Association of Educational Interventions with Clinician Learning and Ventilator-Associated Pneumonia Patient Outcomes: A Protocol for Systematic Review and Meta-Analysis

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ABSTRACT

Recent studies have shown that educational interventions for ventilator-associated pneumonia (VAP) prevention may result in positive outcomes in intensive care units. However, other studies investigating this kind of intervention have produced inconsistent results. Thus this paper reports a protocol for systematic review and planned meta-analysis to investigate the association of instituted VAP educational interventions with clinician learning and patient outcomes. In this review, the authors will identify relevant citations from electronic databases, reference lists, and other sources; screen articles against predetermined eligibility criteria; appraise each study using the Cochrane Collaboration's risk of bias assessment

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tools and combine acquired evidence using the meta-analytic approach. The results of this review are crucial to assist clinicians and policy-makers in making well-informed decisions regarding VAP prevention practices for mechanically ventilated patients. This review protocol followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses for Protocols 2015 guidelines and was registered with PROSPERO as CRD42016051561.

Keywords: clinical outcomes, educational intervention, learning outcomes, review protocol, VAP prevention, ventilator-associated pneumonia

INTRODUCTION

The rapid advances in the fields of intensive and critical care have seen VAP as a priority clinical concern for infection control and prevention programs. VAP is a type of healthcare-associated infection that develops following endotracheal intubation or mechanical ventilation in patients without pre-existing pneumonia on admission. This condition is an important cause of greater morbidity and mortality in the intensive and critical-care settings with substantial impact on healthcare costs.[1–2] Thus, measures to control or prevent its occurrence, especially during the first 96 hours of mechanical ventilatory support, are commonly advocated.

To date, the clinical practice recommendations for the prevention and management of VAP are centered on evidence-based strategies directed to prevent the risk of oropharyngeal aspiration including the build-up of pathogens in the respiratory and digestive tracts, and minimize endotracheal tube and mechanical ventilator utilization.[3–4] Other VAP prevention strategies have also been acknowledged in the literature, including simple and cost-effective measures.[5]

Evidently, one of the recognized cost-effective quality improvement strategies in low-resource intensive care units (ICUs) is the educational intervention.[6] Educational programs that include well-planned evidence-based practice elements to improve both clinician learning and patient outcomes have also become a common practice in multidisciplinary ICUs.[7–9] Over the years, there has been an increasing interest in the use of educational interventions as primary tools to prevent nosocomial pneumonia in mechanically ventilated patients. Recent studies have shown that VAP educational interventions, as the core of learning among health practitioners and professionals have resulted in positive learning and clinical outcomes.[10] Other studies investigating this kind of intervention, however, have produced inconsistent results between pre- and post-assessments, often demonstrating no significant improvements in ventilator bundle compliance.[11–12] VAP incidence,[11,13–14] and other patient clinical outcomes.[11–15] These variations between studies inevitably suggest the need for a systematic review to address clinical uncertainties that are associated with VAP educational interventions; hence, this investigation.

The present review generally attempts to identify, critically appraise, and summarize the best available evidence to address the discordance between the results of studies using systematic review and meta-analysis of association. The review authors specifically aim to investigate whether or not administering educational intervention for VAP prevention is associated with positive outcomes that are beneficial to both the clinicians (learning outcomes) and the mechanically ventilated patients (clinical outcomes). Such an approach is considered essential to guide healthcare practitioners as well as policy-makers in making well-informed decisions regarding infection control and prevention practices for patients requiring mechanical ventilatory support.

METHODS

Design

As part of our a priori efforts in promoting transparency, this paper reports a protocol for systematic review and planned meta-analysis to investigate whether or not the institution of education-based VAP prevention intervention is associated with positive clinician learning and patient outcomes in intensive and critical care units. This review protocol was based on an established methodology [16] and followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses for Protocols (PRISMA-P) 2015 guidelines (Table 1) [17–18]. In addition, this review protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) as CRD42016051561 on November 16, 2016. The latest revisions of the protocol were made on May 26, 2017.

