we will conduct pilot testing on the first 30 screened records to ensure feasibility and conformance with our data collection instruments and to identify potential problem areas and deficiencies in the scoping review protocol. This will enable members of the research team conducting the screening to familiarise themselves with the protocol's procedures. The inclusion and exclusion criteria will be clarified so that the selection criteria can be applied consistently. The reasons for the exclusion of studies that underwent full-text review will be reported.

The outcome of the database search, title and abstract screening, and full-text review will be detailed and documented in a Preferred Reporting Item for Systematic Reviews and Meta-Analysis (PRISMA) flowchart in the scoping review.

Data Extraction

The included studies will be charted into a customized data extraction form to extract all relevant data from each study. Data extraction will be performed independently by two reviewers, with discrepancies reviewed and discussed with a third reviewer, as required. Summary tables will be produced to highlight the evidence base and address the aims of this review. The following data will be extracted to address these primary and secondary objectives.

- First author
- Year of publication
- Type of study (e.g., randomised control trial, cohort study, systematic review, case report, etc.)
- Country of study
- Type of health facility
- Study demographics (e.g., age group, indication for EPP)
- Preoperative assessment (risk assessment, patient selection, and criteria used)
- Preoperative patient preparation

- Operative procedure and anaesthetic management (e.g., drug selection, fluid therapy, stages of anaesthesia)
- Postoperative management (e.g., postoperative analgesia, ICU stay)
- Postoperative complications and prevalence
- Postoperative morbidity and mortality (inpatient, 30-day, and long-term)
- Quality of life outcomes

Data synthesis

Using statistical software (StataCorp 2023 Stata Statistical Software, Release 18; College Station, TX: StataCorp LLC), data will be analysed and descriptively summarised. The data will be presented as counts (proportions), medians (interquartile ranges), and ranges (lowest to highest values). The characteristics of the study will be presented in tabular and graphic formats and summarised using a narrative approach in the text. Whenever possible, inferential statistics will be used to infer from the data the probabilities of observed differences between specific categories. Through a comparison of study and participant characteristics, research gaps will be identified. Where feasible, qualitative data that capture the authors' references to quality-of-life outcomes will be subjected to thematic analysis using Braun and Clarke's inductive-deductive method to identify themes and commonalities in how surgery affects patient quality of life or the impact of surgery on health care resources.

In reporting our findings, we will additionally emphasise similarities and differences in how patients undergoing EPP are selected for surgery and in any risk stratification procedure that occurs as part of their preoperative work. Specifically, this assessment will identify the individual, institutional, and system-level quality of care indicators currently used for patients undergoing EPP.

ETHICS AND DISSEMINATION

This scoping review will be reported in accordance with the PRISMA-ScR guidelines. Approval from the Human Research Ethics Committee will not be required as the proposed review will only review previously published literature and will not involve human subjects or any unpublished data. The results of this study will be disseminated through peer-reviewed publications and professional presentations. Additionally, the scoping review will inform future practice guidelines for perioperative and anaesthetic management of patients undergoing EPP and help summarise the current evidence base.

IMPLICATIONS

This scoping review aims to provide a better understanding of the complexities faced by anaesthetists who care for patients undergoing EPP. Knowledge translation will occur throughout the review with the dissemination of the findings to local, national, and international stakeholders.

Our findings could help to identify current evidence bases and knowledge gaps that, when filled, could aid anaesthetists and perioperative clinicians to reflect on the risks of EPP and provide patients and their families with valuable outcome data to help guide informative discussions about the benefits and risks of proceeding with complex thoracic surgery or seeking alternative management strategies. Finally, to improve the quality of care for a more

efficient healthcare system for patients undergoing EPP, the extracted results will be summarised both quantitatively and qualitatively to assist anaesthetists and other clinicians in shaping their understanding of the anaesthesia challenges for EPP. By summarising the body of evidence of established and potential quality indicators for EPP patients across the continuum of care, such performance measures can be used to determine the quality of care delivery for EPP patients.

