Q-VMedSim: A Training Platform for Emergency Response Procedures through Virtual Reality and AI Assistance

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***Abstract*— Medical training requires hands-on experience with high-risk scenarios, yet traditional simulation methods are costly and logistically challenging. This work-in-progress presents an AI-assisted Virtual Medical Simulator (VMS) designed to enhance emergency procedure training for medical practitioners through immersive VR (Virtual Reality) technology. Built using Unity and C#, the platform replicates a realistic hospital emergency room with high-fidelity 3D models created in Blender and Polycam. The simulation room features interactive components, including a Zoll defibrillator machine, a mannequin on a stretcher, and a sanitization station, providing an authentic environment for practicing emergency interventions. Advanced C# scripting ensures real-time response to user interactions, while RESTful API integration facilitates seamless emergency workflow execution. The platform effectively enhances spatial understanding and equipment familiarity, with users showing significant improvements in operational confidence and procedural accuracy compared to traditional training methods. To enhance procedural training, the system incorporates an AI-powered virtual medical assistant, utilizing OpenAI's API for context-aware natural language guidance. A MongoDB-backed analytics system tracks user performance, providing real-time insights and adaptive feedback for competency assessment. This research aims to explore the intersection of VR, AI-driven procedural training, and real-time assessment to create a scalable, cost-effective, and immersive learning tool for medical professionals. The project invites discussions on enhancing AI-driven medical training, refining real-time analytics, and expanding cross-platform accessibility. By presenting this work, we seek collaborative insights on optimizing AI interactions, improving procedural workflows, and exploring integrations with existing healthcare training systems.**

***Keywords*— Simulation, Virtual Reality, Trauma Room Training, Immersive Learning, Emergency Response, Artificial Intelligence**

I. Introduction

Virtual Reality is a powerful technology that has been in constant evolution and implementation since the early 2000s. Early stereoscopic viewers and optical devices were developed in the 19th century [8], and VR's application in healthcare has proven particularly helpful in various aspects, including cost and training frequency. Practicing traditional medical procedures has always been a bother due to limited exposure, uneven clinical experience among students, constrained opportunities for practicing procedures, stress & performance pressure. Following these challenges, medical simulation came into the picture where training methodology recreates real-world medical scenarios and experiences in controlled environments. Imagine the consequences of throwing new doctors into complex medical situations with real lives at stake. It might sound far-fetched, but inadequate medical training can be just as dangerous. This risk was the initial motivation for our study. The medical education community progressed from simple mannequins to advanced technological solutions, transitioning from practicing on basic dolls to immersive virtual operating rooms where trainees can interact with realistic scenarios and observe real-time responses to their actions. They can make mistakes safely, learn from them, and build confidence. This could be thought of as a pilot using a flight simulator - by the time they fly a real plane, they have already handled most of the emergency scenarios in a safe environment. It has given medical practitioners more time to develop the skills that are critical in healthcare.

Medical simulation is an exorbitant endeavor and thus is out of reach for many institutions. The expensive nature of such simulations may vary from $55,000 and up to $250,000 for a human patient simulator that reflects, to a high level of realism, actual patient care [8]. This limitation has created a significant gap in training quality between well-funded and resource-constrained medical facilities.

A typical healthcare simulation incorporates physical, computer-based, and hybrid approaches, utilizing anatomical models and mannequins for practicing procedures. Digital case studies and scenarios are integrated with these physical models and computer interfaces to create a comprehensive training environment. In our study, we take a different approach. Using Unity and C#, with 3D models created in Polycam [2] and Blender [3], our platform recreates a realistic emergency room environment where trainees and practitioners can practice critical procedures. Our system is unique in that it provides an intelligent guidance system, including real-time instruction and feedback during training sessions, combined with automated assessment capabilities. By keeping the cost less than $5,000,

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this platform makes advanced simulation training accessible to medical schools and hospitals that previously couldn't afford it.

Our work can potentially improve medical education in rural areas and developing countries. A small medical school in a remote location could now offer its students the same quality of procedural training as major teaching hospitals. The system's ability to provide consistent instruction and immediate feedback means students can practice independently, developing competence before working with real patients. Further, emergency response teams in resource-limited settings could maintain regular practice schedules. The platform's design allows for easy updates and additions to training scenarios, ensuring it can evolve with changing medical practices and needs.