Table 1. The PRISMA-P 2015 checklist

Section/topic	#	Checklist item	Information reported	
Administrative information			**Yes**	**No**
Title				
Identification	1a	Identify the report as a protocol of a systematic review	[x]	[ ]
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	[ ]	[x] N/A
Registration	2	If registered, provide the name of the registry (eg, PROSPERO) and registration number in the abstract	[x]	[ ]
Authors				
Contact	3a	Provide name, institutional affiliation, and e-mail address of all protocol authors; provide the physical mailing address of the corresponding author	[x]	[ ]
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	[x]	[ ]
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	[ ]	[x] N/A
Support				
Sources	5a	Indicate sources of financial or other support for the review	[ ]	[x] N/A
Sponsor	5b	Provide name for the review funder and/or sponsor	[ ]	[x] N/A
Role of sponsor/funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	[ ]	[x] N/A
Introduction				
Rationale	6	Describe the rationale for the review in the context of what is already known	[x]	[ ]
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	[x]	[ ]
Methods				
Eligibility criteria	8	Specify the study characteristics (eg, PICO, study design, setting, time frame) and report characteristics (eg, years considered, language, publication status) to be used as criteria for eligibility for the review	[x]	[ ]
Information sources	9	Describe all intended information sources (eg, electronic databases, contact with study authors, trial registers, or other grey literature sources) with planned dates of coverage	[x]	[ ]
Search strategy	10	The present draft of the search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	[x]	[ ]
Study records				
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	[x]	[ ]
Selection process	11b	State the process that will be used for selecting studies (eg, two independent reviewers) through each phase of the review (ie, screening, eligibility, and inclusion in meta-analysis)	[x]	[ ]
Data collection process	11c	Describe the planned method of extracting data from reports (eg, piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	[x]	[ ]
Data items	12	List and define all variables for which data will be sought (eg, PICO items, funding sources), any pre-planned data assumptions and simplifications	[x]	[ ]

Table 1. Continued

Section/topic	#	Checklist item	Information reported	
Administrative information			**Yes**	**No**
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	[x]	[ ]
Risk of bias in individual studies	14	Describe anticipated methods for assessing the risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	[x]	[ ]
Data synthesis				
	15a	Describe criteria under which study data will be quantitatively synthesized	[x]	[ ]
	15b	If data are appropriate for quantitative synthesis, describe the planned summary measures, methods of handling data, and methods of combining data from studies, including any planned exploration of consistency (eg, I^2, Kendall's tau)	[x]	[ ]
	15c	Describe any proposed additional analyses (eg, sensitivity or subgroup analyses, meta-regression)	[x]	[ ]
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (eg, publication bias across studies, selective reporting within studies)	[x]	[ ]
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (eg, GRADE)	[x]	[ ]

GRADE, the Grading of Recommendations Assessment, Development and Evaluation; N/A, not applicable; PICO, Population Intervention Comparison Outcome; PRISMA-P, Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols.
This checklist has been adapted for use with protocol submissions to PROSPERO from Table 3 in Moher D, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Systematic Reviews 2015 4:1

Eligibility Criteria

In compliance with the eligibility criteria, two of the review authors (EP & AD) will independently assess each study involved. Any assessment discrepancy will be resolved by virtue of consensus or consultation with a third investigator (JMG or AJG).

Types of studies

In this review, the review authors will include published and unpublished interventional studies (randomized controlled trials or RCTs, non-experimental quasi-experimental methods, pretest-posttest studies, time series designs) or observational studies (cohort and case-control studies) with equivalent or non-equivalent control groups investigating VAP educational interventions. The studies of one group design will be considered if detailed descriptions of exposure to such interventions are adequately reported. The review authors will exclude basic researches such as animal, cell, genetic, and methodology studies, including descriptive surveys, qualitative research, case series, case reports, diagnostic accuracy trials, review articles, protocols, clinical practice guidelines, brief reports, conference proceedings, commentaries, and editorials.

Types of Participants

All ICU patients, regardless of age, requiring mechanical ventilation and receiving education-based VAP prevention strategies will be included as subjects in this review to examine patient outcomes. In addition, this review will involve all clinicians working in ICU settings as subjects to examine their learning outcomes. These clinicians may include ICU nurses, infection control practitioners, intensivists, respiratory therapists, physicians, and the like. They must be directly involved in the care of mechanically ventilated patients.

