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Background & Aim

- In clinical practice, as in health-technology assessment (HTA), medical devices have additional challenges compared to pharmaceuticals, one of these is the learning curve.
- The effectiveness of most medical devices depends on the skill of the clinician, in:
 - Setting up equipment,
 - Interpreting a monitor,
 - Placing the device,
 - Or handling the device.
- The correct use of medical devices in real-world practice is paramount to both obtaining the clinical effectiveness demonstrated in studies and ensuring patient safety.
- Training on medical devices is a critical aspect of healthcare provision. Providing such training relies on qualified training staff, training materials and location, time off work, and, in certain cases, a certification process.
- Optimizing the training of healthcare providers could result in better use of medical devices, improved patient outcomes, and lower resource drain on hospitals.
- The aim of this work was to assess the use of virtual reality (VR) for training healthcare professionals on correct setup of an extracorporeal membrane oxygenation (ECMO) machine.

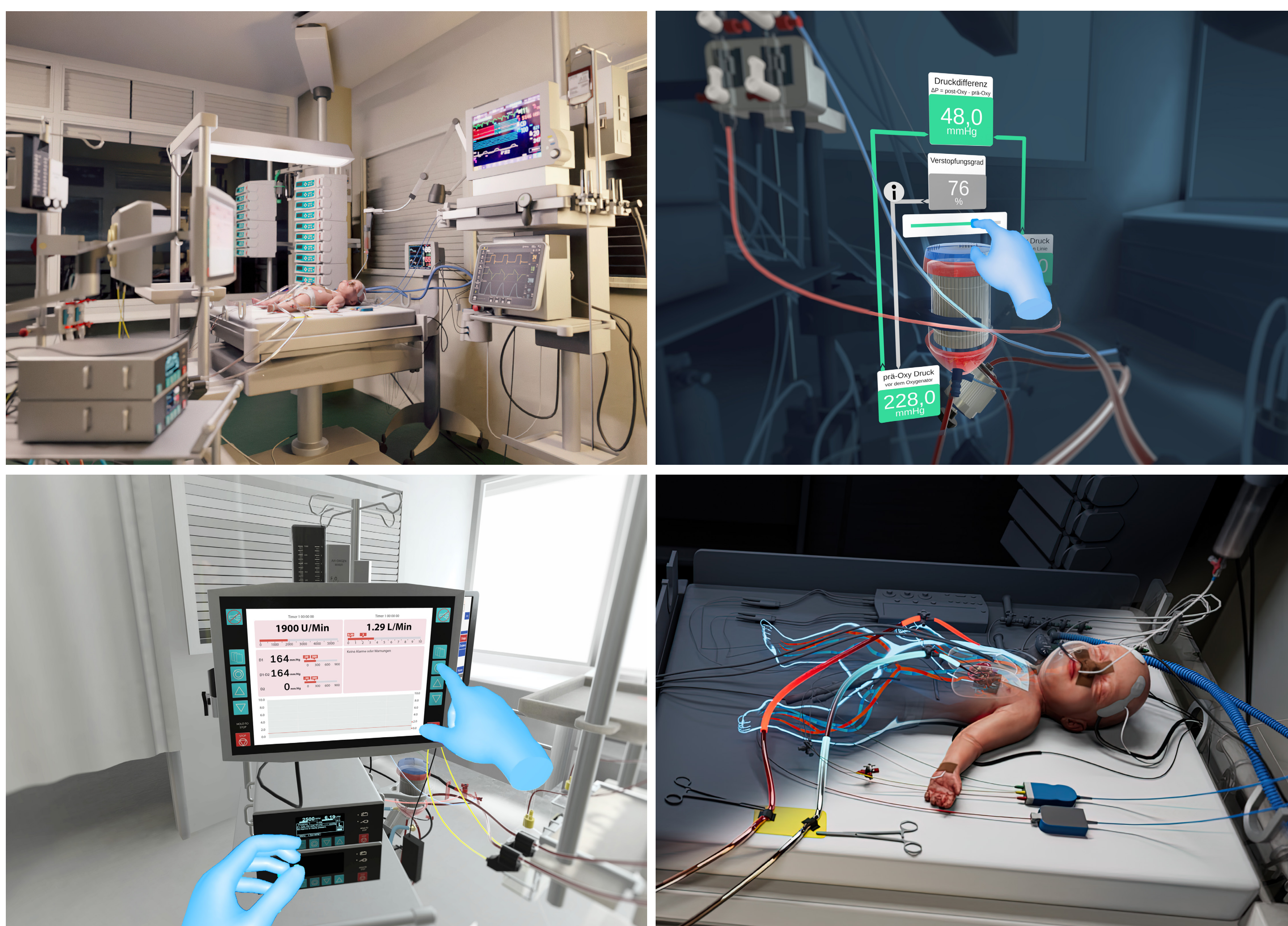


Figure 1 Examples from the VR training.

Table 1 Search string construction

Target	String	Publications
Virtual reality	"augmented reality"[TI] OR "virtual reality"[TI]	11,110
Training	training[tiab] OR education[tiab] AND "Educational Measurement"[Mesh] OR "education, professional"[MeSH]	358,973
Medical	healthcare[tiab] OR hospital[tiab] OR nurse[tiab] OR physician[tiab] OR surgeon[tiab] OR instructor[tiab] OR patient[tiab]	4,305,285