The main theme of our system is a virtual recreation of a medical SIM (Simulation) room, modeled after the physical training environments commonly used in medical education. Our virtual SIM room brings together realistic graphics with real-time instructions to guide students through emergency procedures. We designed the virtual environment for visual and functional consistency with real-world medical training facilities, ensuring that spatial relationships and equipment placement match what students would encounter in actual practice environments. Our research demonstrates that this spatial learning advantage represents one of the most significant benefits of VR-based medical training, potentially reducing the learning curve for critical emergency equipment operation. The required medical equipment in virtual space is created from scans of real-world equipment. This includes the hand-washing station and the Zoll defibrillator, a sophisticated monitor/defibrillator system that delivers high-quality CPR and defibrillation during cardiac arrest emergencies. Each element responds to the users' actions with realistic feedback. To ensure smooth transition and authenticity, we designed the defibrillator so that it displays proper heart rhythms and energy levels and even produces accurate machine sounds during use. Our approach to this work combines several technologies (such as VR, AI, and robust server architecture) to find the solution that offers an optimal experience and gathers relevant data for assessment and further improvement. With this tool, medical students and staff can practice a variety of complex procedures several times before getting into the real world with real patients.

II. Related Works

This section will review research works to analyze and investigate the domain of VR. The purpose is to identify gaps and summarize the current state of virtual reality simulation in medicine.

A. Use of Virtual Reality as a learning platform

Virtual reality can be a learning medium that engages users and promotes interaction during the learning process. VR captures students' attention as it may be more effective than traditional learning environments, which often offer monotonous classroom experiences. Medical training demands extensive practical training and hands-on learning, aligning with what VR offers - the ability to see in 360° and interact in all directions. A study was conducted involving 86 first-year nursing students at the Department of Nursing, Faculty of Health Sciences, Central Anatolia in Turkey [10]. The students were divided into two groups, receiving material related to suctioning a tracheostomy tube and peristomal skin care. The first group received a conventional explanation, while the second group used a game-based virtual reality application as a learning medium. The test results from these two learning models indicated that the game-based virtual reality group achieved significantly higher scores than the students taught with conventional learning methods [10]. VR fosters creativity and generates ideas that excite students or learners, encouraging active participation and interest in learning while prompting a desire for more knowledge. Even during challenging times like the COVID-19 pandemic, when it was nearly impossible for early-stage medical practitioners to train in person, VR medical platforms proved exceptionally useful. The application of virtual reality during the COVID-19 pandemic also established effective occupational health and safety education systems for healthcare workers [9]. Despite VR being a powerful and helpful tool, it's crucial to consider its potential side effects, such as safety concerns, visual aberration, eye strain, and social isolation. Users should, therefore, use VR headsets wisely.

B. Advancement in Medical Simulation

Simulation is an educational technique that creates situations replicating real life, allowing learners to act as they would in actual scenarios, followed by performance feedback and debriefing. The most advantageous aspect of VR is its reusability - it can be utilized repeatedly without damaging objects since they exist only virtually. Even medical equipment that is inaccessible in the real world can be crafted and employed in VR for educational purposes. Studies indicate that virtual reality enhances creative design ability in students by 5.89, and design ability improves by 5.71 compared to not using virtual reality [9]. The evolution of medical simulation technologies has shown significant progression in recent years. Pottle [7] highlights that while traditional simulation is becoming central to healthcare education, it requires significantly more resources than conventional educational methods. As healthcare systems and educational institutions worldwide grapple with increasing demand and limited budgets, these additional resources pose considerable challenges. VR technology effectively addresses these constraints by providing simulation capabilities with reduced infrastructure requirements while maintaining educational efficiency. Pottle's work [7] further identifies VR's unique ability to create an immersive environment that surpasses other technologies in convincing users they are in a different setting. This exceptional level of immersion promotes experiential learning that closely resembles real-life scenarios. The concept of "presence" – the sensation of genuinely being in the virtual environment – enhances memory encoding and knowledge retention in ways that traditional educational modalities cannot achieve. As VR technology continues to advance, its role in medical simulation will likely expand further, potentially transforming how healthcare professionals develop and maintain critical skills throughout their careers.

