



Mixed Reality in Surgery – a Delphi study

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Abstract

Virtual Reality, Augmented Reality and Mixed Reality all have useful applications in the field of medicine, but Mixed reality has great potential because it allows for interaction with both real and digital Objects.

Based on a previous literature review, a preliminary Delphi study was performed to obtain the opinion of a panel of 22 experts from several hospitals on the use of Mixed Reality tools, such as the HoLoLens 2, in surgeries.

After data collection, a consensus letter was signed. According to experts, the most useful areas are medical education and surgical planning.

1 Introduction

Mixed reality (MR) was first mentioned in 1994 by Paul Milgram, and is a blend of physical and digital worlds, unlocking the links between human, computer, and environment interaction and allows clinicians to do something that was previously unthinkable: be in two places at once.

MR allows the user to see virtual and physical objects in the same space and to be able to interact with them without the requirement of touching screens (Teatini, Kumar, Elle, & Wiig, 2021).

Recent research has shown that with the use of advanced technological solutions such as MR, the spaces of the operating rooms tend to decrease and the number of professionals present during a surgery too (Joseph & Allison, 2018), improving the efficiency in the use of resources in a hospital, whether they are human, of space, or technicians and materials and offering surgeons new preoperative planning tools, and a means to collaborate and share expertise across the globe. MR is also used to increase accuracy in some procedures, allowing “hands-free” access, through a virtual environment, to images and pathological results.

Microsoft HoloLens 2 is a MR headset. This tool incorporates a camera and a microphone, which allow visual communication and bidirectional audio between the user of the device and remote users. Therefore, the HoloLens 2 might be used by the healthcare provider as they interact with the patients,

meanwhile the rest of the team watches the healthcare provider's perspective on a computer, allowing remote communication (Levy, et al., 2021).

Between January and February 2021, a consecutive case series of 13 orthopedic surgeries were performed. These were performed by different surgical teams, 15 surgeons, across 13 different countries. Surgeons were able to view holographic images during surgery, share their vision of surgery in real time, drawing on the experience of colleagues from different clinical cases, and train professionals remotely, enriching the practice surgical (Gregory, Gregory, Dacheux, & Hurst, 2022).

The power of MR is very vast: streamline and accelerate processes (training an education), reduce errors, and rework and mitigate issue, ensure operation continuity, protect worker health and safety, better attract, hire, and retain employees and improve bottom and top line business results (Microsoft, 2021).

2 Methods

Based on a previous literature review that allowed identify the existing problems in an operating room, a preliminary Delphi study was performed to obtain the opinion of a panel of experts on the use of MR tools, such as the HoLoLens 2, in surgeries as well as to identify requirements and functionalities that may be developed or applied in the future to improve their experience and patients' outcomes.

The Delphi technique is a structured process to gather the knowledge of an expert group, with the goal of reaching consensus on a certain topic (Heed, et al., 2022). Online Delphi technique needs Internet access and is used in health informatics and healthcare research, since it allows to remotely assemble the opinions of experts located in different regions (Heed, et al., 2022) (Kaufman, et al., 2018).

Microsoft Forms was used in the present Delphi study and is a free tool, available for Office 365 users allowing the export of the participants' answers to Microsoft Excel making easier to analyse the results.

This study had the participation of 22 specialists (surgeons, nurses, and anesthesiologists) from several hospitals. In the first round, 13 specialists responded to the survey, 12 responded to the second and 13 to the third.

This Delphi study has three rounds: two of questions, and the third is a consensus letter, which contains the answers with the most agreement among the experts. Both the first and second rounds have initial questions to characterise the healthcare professionals.

3 Results

The first round of the Delphi study intent to identify the main problems in the operating room and figuring out ways in which technology might help solve these problems and was divided into multiple-choice and open-ended questions. 13 of the 22 experts respond to this round.

The communication between the team members, the team's level of experience, equipment failures, the interaction between the team, the machines and the equipment, and team stress management were the main issues appoint to surgery scenario. Technology can help solve these problems according to the experts that have also agreed that the maintenance of the equipment could be beneficial, as well as easier access to patient information.

The second round had the goal to identify the benefits of technology in the operating room, whereas the other section's aim was to explore the experts' opinion on a mixed reality tool (Microsoft HoloLens 2). 12 of the 22 experts respond to this round.

The experts agreed that it would be useful to transmit surgeries in real time and record it for educational purposes (from the surgeon's point of view), as well as remotely consult another healthcare professionals during the surgeries. Technology could also be helpful in the surgical planning, making it a more interactive process, and the patient's diagnosis, by being able to use 3D CAT or MRI images of the patient (instead of the usual 2D). Finally, technology could enable surgeons with less experience to have the collaboration of another professional during surgery and improve surgical precision.

On the third round 13 responses were found out of a total of 22 respondents. All participants (100%) globally signed the consensus letter which emphasize that consensus was reached. According to experts, the areas where these tools could be most useful are in medical education and surgical planning.

4 Conclusion

This article has focused on the elaboration of a Delphi study to evaluate the use of MR tools (particularly the Microsoft HoloLens 2) in the operating room context. These results reinforce the results of the studies included in our previous literature review.

As a future work, a scenario for surgeons and a scenario for nurses will be designed using HoLoLens2 that include some of the functionalities identified by the specialists in the present study and then applied in the context of the operating room. After its use in a simulation environment, a questionnaire of the usability of the tool will be presented to these professionals to assess the impacts of using these tools in performing surgeries.

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