Both subjects will be classified according to exposures: *exposed* and *non-exposed* groups (controls or comparators), which are defined as those who received and did not receive VAP educational interventions, respectively. Clinicians will be considered as the *non-exposed* group if they practice the usual

or routine care or have no active interventions involved. Patients labeled as *non-exposed* pertain to those who have not received any educational interventions for the VAP prevention program.

Excluded in this review are the non-ICU or non-medical healthcare staff members, as well as, the patients who received mechanical ventilation for less than 24 hours.

Types of Interventions/Exposures

The present review applies to any type of education-based infection control interventions for VAP prevention. These may include formal or non-formal lectures, standardized sessions, use of validated self-study modules, fact sheets, presentations, visual aids (posters), educational handouts, educational conferences, trainings (in-service), seminars, and reinforcement at the bedside or return demonstrations that provided information on guidelines or strategies for the prevention of VAP, such as VAP bundle care or ventilator bundle and the like. The contents of such preventive practices may be based on the Centers for Disease Control and Prevention (CDC) guidelines, Institute for Healthcare Improvement (IHI) and/or from other reputable agencies. Such educational interventions must be preceded by a pre-test (pre-exposure) and followed by a post-test (post-exposure) to determine any change in learning among the clinicians (learning outcomes) and among the patients (patient outcomes). Any non-VAP-related interventions will be excluded.

Types of Outcome Measures

The primary outcomes of this review are knowledge of and adherence to VAP educational intervention (learning outcomes), and VAP incidence (clinical outcomes). Any related VAP definitions will be accepted for inclusion in the systematic review and meta-analysis. Secondary outcomes include duration of mechanical ventilation, ICU/hospital length of stay, microbial colonization (VAP-causing microbes), cost of antibiotic treatment of VAP and hospitalization, and ICU or in-hospital mortality. Non-VAP-related outcomes will be excluded.

Types of ICU Settings

Studies conducted in intensive and critical care settings will be included. The types of ICU may include, but not limited to, combined or general ICU, coronary care unit, cardiovascular/surgical, surgical, trauma, medical, neurological/neurosurgical, surgical trauma, and burn units. The non-ICU settings will be excluded.

Types of Language Use

No language restrictions will be hereby imposed. Non-English studies will be translated accordingly for the purposes of inclusion.

Timing

No date or period restrictions will be imposed for this present review. However, studies that do not meet the above-mentioned criteria will be excluded. A summary of the review eligibility criteria is presented in Table 2.

Search Methods for Identification of Studies

Electronic searches

The review authors will search relevant studies without date and language restrictions in the following scientific databases: MEDLINE through PubMed, The Cochrane Library, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Web of Science, and Education Resources Information Center (ERIC).

Searching Other Resources

Reference lists and citations of the included articles/relevant reviews will be manually checked. Other sources (eg, PROSPERO, OpenGrey, ProQuest Theses & Dissertations, and trial registry: www.clinicaltrials.gov) of potential articles will also be explored. In addition, the review authors will utilize all possible measures to contact the corresponding authors for clarification of unpublished data results by e-mail and other provided contact information. They will also explore the authors' personal page through ResearchGate to identify other similar and/or related studies.

Searching Strategy

Specific search strategy involving the use of Medical Subject Headings (MeSH), Boolean operators, parentheses and truncation symbols will be applied.

Table 2. Eligibility criteria

Types of study designs	Interventional studies Randomized controlled trial or clinical trial Non-randomized study (quasi-experimental design) or pretest-posttest intervention Observational studies Cohort study Case-control study
Types of participants	Clinicians (exposed and unexposed groups) Mechanically ventilated patients (exposed and unexposed groups)
Types of exposures	Educational interventions for VAP prevention (as defined by study authors)
Types of outcome measures	Any of the following outcome measures: Primary outcome measures Learning outcomes: Knowledge (as measured by study authors) Adherence (as measured by study authors) Clinical outcome: VAP incidence (as assessed by study authors) Secondary outcome measures Clinical outcomes: Duration of MV (time, measured in days or equivalent) ICU LOS (time, measured in days or equivalent) In-hospital LOS (time, measured in days or equivalent) Microbial colonization Cost of antibiotic treatment of VAP (currency, converted in US dollars or equivalent) Hospitalization costs (currency, converted in US dollars or equivalent) ICU or in-hospital mortality (as described by study authors)
Types of ICU settings	No restrictions imposed
Types of languages	No restrictions imposed
Timing	No time restrictions imposed