AUTHOR CONTRIBUTIONS

All authors contributed meaningfully to the preparation, drafting, and editing of this scoping review protocol. LW (the guarantor) conceived the idea and guided the research team at all stages of protocol development. LW (corresponding author), SS, JG, TC, SRK and DKL conceptualised the research questions and core research plan. SWY, JL will perform the data extraction before preparing the initial draft of this manuscript. All authors will approve the final submitted manuscript after several iterations and rounds of editing and agree to be accountable for all aspects of this protocol.

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GUARANTOR

Prof. Laurence Weinberg is the guarantor.

COMPETING INTERESTS DECLARATION

None

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None

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Anaesthetic and perioperative considerations for extrapleural pneumonectomy and extended pleurectomy/decortication: a scoping review protocol

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TITLE

Anaesthetic and perioperative considerations for extrapleural pneumonectomy and extended pleurectomy/decortication: a scoping review protocol

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ABSTRACT

Introduction: Extrapleural pneumonectomy (EPP) and extended pleurectomy/decortication (ePD) are surgical cytoreductive techniques aimed at achieving macroscopic resection in malignant pleural tumours such as pleural mesothelioma (PM), non-mesothelioma pleural malignancies such as thymoma and sarcoma, and rarely for pleural tuberculosis, in a more limited fashion. Despite extensive studies on both surgical techniques and consequences, a significant knowledge gap remains regarding how best to approach the perioperative anaesthesia challenges for EPP and ePD.

It is unknown if the risk stratification processes for such surgeries are standardised or what types of functional and dynamic cardiac and pulmonary tests are employed preoperatively to assist in the perioperative risk stratification. Further, it is unknown if the types of anaesthesia and analgesia techniques employed, and the types of haemodynamic monitoring tools used, impact on outcomes. It is also unknown if individualised haemodynamic protocols are used to guide the rational use of fluids, vasoactive drugs, and inotropes.

Finally, there is a dearth of evidence regarding how best to monitor these patients postoperatively or what the most effective enhanced recovery protocols are to best mitigate postoperative complications and accelerate hospital discharge. To increase our knowledge of the perioperative and anaesthetic treatment for patients undergoing EPP/ePD, this scoping review attempts to synthesise the literature and identify these knowledge gaps.

Methods and analysis: This scoping review will be conducted in accordance with the PRISMA-ScR methodology. Electronic databases: OVID Medline, Embase, and the Cochrane Library will be systematically searched for relevant literature corresponding to EPP or ePD and perioperative or anaesthetic management. Data will be analysed and summarised descriptively and organised according to the three perioperative stages: preoperative, intraoperative, and postoperative factors in clinical care.

Ethics and dissemination: Ethics approval was not required. The findings will be disseminated through professional networks, conference presentations, and publications in scientific journals.

Keywords
perioperative, extrapleural, pneumonectomy, pleural, decortication, anaesthesia, complications, mesothelioma, thoracic, surgery

Wordcount
3541

STRENGTHS & LIMITATIONS OF STUDY

Strengths

- This is the first review to synthesise the perioperative anaesthesia considerations for extrapleural pneumonectomy and extended pleurectomy/decortication.
- To ensure systematic searching, screening, and reporting, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews tool is used.
- The protocol includes a comprehensive data extraction template.

Limitations

- Only articles in English will be reviewed.
- This review may miss studies published outside of journals (e.g., book chapters and other grey literature).