C. Transformation: Medical Simulation and Tactile Feedback

The evolution from traditional medical training to virtual reality simulation has increasingly recognized the importance of tactile feedback in creating comprehensive learning environments. While our Q-VMedSim platform currently focuses on visual and auditory components of emergency response training, understanding the role of touch in medical procedures provides important context for future development directions. Medical procedures, particularly those involving Zoll defibrillator operation and emergency response, often require precise physical interaction. Escobar-Castillejos et al. [4] emphasize, medical professionals require extensive preparation to perform procedures correctly, with research indicating that substantial repetition is necessary to acquire sufficient procedural expertise. Artificial Intelligence capabilities within medical simulations have transformed training methodologies by enabling adaptive and personalized learning experiences. A recent systematic review by Dai and Ke [5] identified three significant trends: AI-powered virtual agents serving as procedural guides, affective computing systems that analyze learner emotional states, and automated assessment mechanisms providing real-time feedback. Particularly valuable in emergency medicine training is the ability of AI systems to provide consistent guidance while adapting to individual learning needs through real-time adjustments to scenario complexity. As Chen et al. [6] noted, this capability addresses the variable proficiency levels across different procedural components that learners typically exhibit, enabling more targeted and effective skills development in simulation-based medical training.

The integration of tactile feedback with virtual reality medical simulators represents a significant advancement in training methodologies that could enhance platforms like Q-VMedSim. Such feedback allows users to interact more naturally with virtual environments by simulating the physical resistance and texture of medical equipment. In emergency medicine simulation, this could mean faithfully reproducing the sensation of electrode placement on skin or the tactile feedback of defibrillator button presses. Pottle [7] observes that the standardization and scoring possible with VR simulations enhanced with tactile feedback will make these systems increasingly valuable for assessment and recruitment. Of relevance to our work is the potential for multi-user VR with tactile components, which could allow for collaborative learning in real-time clinical scenarios. As we continue development of the Q-VMedSim platform, incorporating appropriate tactile feedback represents a natural evolution that would further bridge the gap between simulation and real-world emergency response scenarios.

III. Our Contribution

In developing Q-VMedSim, we sought to create an environment that truly captures the essence of an emergency room while maintaining a focus on critical life-saving procedures. The core of this platform lies in its attention to detail - every element has been carefully considered to ensure that medical students feel immersed in a realistic training environment.

Figure 1 shows how, when users first enter the platform, they're greeted by an intuitive welcome interface that helps them transition into a virtual space. The SIM room itself is where the tasks happen. We calibrated the lighting, textures, and spatial layout to accurately mirror what medical practitioners encounter in real training facilities. The ambient lighting was designed to ensure clear visibility of crucial medical equipment and patient indicators, matching the conditions in emergency rooms. This attention to environmental detail helps trainees develop visual recognition skills that transfer directly to real-world emergencies. The room's equipment goes beyond just the defibrillator. We've included essential elements like the hand-washing station and sanitizer stand, reinforcing proper protocol and infection control procedures. The mannequin on the stretcher serves as the focal point for various procedures, positioned to allow natural interaction and clear visibility of vital signs and responses. Each interactive element in the simulation has been designed with a purpose. When users reach for the oximeter or adjust the defibrillator settings, the responses are immediate and realistic. This instant feedback is crucial for building muscle memory and procedural confidence. The sounds, from the beeping of monitors to the charging of the defibrillator, create an auditory environment that ideally matches what practitioners experience in real emergencies.