ICU, intensive care unit; LOS, length of stay; MV, mechanical ventilation; US, United States; VAP, ventilator-associated pneumonia

Table 3. MEDLINE (via PubMed) search strategy

#1. Mechanically ventilated or ventilated patient* or intubated patient* or critically ill
#2. Critical care nurs* or intensive care nurs*
#3. Critical care or critical care unit or intensive care or intensive care unit or ICU
#4. #1 OR #2 OR #3
#5. Education or teach or educational intervention or educ* intervention* educ* program* or staff education or clinical education or clinician education or provider education or VAP education or training program*
#6. Ventilator bundle or bundle care or VAP bundle or oral care
#7. Infect* control or infect* prevention
#8. #5 OR #6 OR #7
#9. VAP group or non-VAP group or with VAP or without VAP or exposed or non-exposed
#10. Pretest-posttest or pre-post or pretest or posttest or pre-test or post-test or pre-intervention or post-intervention
#11. #9 OR #10
#12. Learning outcome* or clinician outcome* or knowledge or adherence or compliance
#13. Patient outcome* or clinical outcome* or ventilator-associated pneumonia or ventilator-acquired or VAP or VAP incidence or VAP rate or early VAP or late VAP or nosocomial pneumonia or length of stay or death or fatal or mortality or cost
#14. #12 OR #13
#15. Randomized trial or randomized control* trial or RCT or quasi-experimental or cohort stud* or case-control stud*
#16. #4 AND #8 AND #11 AND #14 AND #15

ICU, intensive care unit; RCT, randomized controlled trial; VAP, ventilator-associated pneumonia

The search strategy will be framed using the recommended modified PICO (population, intervention, comparator, outcomes) format: types of study population, exposure of interest, comparators, and outcomes or response (PECO).[16] The generated MeSH terms and keywords will be combined with 'OR' to give a set of results for each part of PECO, including the study design (S). Thereafter, the review authors will combine the sets of results for P, E, C, O, and S using 'AND' to narrow the search.

A sample draft of the MEDLINE search strategy is shown in Table 3. This was developed by the first

review author (JMG) and independently validated by the other review team members (EP, JA, AS, and AD) through the above-mentioned databases. Disagreements in the design were resolved through discussions among the authors. The final version of the MEDLINE search strategy will be adapted to other databases as applicable.

Data Collection and Analysis

Selection of Studies

Two independent review authors (EP and AD) will sufficiently record the flow of information through the different phases of review. This process involves identification of relevant citations from multiple databases and other sources (reference lists, similar studies or reviews, citation tracking, unpublished manuscripts); de-duplication of search results using Microsoft® Office software, Mac Excel 2011 version; screening of titles and abstracts for relevance; retrieval of full-text articles for eligibility assessment and inclusion of potential study articles in qualitative and quantitative syntheses.

Using Microsoft® Excel, the review authors will manually transcribe the following data: first author, study title, journal name, publication date and publisher. These data will be screened for duplicates and relevance by manually searching as they automatically appear within the Excel file. Following the study selection process, the review authors will generate study codes for the included articles. For instance, the most recent included article (study 1) will be encoded as 2017–0001 (published year-assigned code). Afterward, they will use the succeeding published dates with corresponding assigned codes to other included studies (eg, 2017–0002 for study 2; 2017–0003 for study 3). For multiple reports of the same study, they will allocate a single study code. A third review author (JMG or AJG) will be consulted to resolve any discordant assessments. Figure 1 illustrates the PRISMA flow diagram of study selection.[20]

Quality Assessment

In order to critically appraise the quality of included studies, the review authors will be using the Cochrane Risk of Bias Tool [19] and the ROBINS-I (Risk Of Bias In Non-randomized Studies of Interventions) [21] for RCTs and non-randomized studies (quasi-randomized, cohort and case-control studies), respectively. These tools will provide a systematic approach to organize and present the available evidence relating to the risk of bias and quality assessment.