BACKGROUND AND RATIONALE

Extrapleural pneumonectomy (EPP), also known as pleuro-pneumonectomy, is a standardised procedure of en-bloc resection of the parietal and visceral pleura with the ipsilateral lung, pericardium, and hemidiaphragm(1, 2, 3, 4). This technique was first documented in 1949 for the treatment of adult pulmonary tuberculosis(5) and has a contemporary role as a surgical option for management of pleural malignancies(6), primarily in resecting pleural mesothelioma (PM), in addition to other uncommon non-mesothelioma pleural malignancies such as thymoma and sarcoma, and rarely for pleural tuberculosis, in a more limited fashion. (7, 8, 9). In contrast, a second surgical technique, extended pleurectomy/decortication (ePD)(10, 11, 12) is a lung-sparing procedure for debulking PM– however confers a theoretical risk of leaving behind residual disease from the in-situ ipsilateral lung(13). In recent times, ePD has grown increased popularity owing to an improved perioperative safety profile(14, 15, 16, 17, 18). Several meta-analyses comparing have revealed increased postoperative morbidity, mortality and complications in those receiving EPP compared to ePD with comparable disease recurrence rates and overall survival(16, 19, 20). However, EPP may still be considered in limited and rare contexts depending on the extent of disease and surgeon familiarity(21). To improve tumour control and prevent recurrence, EPP or ePD are usually performed as part of a multimodality treatment program, consisting of hyperthermic intrathoracic chemotherapy (HIOC)(22, 23), and perioperative neoadjuvant chemo/radiotherapy(24, 25, 26).

The role of EPP/ePD in PM management remains controversial and EPP is no longer the procedure of choice recommended for PM. In particular, two large multi-centre randomised control studies - Mesothelioma and Radical Surgery (MARS)(27) in 2011 and Mesothelioma and Radical Surgery 2 (MARS2)(28) in 2023, demonstrated no survival or quality of life benefit for patients undergoing either surgery compared to a nonsurgical chemotherapy control group(29). Despite controversy and academic scrutiny, these radical surgeries continue to be offered in limited contexts as a potential curative option to control pleural lesions(6, 21, 30). In some centres, the only indication for EPP in PM is if tumuor invades the lung and the disease is otherwise not resectable i.e., advanced disease.

A recent small study by an Italian single-centre thoracic unit highlighted the role of ePD in improving short-term survival outcomes if performed prior to the administration to systematic chemotherapy compared to post-chemotherapeutic treatment.(31) To date, there is considerable bias in the literature pertaining to outcome measures post-EPP and post-ePD dependent on institutional experience and limited sample size reporting.(31) Thus, the decision to perform EPP or ePD, and the role of surgery in the multimodality treatment of PM, should be made on a case-by-case basis by a multidisciplinary team of specialists, including thoracic surgeons, medical oncologists, radiation oncologists, pulmonologists, and anaesthetists in consultation with the patient and their family(31, 32, 33).

Surgery for EPP/ePD is a morbid and prolonged procedure involving the mediastinum, resulting in significant perturbations in cardio-pulmonary haemostasis(4), and other complications such as supraventricular arrythmia(16, 34, 35, 36, 37, 38, 39), cardiac failure(34, 38), thromboembolism(34, 37), respiratory failure(34, 38), renal failure(34), pneumonia(35, 36, 38), empyema and bronchopleural fistula(34, 38, 39). Consequently, a 2018 systematic review found perioperative mortality from EPP to be as high as 11.8%, with complications occurring in 82.6% of patients(2) – a reflection of the many challenges that may arise throughout the perioperative period. In contrast to EPP, ePD has seen increasing

popularity as the surgical-technique-of-choice for PM debulking – with some studies reporting lower 30-day mortality rates of 2.35% and improved overall survival time(40, 41). Given intraoperative and postoperative complications are not uncommon for either EPP or ePD, there are major impacts on quality of life and long-term survival, in addition to implications for health resource management.