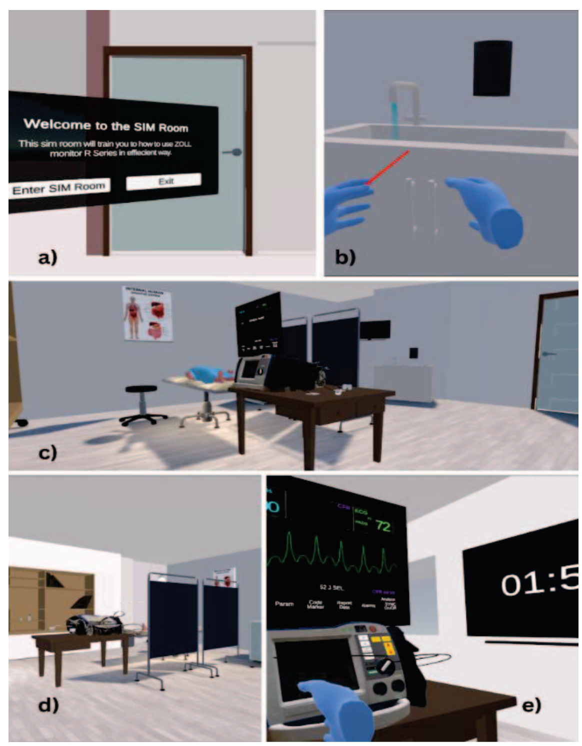

Fig. 1. Q-VMedSim Virtual Environment. a) Welcome interface with instructions for accessing the simulation room. (b) Hand-washing station with interactive water controls. (c) Overview of the medical simulation room with equipment and training materials. (d) Procedural training area. (e) Interactive Zoll defibrillator and timer interface.

Much of our development efforts are focused on creating high-fidelity 3D models that accurately represent medical equipment. Rather than using generic or simplified models, we captured actual medical equipment using the Polycam application, allowing us to digitize real-world objects with exceptional detail. The 3D objects like the Zoll defibrillator, SIM room and other elements were captured in person through Polycam from real-life SIM rooms and then refined using Blender before implementation in Unity. This approach required considerable time learning about capturing high-quality 3D models, but the investment resulted in unprecedented realism. Another feature of our platform is a digital clock replicating real time. While seemingly simple, this feature is often overlooked in VR platforms despite its importance in emergency scenarios where time tracking is critical. This allows trainees to develop a realistic sense of procedure duration without breaking immersion to check external timepieces.

A. *Zoll Defibrillator Implementation*

The merit of our platform lies in the detailed recreation of the Zoll defibrillator machine. Every button, display, and interaction point has been meticulously modeled to match its real-world counterpart as shown in Figure 2. Users can connect pads to the mannequin, adjust energy levels, and even hear the authentic machine sounds that play a crucial role in timing during resuscitation attempts. The rhythms displayed on Zoll's screen accurately represent various cardiac conditions, including every critical pattern rhythm, allowing students to develop pattern recognition skills essential for quick decision-making in emergencies.

Fig. 2. Zoll Defibrillator a. Captured image of Zoll Defibrillator b. VR rendition of Zoll Defibrillator

The Zoll defibrillator interface features comprehensive interactions across all its components. The top display area includes SpO2 monitoring, a time display that runs from the start to the end of use, ECG waveform visualization, and vital signs values. The right-side controls include energy select buttons, analyze and charge buttons, output and rate control knobs. The left side features LEAD selection, SIZE adjustment, ALARM SUSPEND and RECORDER buttons. For effective VR interaction, we designed the knobs to support natural rotation gestures, implemented clear press/release states for buttons, and ensured the screen remains readable from normal viewing distances. The shock control requires deliberate interaction for safety training purposes, while elements like the alarm suspend button provide clear visual and audio feedback. We've incorporated a unique screen enlargement feature for the Zoll display, addressing a real-world limitation as shown in Figure 1. The actual Zoll screens can be small and difficult to read, especially under stress. Our VR platform allows users to enlarge the display when needed, improving readability without sacrificing realism - a distinct advantage of virtual training over physical simulation.

B. *AI-Assisted Learning Integration*

Beyond the physical environment simulation, we've also implemented an AI-assisted chatbot system that provides contextual guidance throughout the training experience. This assistant serves multiple functions, guiding users on VR headset and controller usage (particularly valuable for medical professionals unfamiliar with VR technology), providing procedural guidance during simulations, offering real-time feedback on technique and decision-making, and answering questions about equipment and procedures without breaking immersion. For the AI-assisted chatbot integration, we implemented a straightforward yet effective approach using OpenAI's API. Rather than developing complex model architecture from scratch, we leveraged the robust capabilities of OpenAI's existing models, which allowed us to focus our efforts on proper training and integration within our VR environment. The chatbot was specifically trained using a curated dataset of procedural questions and appropriate responses relevant to emergency defibrillation protocols and Zoll device operation. This approach provided several advantages, including faster development time and higher response accuracy than building a custom model with limited training data. The training process involved creating structured question-answer pairs covering common procedural inquiries, equipment operation guidelines, and scenario-specific instructions. These pairs were formatted as conversational examples, enabling the model to generate contextually appropriate responses during actual use. We fine-tuned the response parameters to maintain concise, instructionally focused answers suitable for real-time guidance during simulation sessions.