The Cochrane Collaboration's tool for assessing the risk of bias in randomized trials covers six important domains of biases: selection bias (random sequence generation and allocation concealment), performance bias, detection bias, attrition bias, reporting bias and other biases. Within each domain, assessments are made for one or more items, which may cover different aspects of the domain or different outcomes. The bias in each of the identified domains is given the following judgment labels: "low risk" if any bias that is present is unlikely to seriously alter the results; "high risk" if the bias may alter the results seriously; or "unclear risk" if the risk of bias raises some doubt on the results. The assessments will be reported along with descriptive justifications or a summary of the pertinent characteristics of the study being evaluated to show bases of such judgment.

The ROBINS-I tool, on the other hand, covers similar important domains of biases that can be attributed to non-randomized studies. The first two are bias due to confounding and bias in the selection of participants; both cover issues during the pre-intervention phase (baseline). The third domain at the intervention phase includes bias in the classification of interventions. The four domains pertinent in the post-intervention phase include biases due to deviations from intended interventions, missing data, measurement of outcomes and selection of the reported result. The judgment of bias risk in each domain, which, in turn, affects the overall risk of bias will be facilitated by answering the signaling questions with "Yes", "Probably Yes", "No", "Probably No", or "No Information". From these questions, the domain-level or the overall risk of bias can then be identified as "low risk", "moderate risk", serious risk", "critical risk", or if the needed information is not available, "no information". Studies that will reveal being at "critical risk" or "serious risk" of bias will be excluded from the analysis, while those studies with no clear indication of biases or lacking important information will be used with caution.

All review authors will perform the above-mentioned quality assessment measures. In particular, for studies with learning outcomes, two review authors (AS & JA) will independently assess the quality of