While EPP/ePD has been comprehensively investigated from a surgical perspective(42, 43, 44), there is minimal research dedicated to mapping the perioperative anaesthetic care of such patients(45, 46, 47, 48), despite the vital role anaesthetists have in preventing and treating the physiological and metabolic derangements that occur in the perioperative setting(49, 50). This contrasts with the literature pertaining to the anaesthesia management of the pneumonectomy patient(51, 52, 53). However, there are several "EPP/ePD-specific" anaesthetic challenges that need to be considered to ensure safe delivery of anaesthesia and operation success(47, 48, 54). These include greater risks of blood loss, arrythmias, impediments to venous return, haemodynamic instability, pulmonary dysfunction, and postoperative pain compared to standard pneumonectomy – owing to greater disruptions to mediastinal anatomy and procedural complexity(46). Moreover, the assessment of postoperative complications is poorly described. Additionally, EPP for treatment of PM is commonly performed with intra-operative administration of "intracavitary heated chemotherapeutics" to reduce any residual tumour cells in the empty hemithorax, which also needs to be factored into the anaesthetic plan(45, 46). There is little research into the anaesthesia-related considerations specific to these advanced therapies that occur in combination with EPP/ePD. Therefore, increasing this knowledge base is necessary to improve perioperative outcomes and reduce acute and longer-term complications.

To date, there have been no scoping or systematic reviews charting the available literature relating to anaesthetic and perioperative practices for patients undergoing EPP. Additionally, a review published in 2008 by Ng and Hartigan did not detail the anaesthetic management specific to each intra-operative surgical stage of the EPP procedure(46). Whilst piecemeal case reports and single-centre experiences have been published regarding the anaesthetic considerations of ePD(48), to the best of our knowledge, no systematised reviews on this subject matter have also been researched.

As such, a significant knowledge gap remains regarding how to approach the perioperative anaesthesia challenges for EPP and PD surgery. It is unknown if the perioperative risk stratification processes for EPP/ePD are standardised across the speciality units, what types of functional and dynamic cardiac and pulmonary tests are necessary, and whether they impact on postoperative outcomes; further, it is also unknown whether different types of prehabilitation programs impact on outcomes, and if so, what the prehabilitation program specifically incorporates. Importantly, it is unknown if the types of anaesthesia (volatile, intravenous, combination) and analgesia techniques (epidural vs. extrapleural/paravertebral catheter vs. systemic opioid based analgesia), and the types of perioperative hemodynamic monitoring tools used (e.g., transesophageal echocardiography, pulmonary artery catheters) impact on outcomes. It is also unknown if individualised hemodynamic protocols are used to guide the rational use of fluids, vasoactive drugs, and inotropes. Finally, there is a dearth of evidence regarding how to best monitor this patient group postoperatively or what the most effective enhanced-recovery-after-EPP/ePD protocols are to best mitigate postoperative complications and accelerate hospital discharge.

To address this research gap, we propose to undertake a scoping review of the peer-reviewed literature relating to "anaesthetic" and "perioperative" considerations of extrapleural pneumonectomy and extended pleural decortication. A scoping review is appropriate for this topic due to the limited quantity of published studies, allowing for more flexible and dynamic concept mapping. Additionally, the identification of key gaps in knowledge may be better assessed through a scoping review methodology(55). Subsequently, this review aims to provide an updated understanding of perioperative care and anaesthetic treatments for patient cohorts undergoing EPP/ePD, including step-by-step considerations for each of the intraoperative stages unique to this procedure.

OBJECTIVES

The objective of this scoping review will be to appraise and map the current understandings of perioperative and anaesthetic management for patients undergoing EPP/ePD. This review will add to the current evidence base with the goal of improving medical practices and guiding future research. Specifically, this review will aim to:

1. Identify the current indications for EPP/ePD
2. Evaluate and describe preoperative risk ratification tools to guide patient-focused discussions regarding the risk and benefits of anaesthesia and surgery
3. Evaluate the types of perioperative prehabilitation programs that are being employed to optimise fitness for surgery
4. Evaluate what investigations are being conducted before surgery to aid in anaesthesia patient risk stratification for EPP versus ePD surgery
5. Explore the types of anaesthesia and analgesia techniques being used to care for patients undergoing EPP/ePD
6. Explore similarities and differences in anaesthesia and analgesia techniques being used to care for patients undergoing EPP versus ePD
7. To evaluate similarities and differences in the types of haemodynamic monitoring devices (e.g., transoesophageal echocardiography, pulmonary artery catheter) that are being used intraoperatively to guide the rational use of fluid and vasoactive medications for patients undergoing EPP versus ePD
8. Evaluate and describe the similarities and differences in intraoperative complications (e.g., arrythmias, bleeding, cardiac dysfunction) for EPP versus ePD, and what strategies are employed to prevent or treat these
9. Evaluate postoperative analgesia techniques (e.g., epidural, extrapleural catheter, patients controlled opioid analgesia) and whether these impact postoperative outcomes
10. Evaluate and describe postoperative complication rates (e.g., acute kidney injury, stroke, bleeding, cardiac failure, pneumonia, and need for prolonged mechanical ventilation), and describe similarities and differences for EPP versus ePD cohorts
11. Identify risk factors that may predict complications and mortality
12. Summarise the duration of the intensive care and the hospital length of stay, and describe similarities and differences for EPP versus ePD cohorts
13. Identify the inpatient readmissions to the intensive care unit, and describe similarities and differences for EPP versus ePD cohorts
14. Identify in-patient 30-day, 1-year, 5-year, and 10-year mortality rates, and describe similarities and differences for EPP versus ePD cohorts

15. Identify gaps in the sociodemographic and health status of patients undergoing EPP/ePD and determine how these differ across various health domains, countries, ethnicities, and sexes
16. Identify and compare the impact of EPP/ePD on the patient's quality of life

METHODS AND ANALYSIS

The scoping review will be conducted following the relevant aspects of the Preferred Reporting Items for Systematic Review and Meta-Analysis Extension for Scoping Review Protocols (PRISMA-ScR) guidelines, allowing for a systematic review of the existing literature to ensure rigor and replicability. Additionally, the methodological framework described by Arskey & O'Malley (2005)(56) and furthered by Levac et al. (2010)(57) will be utilised.

Protocol and Registration

Following discussions with perioperative thoracic surgeons, intensivists, respiratory physicians, anaesthetists, and physiotherapists working in thoracic surgery, this protocol was developed with the broad research question of describing the anaesthesia considerations in managing patients undergoing EPP/ePD. Outcomes of interest will focus on preoperative risk stratification techniques, pre-rehabilitation strategies, intraoperative anaesthesia and analgesic techniques, and the prevention and management of perioperative complications, including mortality. Finally, the impact of EPP/ePD on quality of life will be explored. In order to guarantee the protocol's dissemination, public accessibility, transparency, and opportunity for feedback from other significant stakeholders, including patients and their carers or families, it has been submitted to an open-access peer-reviewed journal.

Search Strategy

Literature search strategies were developed using medical subject headings (MeSH) and text words related to EPP/ePD quality indicators. MeSH terms and keywords relating to the "extrapleural pneumonectomy" or "extended pleural decortication" procedure, "anaesthesia" techniques, "intraoperative" techniques and strategies, and "perioperative" care. Studies will be identified by searching Medline (OVID interface), CINAHL (EBSCO interface), EMBASE (OVID interface), and the Cochrane Central Register of Controlled Trials (Cochrane Library) (see Supplementary File 1). Finally, experts in the field of EPP/ePD will be contacted and consulted to ensure that all relevant data is obtained.

Types of Studies

Primary empirical research studies will be eligible for inclusion, while editorials, protocols for planned studies, abstracts, and dissertations were excluded.

Eligibility Criteria

Publications reporting on medical care related to perioperative or anaesthetic medicine on patients undergoing EPP/ePD were included. For this review, "perioperative medicine" will be defined according to the Australian and New Zealand College of Anaesthetist (ANZCA), comprising a broad, multidisciplinary science and practice prioritising patient optimisation throughout the operative period to mitigate risk and manage perioperative complications(58). This encapsulates the three broad stages of the perioperative period: preoperative (risk assessment, decision for surgery, patient selection, optimisation), intraoperative (stages of

anaesthesia), and postoperative (recovery and complication management, monitoring, rehabilitation) care(58). The focus of this scoping review will be the role of the anaesthetist or anaesthesiologist in providing perioperative care for patients undergoing EPP/ePD.

