

# Individualized PEEP for Laparoscopic and Robotic Surgery

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## Problem Statement & Purpose

- Post-operative pulmonary complications occur just as commonly as cardiac complications, cost more, and are associated with the longest length of hospital stay.
- Laparoscopic surgery has been established as the gold standard versus open surgery for many common procedures.
- The objective of this review is to explore methods of identifying individualized PEEP for laparoscopic surgical patients and to determine whether outcomes data show a change in postoperative pulmonary complications.

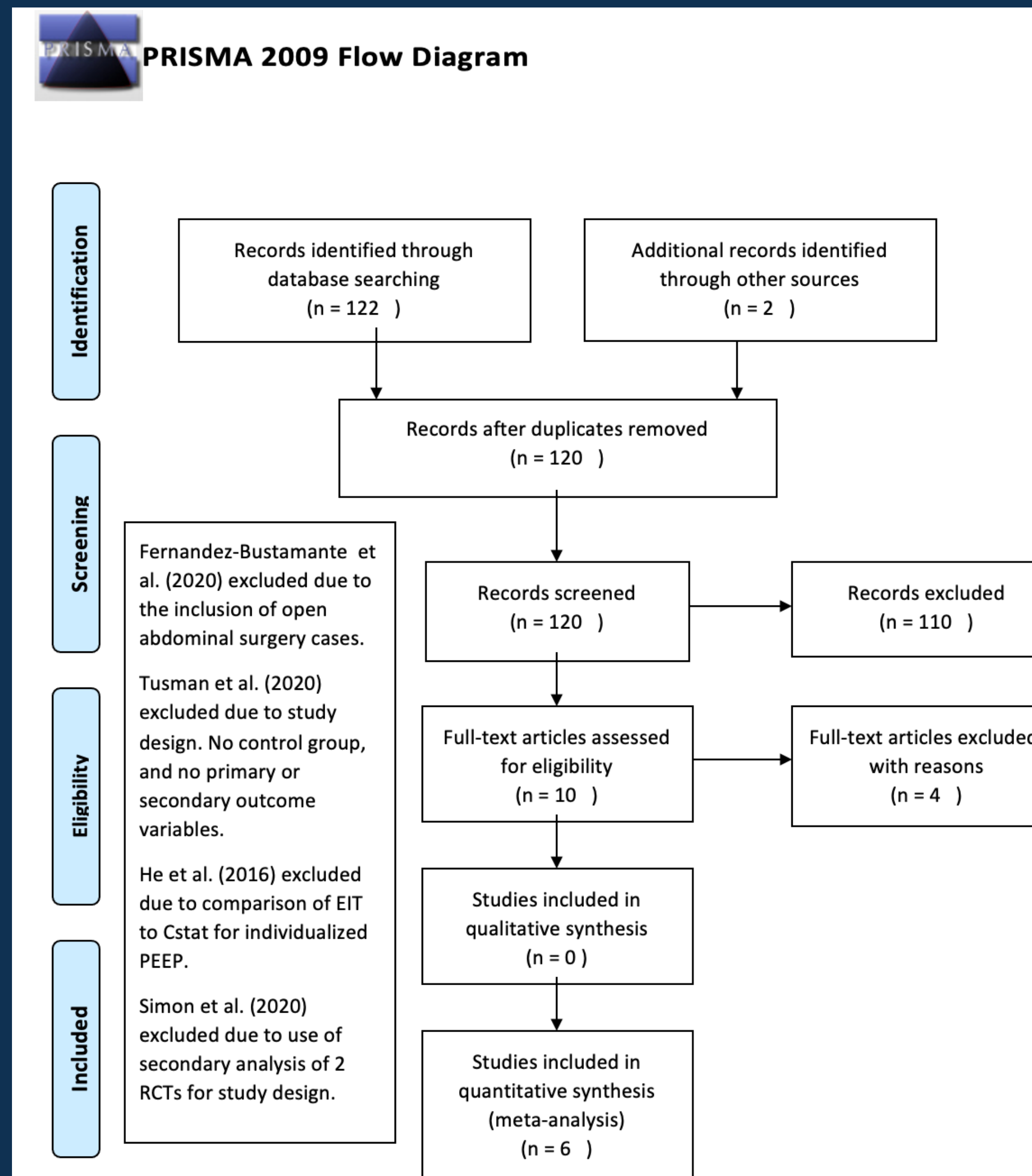
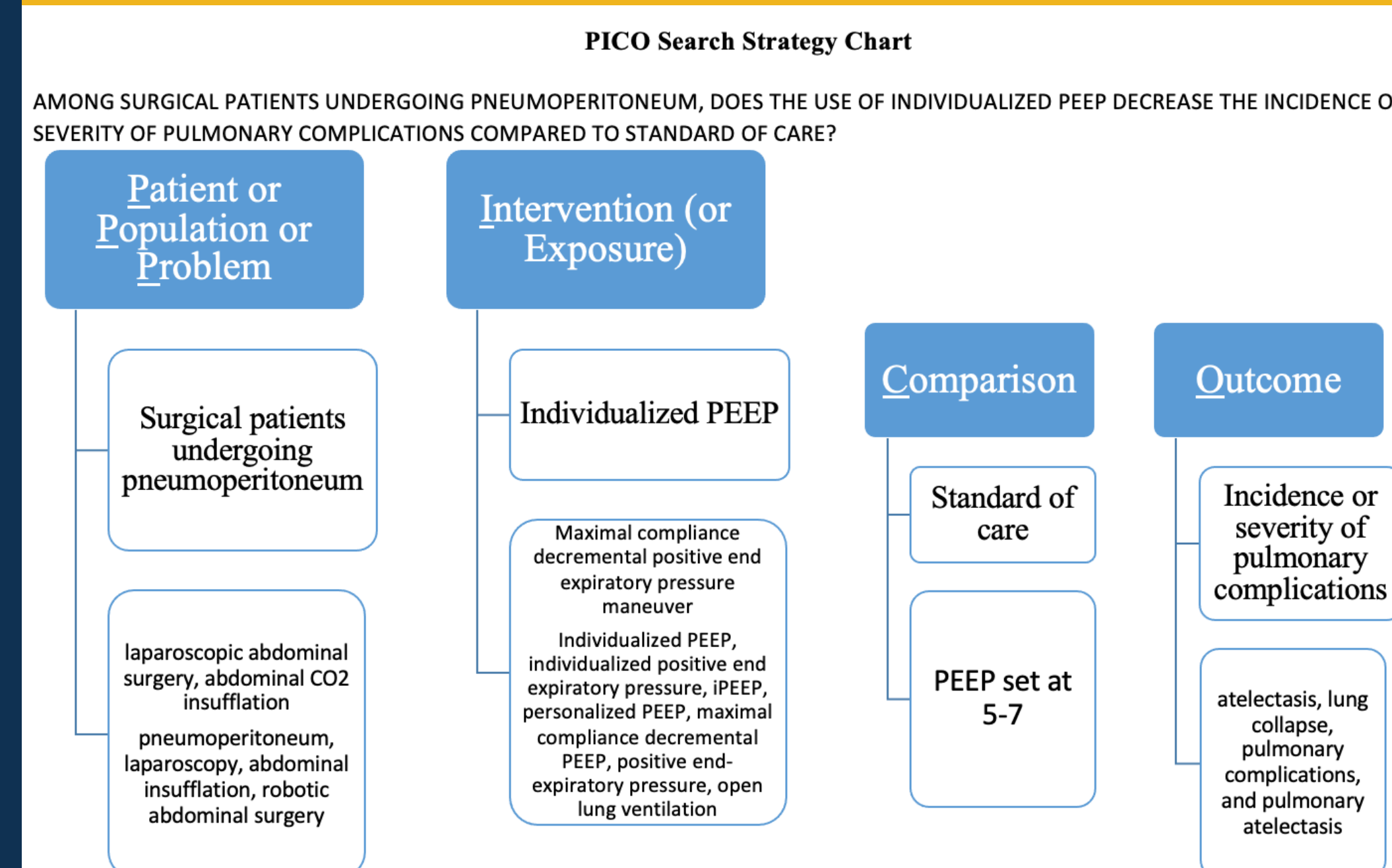
## Introduction

- Traditional ventilatory strategies comprised of high tidal volumes with low or no positive end expiratory pressure (PEEP) have been demonstrated to result in increased atelectasis, surfactant depletion, inflammation, edema, and fibrotic formations.
- Ideal individualized PEEP following recruitment maneuvers serves to maintain alveoli in the open state throughout the ventilatory cycle, thereby reducing atelectasis, cyclic recruitment-decrecruitment, and the accompanying inflammatory complications.