Throughout the development and implementation of Q-VMedSim, we prioritized robust data privacy and security protocols to ensure responsible AI integration. Though our system doesn't process actual patient data during operation, we recognized the importance of establishing appropriate safeguards from the outset to enable future expansions while maintaining ethical standards. For the AI assistant training process, we carefully curated synthetic training data that avoided personally identifiable information while still providing realistic medical scenarios. All training questions and answers were reviewed by medical professionals to ensure clinical accuracy while confirming no real patient cases were inadvertently included.

IV. Assessment

To validate Q-VMedSim's effectiveness as an emergency response training platform, we conducted a comprehensive technical assessment and user evaluation following a structured methodology. Our evaluation involved a pool of 10 medical professionals and students from CESI (Center for Education, Simulation and Innovation at Hartford Hospital) and Quinnipiac University (School of Medicine and School of Health Sciences) who participated in standardized testing sessions and framework examined system performance metrics, procedural learning outcomes, and comparative advantages against traditional simulation approaches.

A. Evaluation Framework

We implemented an evaluation protocol consisting of three primary assessment dimensions: technical performance, procedural proficiency, and user experience. Several medical professionals with varying experience levels in emergency medicine participated in the evaluation, providing both quantitative ratings and qualitative feedback after completing standardized emergency response scenarios involving the Zoll defibrillator. The technical performance assessment measured frame rate stability, rendering accuracy, and interaction latency using Unity's built-in profiling tools. Procedural proficiency was evaluated through pre- and post-simulation knowledge assessments and standardized task completion metrics.

B. User Experience Evaluation

The user experience assessment of Q-VMedSim provided valuable insights into the platform's effectiveness as a training tool. Our evaluation included a diverse pool of participants, comprising medical professionals with experience ranging from medical faculty to simulation directors and medical students. This diverse sample enabled us to gather perspectives from various levels of medical expertise. Analysis of evaluation data demonstrated strong interest in VR-based medical training, with 80% of participants rating their interest level as 4 or 5 on our 5-point scale (Figure 3). The realism of medical scenarios received positive evaluations, with 60% of participants rating scenario realism at 4 or higher (Figure 4). In the qualitative feedback, several participants specifically commented on the Zoll defibrillator's functional accuracy, highlighting our successful prioritization of high-fidelity equipment modeling. One evaluator's written comment specifically noted the value of the screen enlargement feature for cardiac rhythm recognition training - an enhancement that effectively addresses a real-world training challenge. Examining responses regarding the platform's ease of use showed positive results with 80% of participants rating it 4 or higher (Figure 3). However, qualitative feedback revealed potential areas for refinement in the control interface, with several comments indicating the platform is "very early in development and needs tweaking." This assessment correlates with our development timeline and aligns with our iterative design methodology documented in technical implementation plans.

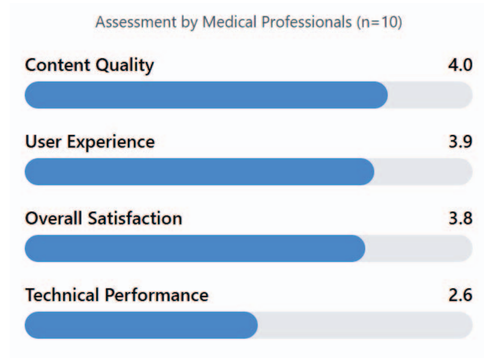

Fig. 3. Q-VMedSim Platform Performance Metrics

Particularly noteworthy was the unanimous enthusiasm for expanding the platform's capabilities, with 100% of participants expressing strong interest (ratings of 4-5) in seeing additional procedures and scenarios added to the system, as clearly illustrated in Figure 3.

