

# INPLASY

## Toward a Frontierless Collaboration in Neurosurgery: A Systematic Review of Remote Augmented and Virtual Reality Technologies

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### ADMINISTRATIVE INFORMATION

**Support** - None.

**Review Stage at time of this submission** - Completed but not published.

**Conflicts of interest** - None declared.

**INPLASY registration number:** INPLASY202420028

**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 06 February 2024 and was last updated on 06 February 2024.

## INTRODUCTION

**Review question / Objective** P: Patients undergoing neurosurgical procedures or unanimated models used for neurosurgery teaching. I: Use of Augmented, Virtual, or Extended Reality Technologies remotely between at least two surgical groups or teams. C: NA. O: Feasibility outcomes (e.g., cases performed successfully, utility assessment, and technical difficulties).

**Rationale** Augmented Reality (AR) and Virtual Reality (VR) technologies have been introduced to Neurosurgery with the goal of improving the experience of human visualization. In recent years, the application of remote AR and VR has opened new horizons for neurosurgical collaboration across diverse domains of education and patient treatment. Herein, we aimed to systematically review the literature about the feasibility of this technology and discuss the technical aspects, current limitations, and future perspectives.

**Condition being studied** Recent developments have reported the use of AR and VR in a remote fashion to expand the outreach and shareability of visualization at local, national, and international levels. Thus, representing boundless possibilities for seamless partnership. However, the feasibility and technical details of this transformative technology have yet to be well-defined. Herein, we performed a systematic review of the literature to explore the remote applications of AR and VR in Neurosurgery with an emphasis on the technical details, utility, limitations, and future perspectives for global scaling.

## METHODS

**Search strategy** ("remote\*" OR "tele\*") AND ("virtual reality" OR "VR" OR "augmented reality" OR "AR") AND ("neurosurgery" OR "spine surgery").

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**Participant or population** Patients undergoing neurosurgical procedures or unanimated models used for neurosurgery teaching.

**Intervention** Use of Augmented, Virtual, or Extended Reality Technologies remotely between at least two surgical groups or teams.

**Comparator** Not applicable.

**Study designs to be included** Observational.

**Eligibility criteria** We included observational studies published in English evaluating the remote use of AR and VR in Neurosurgery. A remote collaboration was defined as a real-time interaction performed in different environments in the same clinical facility, at different hospitals in the same country, or at institutions in distinct countries.

**Information sources** PubMed, Embase, Scopus, and Cochrane Library.

**Main outcome(s)** Technical outcomes and limitations (subjective report, number of cases performed, accuracy, audiovisual latency).

**Quality assessment / Risk of bias analysis** The quality and risk of bias assessment of studies were assessed using the modified version of the Newcastle-Ottawa Scale by Murad et al. Murad MH, Sultan S, Haffar S, Bazerbachi F. Methodological quality and synthesis of case series and case reports. *BMJ Evidence-Based Medicine*. 2018;23(2):60-63. doi:10.1136/bmjebm-2017-110853.

**Strategy of data synthesis** Data is synthesized as counts and proportions.

**Subgroup analysis** NA.

**Sensitivity analysis** NA.

**Language restriction** English.

**Country(ies) involved** Peru, United States, Egypt, and Bolivia.

**Keywords** Telepresence; Telesurgery; Virtual Reality; Augmented reality; Extended reality; Neurosurgery; Spine Surgery.

#### **Contributions of each author**

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