As the primary aim of this review is to provide a broad overview of all the perioperative anaesthesia considerations for EPP/ePD, the search and inclusion of studies will not be restricted to any specific period of the perioperative timeline. Similarly, there will be no restrictions placed on the age of the human patients studied (i.e., both adult and paediatric populations will be included). Additionally, there will be no restrictions to the types and modes of anaesthesia administered for EPP/ePD included in the review.

A proposed list of preoperative, intraoperative, and postoperative considerations will be included (Table 1). This may be subject to adjustments during the conduct of the review and will be guided by what parameters and considerations have been studied and documented in the available peer-reviewed literature.

Table 1. *Summary of proposed perioperative (preoperative, intraoperative and postoperative) considerations to be included in the scoping review*

Perioperative period	Clinical Practice Considerations
Preoperative	• Patient selection • Risk assessment • Investigations (e.g., blood studies, echocardiography, respiratory function tests, cardiopulmonary exercise testing, radiological studies) • Malignancy staging • Pre-rehabilitation programs
Intraoperative	• Preoperative patient preparation (e.g., monitoring, lines) • Use of a double lumen tube (type and size) or bronchial blocker to achieve lung separation • Choice of anaesthetic agents (induction, maintenance, emergence) • Use of brain function monitoring and cerebral oximetry • Analgesia techniques • Lung isolation and one-lung anaesthesia techniques • Use of lung recruitment manoeuvres or strategies • Anaesthetic considerations during each major stage of the procedure (e.g., during tumour dissection, dissection of great pulmonary vessels) • Anaesthetic considerations of adjuvant therapy during the EPP/ePD procedure (e.g., intraoperative intracavity hyperthermic chemotherapy) • Use of vasoactive medications or inotropes • Use of haemodynamic algorithms to guide fluid therapy and use of vasoactive agents • Fluid therapy (type and amount) • Frequency and management of arterial blood gas derangements

	• Cardiac complication management, e.g., arrythmia management • Other intraoperative complication considerations
Postoperative	• ICU admission & length of stay in hospital • Cardiac complications including assessment of cardiac function • Incidence and management of right ventricular dysfunction • Respiratory complications and management • Renal complications and management • Surgical site complications • Pain management considerations • Tumour-related complications • Rehabilitation • Morbidity and mortality

Only publications or abstracts in English will be included to ensure their relevance to the studied healthcare contexts and feasibility of implementation. However, limiting the search to English-specific studies may result in a degree of bias towards countries that primarily communicate in English. The types of evidence that will ultimately be included for analysis in the review will comprise primary empirical research studies (prospective or retrospective) and other full-text publications (e.g., reviews). Conversely, editorial pieces (e.g., position statements), protocol studies, abstracts, posters, and articles that cannot be retrieved with a full-text version will be excluded. This review will include all studies published from 1st January 1949 to 6th March 2024.

Screening Procedure

Publications will be reviewed and screened via the web-based systematic review application Covidence. A three-step screening process of the title, abstract, and full-text review will be undertaken. First, two study reviewers will independently screen titles and abstracts obtained from the database search in accordance with the inclusion and exclusion criteria. Abstracts not available in English will be excluded. If the abstract is available in English and fulfils the eligibility criteria, but the main manuscript is not in English, then the full manuscript will be translated into English and included. Limiting the search to the English language may result in bias in the results of English-language speaking countries and reduce generalisability to non-English-speaking countries, but it was accepted by the authors given the scoping nature of the review rather than inform evidence-based practice.

To enhance the reliability of the screening by the two reviewers, a random sample of 50 publications will undergo a pilot test of the initial screening based on the eligibility criteria described above. The kappa statistic will then be computed to ascertain the inter-rater agreement for inclusion in the study(59). The kappa result will be interpreted as follows: values less than zero indicate no agreement, 0.01 to 0.20 indicate none to slight agreement, 0.21 to 0.40 indicate moderate agreement, 0.41 to 0.60 indicate considerable agreement, and 0.81 to 1.00 indicate nearly perfect agreement. A kappa value between 0.80 and 0.90 (representing a high level of agreement) will serve as the acceptance criterion. Any disagreement will be discussed and resolved by a third reviewer of the study. The data-charting form will be revised, if necessary, in response to any discrepancies discovered by the third reviewer of the study.