Timeframe	2015/01/01:2023/06/30[dp]	11,285,343
Combined	("augmented reality"[TI] OR "virtual reality"[TI]) AND (training[tiab] OR education[tiab]) AND (healthcare[tiab] OR hospital[tiab] OR nurse[tiab] OR physician[tiab] OR surgeon[tiab] OR instructor[tiab] OR patient[tiab]) AND ("Educational Measurement"[Mesh] OR "education, professional"[MeSH]) AND 2015/01/01:2023/06/30[dp]	196

METHODS

- We undertook a narrative review of VR for training in the healthcare setting to supplement the initial outcomes of a proof-of-concept study investigating the use of VR training for ECMO.
- Literature review in PubMed for articles published between January 2015 and June 2023 using key terms (Table 1).
- A German cardiac center provided the environment for proof-of-concept study.
- The training aimed to avoid errors in setup of the department's ECMO machine.
- After photographing the ECMO room and equipment, the location was recreated in VR (Figure 1).
- Each element of the ECMO machine was individually modeled to allow for training actions to be applied to the element.
- Training actions included identifying, moving, placing, or adjusting settings on the element.
- Clinical and training staff were included in the design of the VR training and the training topics covered.
- Interviews with healthcare staff were undertaken to assess the impact and usefulness of VR training.

Conclusion

- Moving medical device training to a VR environment is possible and may reduce, but not eliminate, hands-on training time.
- In this example, it resulted in a reduction in staff training time and fewer errors in device setup.
- Whether outcomes are reproducible across different devices remains to be answered.