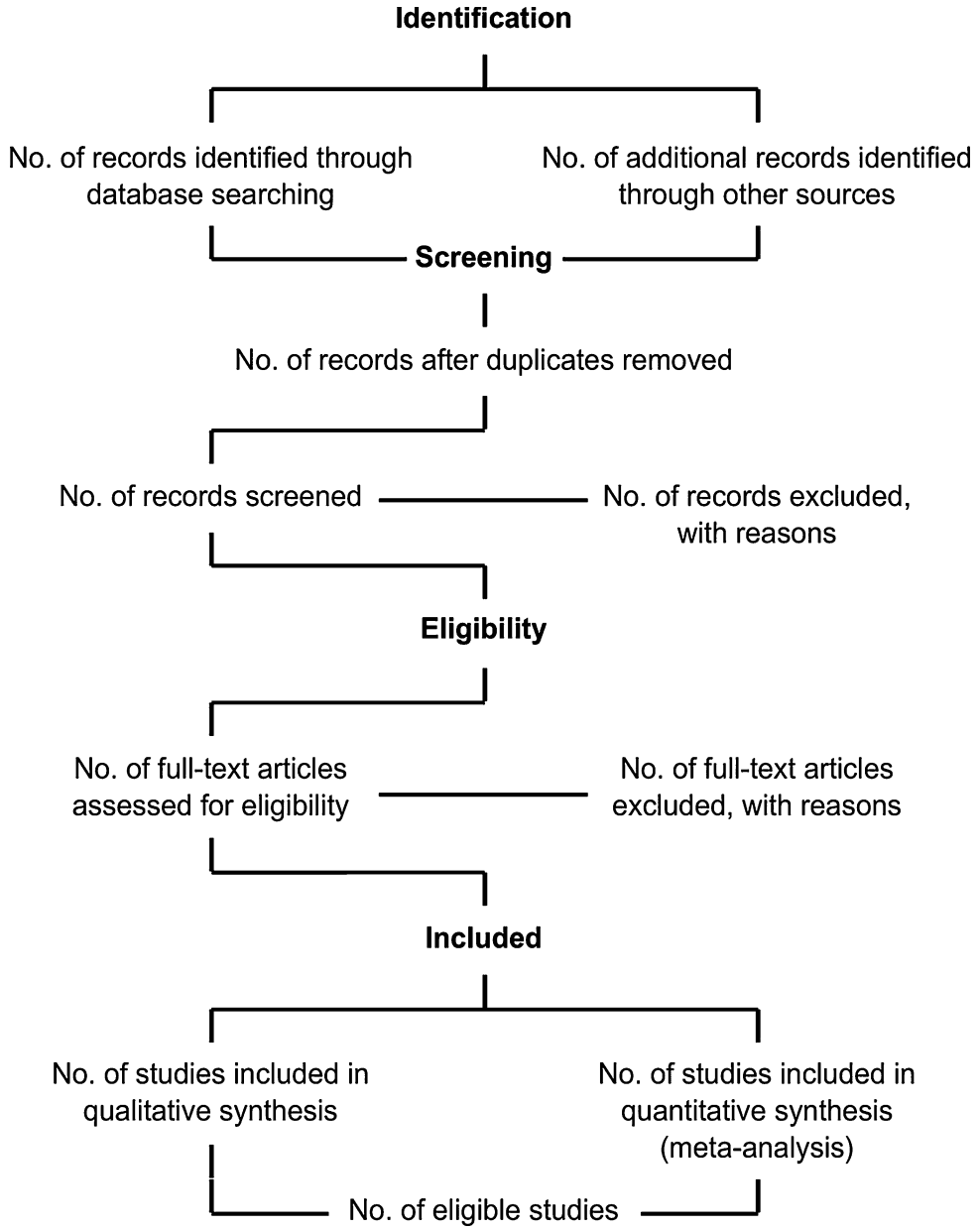

Figure 1. PRISMA flow diagram of study selection

included studies. The paralleled quality assessment methodology will be employed for studies with clinical outcome measures by two additional independent review authors (EP & AD). Any disagreements in the assessments will be resolved through discussions until a consensus is reached. Otherwise, a third party (JMG or AJG) will be consulted.

Data Extraction and Management

Data will be abstracted based on the following variables: first author, study location, time points or follow-up periods, study design, setting, types of participants, VAP definitions, comparators, confounders, eligibility criteria, descriptions of educational program including contents of the study module, isolated microorganisms, and learning and clinical outcome measurements.

Two of the review authors (AS & JA) will abstract the above-mentioned data from each individual report using a structured investigator-made data extraction form, which will be piloted prior to formal data extraction and management. Disagreements between data extractors will be resolved either through a group discussion or the mediation of a third party (JMG or AJG). The review authors will attempt to contact the corresponding authors of the included studies if there are insufficient data that require acquisition. During this period, all requests will be documented and included in the list of studies awaiting assignment.

Data Analysis and Synthesis

All relevant patient information, including the data on VAP incidence and microbial colonization, will be pooled using the following descriptive statistics: number, frequency, percentage, mean and standard deviation. These will be calculated and analyzed using the Statistical Package for Social Sciences software (SPSS, Inc, Armonk, NY) for Windows, version 21.0.

For the meta-analysis, the review authors will initially assess the method on how the studies in the analysis were sampled including the types of educational interventions in order to select an appropriate statistical model. If the studies are functionally identical or equivalent and share a common effect size, they will choose a fixed-effect model; otherwise, the random-effects model will be performed.

To compare the learning outcomes with binary data, they will specifically analyze the frequency or proportion of correct response (knowledge) and adherence to VAP prevention strategies using the difference of arcsines transformed proportions (AS) with 95% confidence interval (CI) for each study. Thereafter, pooled arcsines risk difference with 95%CI will be calculated using either binary fixed-effect inverse variance (IV) model or random-effects DerSimonian-Laird (DL) model as appropriate. For learning outcomes with continuous data, they will calculate the mean difference with 95%CI for each study and combine the effect size using either continuous fixed-effect IV model or random-effects DL model. The review authors will be using OpenMeta[Analyst] for Mac OS X version 0.1503 for the said types of meta-analyses. On the other hand, for clinical data (VAP incidence and mortality) with dichotomous outcomes, they will calculate risk ratios (RR) with 95%CI using either Mantel-Haenszel (M-H) fixed-effect model or random-effects model as applicable.

For data with continuous outcome measures (duration of mechanical ventilation, length of stay, antibiotics and hospitalization costs), the review authors will calculate the mean difference with 95%CI using either IV fixed-effect model or random-effects model as suitable. For these types of meta-analyses, they will be using the Review Manager (RevMan) Software (Copenhagen: Nordic Cochrane Centre, Cochrane Collaboration, 2014) for Mac OS X version 5.3.

The first author (JMG) and the other five review authors (AS, JA, AD, EPJ and AJG) will perform the meta-analysis with the former entering the data into the above-mentioned meta-analysis software packages, and the latter checking the data entry for each outcome measurement to ensure completeness and accuracy.