Then, the full-text publications of all relevant and potentially relevant studies will be retrieved and independently screened by two reviewers, with any discrepancies resolved by a third reviewer, and all studies that do not satisfy the inclusion criteria will be excluded. In addition, summary tables and reference lists will be manually combed for additional publications that qualify. Prior to implementing the full scoping review, we will conduct pilot testing on the first 30 screened records to ensure feasibility and conformance with our data collection instruments and to identify potential problem areas and deficiencies in the scoping review protocol. This will enable members of the research team conducting the screening to familiarise themselves with the protocol's procedures. The inclusion and exclusion criteria will be clarified so that the selection criteria can be applied consistently. The reasons for the exclusion of studies that underwent full-text review will be reported.

The outcome of the database search, title and abstract screening, and full-text review will be detailed and documented in a Preferred Reporting Item for Systematic Reviews and Meta-Analysis (PRISMA) flowchart in the scoping review.

Data Extraction

The included studies will be charted into a customized data extraction form to extract all relevant data from each study. Data extraction will be performed independently by two reviewers, with discrepancies reviewed and discussed with a third reviewer, as required. Summary tables will be produced to highlight the evidence base and address the aims of this review. The following data will be extracted to address these primary and secondary objectives.

- First author
- Year of publication
- Type of study (e.g., randomised control trial, cohort study, systematic review, case report, etc.)
- Country of study
- Type of health facility
- Study demographics (e.g., age group, indication for EPP/ePD)
- Choice of EPP or ePD and rationale for surgical approach
- Preoperative assessment (risk assessment, patient selection, and criteria used)
- Preoperative patient preparation
- Operative procedure and anaesthetic management (e.g., drug selection, fluid therapy, stages of anaesthesia)
- Postoperative management (e.g., postoperative analgesia, ICU stay)
- Postoperative complications and prevalence
- Postoperative morbidity and mortality (inpatient, 30-day, and long-term)
- Quality of life outcomes

Data synthesis

Using statistical software (StataCorp 2023 Stata Statistical Software, Release 18; College Station, TX: StataCorp LLC), data will be analysed and descriptively summarised. The data will be presented as counts (proportions), medians (interquartile ranges), and ranges (lowest to highest values). The characteristics of the study will be presented in tabular and graphic formats and summarised using a narrative approach in the text. Whenever possible, inferential statistics will be used to infer from the data the probabilities of observed

differences between specific categories. Through a comparison of study and participant characteristics, research gaps will be identified. Where feasible, qualitative data that capture the authors' references to quality-of-life outcomes will be subjected to thematic analysis using Braun and Clarke's inductive-deductive method to identify themes and commonalities in how surgery affects patient quality of life or the impact of surgery on health care resources.

In reporting our findings, we will additionally emphasise similarities and differences in how patients undergoing EPP/ePD are selected for surgery and in any risk stratification procedure that occurs as part of their preoperative work. Where feasible, the differences in perioperative outcomes and management strategies between patients undertaking an EPP versus ePD will be highlighted. Specifically, this assessment will identify the individual, institutional, and system-level quality of care indicators currently used for patients undergoing EPP/ePD.

Patient and Public Involvement

This work analyses existing research studies, and therefore, involves no patients or members of the public.

ETHICS AND DISSEMINATION

This scoping review will be reported in accordance with the PRISMA-ScR guidelines. Approval from the Human Research Ethics Committee was not required as the proposed review will only review previously published literature and will not involve human subjects or any unpublished data. The results of this study will be disseminated through peer-reviewed publications and professional presentations. Additionally, the scoping review will inform future practice guidelines for perioperative and anaesthetic management of patients undergoing EPP/ePD and help summarise the current evidence base.