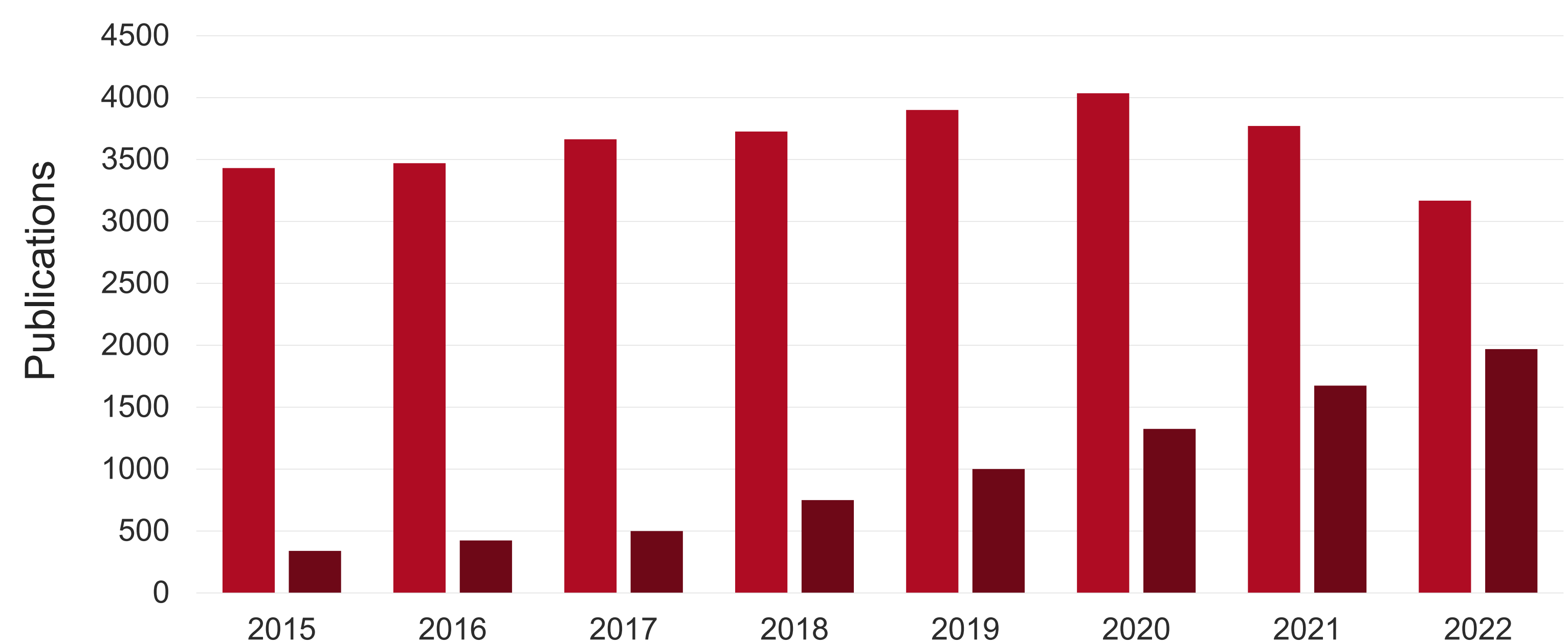


Figure 2 Publications identified for ■ Medical training ((training[tiab] OR education[tiab] AND (healthcare[tiab] OR hospital[tiab] OR nurse[tiab] OR physician[tiab] OR surgeon[tiab] OR instructor[tiab] OR patient[tiab]) AND ("Educational Measurement"[Mesh] OR "education, professional"[MeSH]) AND 2015/01/01:2023/06/30[dp]) and ■ VR (("augmented reality"[TI] OR "virtual reality"[TI]) AND 2015/01/01:2023/06/30[dp]) per year for the last 7 years

RESULTS

- The search returned 196 articles (Table 1), of which 149 remained after screening.
- An increasing interest in VR was identified over that last seven years (Figure 2).
- Common benefits reported in research and review articles of VR training were:
 - Effectiveness, mostly in terms of trainee recall.
 - Motivation, with the VR environment encouraging continued learning and progression.
 - Engagement, whereby interaction with the VR environment kept the trainee focused on the learning targets.
- Tactile feedback, such as required for device handling, was the main topic identified as better performed in traditional training environments.
- For the developed VR training for ECMO setup, feedback was positive from both the clinical and education teams.
- The VR training did not completely replace traditional, in-person training.
 - Educators reported that training time for ECMO was reduced by 25%, from four days to three days.
- The clinical team noted fewer errors in the ECMO set-up after VR-training roll out.

DISCUSSION

- VR training cannot, and likely should not, replace all face-to-face and hands-on training.
- Our findings follow those of other studies, with VR training increasing knowledge and reducing errors.
 - Hands on training for tactile techniques, e.g. how to connect parts of a machine together or how much pressure to apply to a wound, is required.
- Recall can be extremely important in clinical practice, and here we show that better knowledge of ECMO can reduce errors in the setup of the ECMO machine.
 - Hospital management reported that each error led to costs of circa EUR 4,000 for wasted single-use supplies.
- Other areas likely to benefit from VR training include situational awareness and decision-making. Areas that we aim to explore in future studies.

Acknowledgements

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Disclosure

RS is the owner of Coreva Scientific GmbH & Co KG.