A predetermined alpha, which is set at $p < 0.05$, will be considered significant for all of the above-mentioned analyses. Figure 2 illustrates the planned decision-making algorithm for meta-analysis. In addition, the review authors will assess statistical heterogeneity, perform subgroup and sensitivity analyses, and evaluate publication bias using RevMan. To detect the heterogeneity between studies, they will be applying the Cochran's Q test or X^2 test with a p-value of <0.10 as the level of significance. The statistical heterogeneity will be quantified using the I^2 statistic for both learning and clinical outcomes.

In the present study, the review authors will be applying the recommended threshold of I^2 range values as described in the *Cochrane Handbook for Systematic Reviews of Interventions*.[19] The I^2 range values for not important, moderate, substantial and considerable heterogeneity are 0–40%, 30–60%, 50–90% and 75–100%, respectively. If considerable heterogeneity is present and if there is available data, they will investigate the possible differences between the studies and perform subgroup analysis by separating similar study designs, educational interventions, types of ICUs and VAP diagnostic criteria as necessary. Furthermore, they will perform sensitivity analyses by omitting outliers or low-quality evidence (studies with a high risk of bias).

Evidence of publication bias will also be visually investigated using funnel plots for asymmetry. To provide clear presentations and illustrations, the review authors will provide summaries of the findings of included studies using both narrative and tabular syntheses (or in figures as needed). However, if there are methodological issues and significant heterogeneity of samples, they will not perform a meta-analysis, but rather investigate individual study effect size with corresponding 95%CI in a forest plot without calculating the pooled estimates.

Summary of Findings

The principles of GRADE (Grading of Recommendations, Assessment, Development and Evaluation) system will be used as a guide element to assess the quality of cumulative evidence. [22] Two independent reviewers (JMG & AS) will