## Relevant Literature

- Providing physiologic tidal volumes with an arbitrary PEEP of 5-7 cm H<sub>2</sub>O has been shown to do little in preventing widespread atelectasis while the patient is undergoing abdominal CO<sub>2</sub> insufflation.
- The open lung approach utilizes recruitment maneuvers and appropriate levels of PEEP to achieve the desired tidal volume with a lower driving pressure.
- The cornerstone for application of the open lung approach is the point of maximal pulmonary compliance. PEEP and driving pressures lower than those achieving maximal compliance result in atelectasis, while pressures higher than this point risk alveolar overdistension, so-called volutrauma.
- Cyclic alevolar recruitment-derecruitment promotes surfactant depletion, contributing to atelectrauma.
- Open lung ventilation supports adequate patency of alveoli throughout the ventilatory cycle to reduce atelectrauma and surfactant depletion while preserving gas exchange.

## Search Strategy



## Results

### Electrical Impedance Tomography

- Girrbach et al. (2020):** EIT-iPEEP vs 5cmH<sub>2</sub>O improved PaO<sub>2</sub>:FiO<sub>2</sub> ratio, EELV, and driving pressure. Mean iPEEP = 14.7(3.3)cmH<sub>2</sub>O
- Nestler et al. (2017):** EIT-iPEEP vs 5cmH<sub>2</sub>O improved PaO<sub>2</sub>:FiO<sub>2</sub> ratio, EELV, and driving pressure in obese subjects. Mean iPEEP = 18.5(4.6)cmH<sub>2</sub>O
- Periera et al. (2018):** EIT-iPEEP vs 4cmH<sub>2</sub>O improved PaO<sub>2</sub>:FiO<sub>2</sub> ratio, driving pressure, and pulmonary collapse on CT. Mean iPEEP = 13.5(1.6)cmH<sub>2</sub>O

### Maximal Compliance

- Liu et al. (2020):** Max Cstat-iPEEP + Vt 7ml/kg IBW vs 0cmH<sub>2</sub>O + Vt 9ml/kg IBW improved PaO<sub>2</sub>:FiO<sub>2</sub> ratio and postop atelectasis
- Yoon et al. (2021):** Max Cdyn-iPEEP vs 7cmH<sub>2</sub>O improved intraop atelectasis but increased crystalloid and vasopressor use. Mean iPEEP = 14cmH<sub>2</sub>O

### Lung Ultrasound

- Elshazly et al. (2021):** Lung ultrasound-iPEEP vs 4cmH<sub>2</sub>O improved PaO<sub>2</sub>:FiO<sub>2</sub> ratio, dynamic compliance, and postop hypoxia in obese subjects, but lower MAP. Max iPEEP capped at 10cmH<sub>2</sub>O by authors

## Conclusion

- This systematic review identified intraoperative benefits to the use of individualized PEEP (improved PaO<sub>2</sub>:FiO<sub>2</sub> ratio, increased compliance, and reduced driving pressures).
- Among included studies, the mean ideal PEEP was around 14cmH<sub>2</sub>O for adult subjects; 18cmH<sub>2</sub>O for obese subjects; these values were highly variable and PEEP must be individualized
- Two studies found decreased rates of postoperative pulmonary atelectasis with iPEEP (Periera et al., 2018; Yoon et al., 2021)
- One study found decreased rates of postoperative hypoxia with iPEEP (Elshazly et al., 2021)
- The impetus for this systematic review was to determine whether postoperative pulmonary complications were impacted by individualization of PEEP.
- The body of evidence examined in this review does not consistently support an impact of individualized PEEP on postoperative pulmonary complications after the immediate post-operative period.

## Limitations

- The included studies were limited by sample size, a lack of blinding of investigators, and exclusion of esophageal manometry studies.
- Overall, a total of 324 participants were included in the studies.
- Larger studies would be of benefit to improve the power of future research and permit the detection of significant differences in outcomes.

## References

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