IMPLICATIONS

This scoping review aims to provide a better understanding of the complexities faced by anaesthetists who care for patients undergoing EPP/ePD. In particular, knowledge translation will occur throughout the review with the dissemination of the findings to local, national, and international stakeholders.

Our findings could help to identify current evidence bases and knowledge gaps that, when filled, could aid anaesthetists and perioperative clinicians to reflect on the risks of EPP/ePD and provide patients and their families with valuable outcome data to help guide informative discussions about the benefits and risks of proceeding with complex thoracic surgery or seeking alternative management strategies. Finally, to improve the quality of care for a more efficient healthcare system for patients undergoing EPP/ePD, the extracted results will be summarised both quantitatively and qualitatively to assist anaesthetists and other clinicians in shaping their understanding of the anaesthesia challenges for EPP/ePD. By summarising the body of evidence of established and potential quality indicators for EPP/ePD patients across the continuum of care, such performance measures can be used to determine the quality-of-care delivery for EPP/ePD patients.

CONTRIBUTORS

All authors contributed meaningfully to the preparation, drafting, and editing of this scoping review protocol. LW (the guarantor) conceived the idea and guided the research team at all stages of protocol development. LW (corresponding author), SS, JG and DKL conceptualised the research questions and core research plan. SWY, JL performed the data extraction before preparing the initial draft of this manuscript. JG, TGC, SAB, SN and DKL helped write and approve the final submitted manuscript after several iterations and rounds of editing. LW and SWY agree to be accountable for all aspects of this protocol.

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Supplementary File 1. Search Strategy – Extrapleural pneumonectomy and pleural decortication. Search dates: MEDLINE (1st January 1946), EMBASE (1st January 1974) to March 6th 2024

Database	Search Strategy	Number of Searches
MEDLINE	(("extrapleural pneumonectomy" or "extended pleurectomy decortication" or "extended pleurectomy decortication" or "pleurectomy decortication") and (anaesthe* or anesthe* or anaesthesia or anesthesia or periop* or perioperative or preop* or intraop* or postop* or haemodynamic or "risk assessment" or mortality or morbidity or "critical care")).tw.	435
EMBASE	(("extrapleural pneumonectomy" or "extended pleurectomy decortication" or "extended pleurectomy decortication" or "pleurectomy decortication") and (anaesthe* or anesthe* or anaesthesia or anesthesia or periop* or perioperative or preop* or intraop* or postop* or haemodynamic or "risk assessment" or mortality or morbidity or "critical care")).tw.	693
Cochrane	("extrapleural pneumonectomy":ti,ab OR "extended pleurectomy decortication":ti,ab OR "extended pleurectomy decortication":ti,ab OR "pleurectomy decortication":ti,ab) AND (anaesthe*:ti,ab OR anesthe*:ti,ab OR anaesthesia:ti,ab OR anesthesia:ti,ab OR periop*:ti,ab OR perioperative:ti,ab OR preop*:ti,ab OR intraop*:ti,ab OR postop*:ti,ab OR haemodynamic:ti,ab OR "risk assessment":ti,ab OR mortality:ti,ab OR morbidity:ti,ab OR "critical care":ti,ab)	39 (1 review, 38 trials)

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.	2
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.	4,5
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.	6
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.	N/A
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.	7,8
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.	7
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	7
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	7
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.	7,8
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	10

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
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).	10,11
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	10
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.	N/A the review has not been performed yet. This is the scoping review protocol
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	N/A the review has not been performed yet. This is the scoping review protocol
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	N/A the review has not been performed yet. This is the scoping review protocol
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.	N/A the review has not been performed yet. This is the scoping review protocol
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	N/A the review has not been performed yet. This is the scoping review protocol
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.	N/A the review has not been performed yet. This is the scoping review protocol
Limitations	20	Discuss the limitations of the scoping review process.	3
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.	N/A the review has not been performed yet. This is the scoping review protocol
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.	12

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.