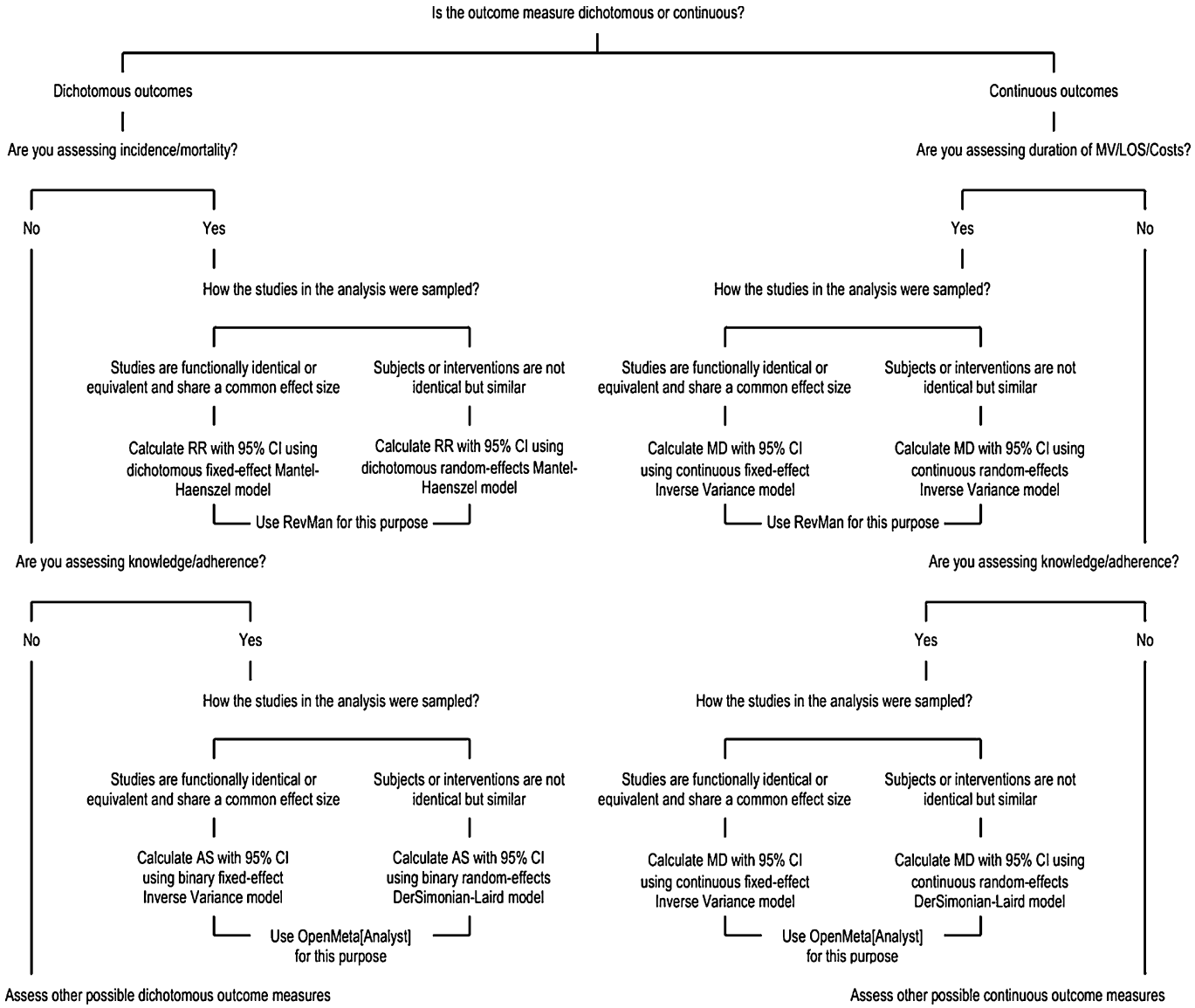

Figure 2. Meta-analysis decision-making algorithm
AS, arcsines risk difference; CI, confidence intervals; LOS, length of stay; MD, mean difference; MV, mechanical ventilation; RR, risk ratio; VAP, ventilator-associated pneumonia.

perform quality assessment measures, considering the risk of bias, inconsistency, indirectness, heterogeneity, imprecision and other considerations for the above-mentioned outcome measures. For each outcome measure, the quality of evidence will be categorized in one of the four levels of grades as recommended: high, moderate, low and very low. Subsequently, they will generate a GRADE evidence table to summarize the review findings. Any disagreements in the grade assignment will be settled through deliberations.

DISCUSSION

Despite being considered as one of the most preventable types of device-associated nosocomial infections, VAP remains to be a persistent global health concern. Fortunately, this condition can be reduced using a variety of VAP prevention strategies, including well-designed staff education programs. In fact, a number of educational interventions have been revealed to be effective in promoting positive learning and clinical outcomes in intensive and critical care settings. However, there are existing studies that have published conflicting results.

These variations between and among studies may preclude the adoption of an effective VAP educational intervention within intensive and critical care units. Hence, assessing the impact of this kind of intervention on clinicians' learning and patients' outcomes is critical to many areas of healthcare evaluation. This may further suggest the need for a

systematic review to establish the true effect of the intervention or the association between learning and clinical outcomes.

This current systematic review, therefore, will attempt to summarize the available evidence to address the discordant results between and among studies, and to determine whether or not the institution of educational interventions for VAP prevention is associated with positive outcomes in ICUs.

Insofar as the knowledge of the authors of the present review is concerned, no meta-analysis of association has been previously carried out or conducted on educational intervention for VAP prevention. Although one similar systematic review [10] was conducted, it only addressed research studies that were published between the years 2003 and 2012. Henceforth, an increasing number of similar individual studies have been published in the international body of literature, which warrants further investigation. This current review, therefore, intends to include as many related studies with no date and language restrictions as applicable, considering the unpublished data results, significant heterogeneity between studies and a range of other potential biases. For this reason, the review authors anticipate a number of educational interventions advocating multiple VAP prevention strategies for diverse critically ill populations. They also anticipate a variety of study designs, VAP definitions and patient outcomes. The foregoing relevant issues will be addressed using sound meta-analytic approaches as described above (Figure 2).

On the whole, in this current review, the authors suppose that the results will primarily address the varying and inconsistent approaches to educational interventions in most ICUs, which often lead to uncertainty in improving VAP prevention practices and infection control. Validation of the outcomes will definitely benefit the clinicians, and more importantly, the patients. Furthermore, the study is expected to generate baseline data that will serve as a reference to both ongoing and future clinical practice guidelines and the development of policies, which in turn will help improve healthcare in general.

Conflict of Interest

None declared.

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