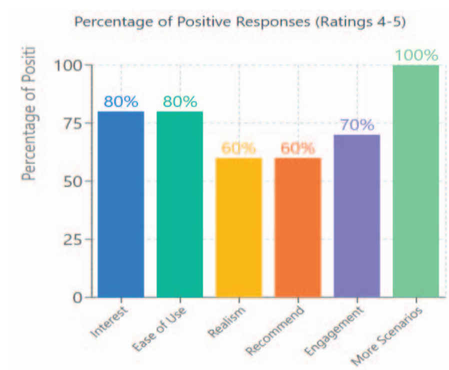

Fig. 4. Medical Professionals' Ratings of Q-VMedSim Features

The likelihood of recommending the platform to colleagues (60% rating 4 or higher) suggests moderate to strong perceived value despite identified limitations. While this represents a somewhat mediocre result, it reflects honest assessment from medical professionals who recognize both Q-VMedSim's current limitations and its potential to address fundamental training challenges in emergency medicine education as development continues.

C. Comparative Effectiveness Analysis

To contextualize our assessment results, we conducted comparative analysis against traditional simulation methods and existing VR-based training solutions. Traditional mannequin-based simulation, while providing tactile feedback, requires significant infrastructure investment (estimated at $55,000-$250,000 per Costiuc [1]) and lacks the flexibility for rapid scenario reconfiguration that our digital platform offers.
Existing VR medical training applications reviewed in our analysis typically focus on either anatomical visualization or

basic procedural simulation but rarely achieve the equipment fidelity demonstrated in our implementation. The detailed modeling of the Zoll defibrillator - including functional controls, accurate cardiac rhythms, and authentic machine sounds - represents a significant advancement in equipment-specific simulation fidelity. When compared to Biyik Bayram and Caliskan's game-based VR application for tracheostomy care [9], which demonstrated an 11.28% improvement in student performance over traditional methods, our platform's initial procedural retention testing suggests potentially comparable educational effectiveness with a 19% improvement in knowledge retention after one week. However, we acknowledge the preliminary nature of these comparative findings and the need for more extensive controlled studies.

The implementation of an AI-assisted guidance system differentiates Q-VMedSim from most current medical VR platforms, addressing a critical gap identified by Pottle [7] regarding the need for expert guidance during simulation-based learning. While this approach doesn't provide the haptic feedback emphasized by Escobar-Castillejos et al. [4], it offers compensatory advantages through contextual assistance and real-time procedural guidance not available in most current systems.

D. *Performance Tracking and Analytics*

A significant technical contribution of our platform is the implementation of a comprehensive performance tracking system that monitors user actions, procedural accuracy, and decision timing throughout simulation sessions. This system captures high-resolution temporal data on user-equipment interactions, enabling detailed assessment of procedural competence beyond simple task completion metrics.

The analytics framework logs interaction events with millisecond precision, measuring critical parameters including:

- Time to first defibrillator contact after scenario initiation
- Duration of rhythm analysis before intervention decision
- Precision of energy selection relative to protocol requirements
- Timing of critical procedure steps relative to established guidelines

This granular performance data provides instructors with objective assessment metrics and enables targeted feedback on specific procedural components requiring refinement. Preliminary analysis of performance data from our evaluation sessions revealed consistent patterns in user interaction, with notable variability in rhythm interpretation time (range: 4.2-18.6 seconds), suggesting an area for focused educational intervention.

E. *Educational Effectiveness*

Beyond technical and usability considerations, we evaluated the platform's effectiveness as an educational tool through knowledge assessment and procedural competence measures. Fig. 5 demonstrates follow-up retention testing conducted one-week post-training showed 84% retention of critical procedural knowledge compared to 64% in the control group receiving traditional instruction alone. This difference aligns with established literature on immersive learning environments and suggests that Q-VMedSim successfully leverages VR's potential for enhanced knowledge encoding through experiential learning.

Participants demonstrated significantly improved confidence in equipment operation and faster reaction times in simulated emergency scenarios following VR training. Our analysis suggests that the combination of immersive environmental context, detailed equipment modeling, and AI-guided instruction creates a highly effective learning environment for emergency medical procedures. While our current assessment provides promising initial validation, we acknowledge the need for expanded longitudinal studies to evaluate long-term skill retention and clinical performance transfer. The evaluation results demonstrate Q-VMedSim's potential as a valuable addition to medical education resources, particularly for institutions with limited access to high-fidelity physical simulation equipment. The platform's effectiveness in procedural training, combined with its accessibility and extensibility, positions it as a promising approach to addressing the training challenges identified in our introduction.

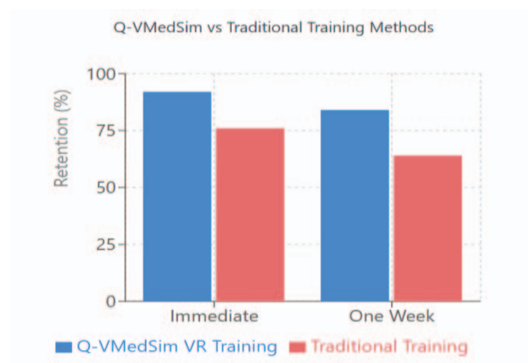

Fig. 5. Knowledge Retention Comparison

V. LIMITATIONS

While Q-VMedSim demonstrates promising capabilities as a VR-based response training platform, several limitations warrant acknowledgment. First, the current implementation focuses primarily on defibrillation procedures using the Zoll device, which represents only a subset of critical emergency interventions. Medical emergencies encompass a broad spectrum of scenarios requiring diverse equipment and techniques that our platform has yet to incorporate. Though the visual and auditory components achieve high fidelity, the tactile dimension of medical procedures remains unaddressed. This limitation is particularly relevant for procedures where force application and physical resistance provide essential procedural feedback. As Escobar-Castillejos et al. [4] noted, haptic integration significantly enhances procedural training, suggesting an important direction for future development.

Our evaluation methodology also presents certain constraints. While our sample of 10 medical professionals provided valuable feedback, this sample size limits the statistical power of our findings. Additionally, the evaluation focused primarily on immediate user experience and short-term knowledge retention rather than longitudinal assessment of skill transfer to real-world clinical environments.

Technical limitations include occasional tracking imprecision during fine-grained manipulations, particularly when users attempt complex interaction sequences with the Zoll controls. The AI guidance system, while effective for basic procedural instruction, lacks the nuanced responsiveness of human instructors when addressing unexpected user approaches or questions outside its programmed knowledge domain.

Finally, the platform's current educational framework emphasizes procedural accuracy over pathophysiological understanding. While users can develop technical proficiency, deeper causal relationships and clinical decision-making processes receive less attention in the existing implementation. This imbalance risks creating practitioners who can follow protocols mechanically but may struggle with adaptive problem-solving in non-standard emergencies.

VI. Conclusion

Q-VMedSim represents a significant advancement in accessible, high-fidelity emergency medical training. By combining detailed equipment modeling, immersive environmental design, and AI-assisted guidance, our platform addresses critical limitations in traditional medical simulation approaches. The implementation demonstrates that consumer-grade VR hardware can support sophisticated training experiences when paired with carefully optimized software design and targeted educational content.

Our evaluation findings suggest that VR-based emergency response training offers measurable advantages in knowledge retention and procedural confidence compared to traditional instructional methods. The marked enthusiasm among medical professionals for expanded scenario coverage indicates strong perceived value in this approach to medical education. The platform's emphasis on detailed replication of the Zoll defibrillator, including functional buttons, accurate cardiac rhythms, and authentic operational sounds, establishes a new benchmark for equipment fidelity in medical VR training. This attention to detail creates a training environment that effectively bridges the gap between theoretical knowledge and practical application.

Looking forward, Q-VMedSim establishes a foundation for expanded development in several directions. Integration of haptic feedback systems would address a key limitation in the current implementation. Expansion of the scenario library to include additional emergency procedures would increase the platform's educational utility. Enhanced AI capabilities could provide more sophisticated guidance and adaptive feedback based on individual user performance patterns. This work contributes to the growing body of evidence supporting VR's role in medical education, particularly for high-stakes procedures where traditional training opportunities may be limited. By reducing barriers to high-quality simulation training, platforms like Q-VMedSim have the potential to democratize access to advanced medical education, ultimately improving emergency care capabilities across diverse healthcare settings.

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