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Unpacking the impact: A narrative review and Kirkpatrick Evaluation of table-top simulations in medical education

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Abstract

Introduction

Table-top simulation (TTS) is a low-fidelity, high-engagement, simulation-based educational method that has gained popularity in medical education in recent years. Despite its increasing use, there is limited synthesis of evidence evaluating its educational effectiveness. This narrative review explores the utility of table-top simulations in medical education and assesses their impact using Kirkpatrick's four-level evaluation framework.

Methods

A comprehensive literature search was conducted across multiple databases to identify studies on the effectiveness of table-top simulation in medical education. Both qualitative and quantitative studies were included. The screening process yielded 32 studies for in-depth review. A realist-informed approach was used to extract and synthesise data according to three domains: context, mechanism and outcomes. Subsequently, the reported outcomes of each study were systematically evaluated and categorised according to Kirkpatrick's four-level model, encompassing participant reactions, learning, behavioural change, and broader results or impacts on practice.

Results

Table-top simulation was used for different reasons. Most commonly it was used to identify gaps in clinical work, to transfer knowledge or as a type of assessment. As an educational tool it was found to be effective on the examined levels of the Kirkpatrick model. It was also found to be equally effective when compared with high-fidelity simulation.

Discussion

Table-top simulation encompasses a heterogeneous group of low-fidelity educational interventions. The available evidence suggests that it supports knowledge acquisition, confidence, teamwork, communication, and learner engagement across a variety of clinical contexts. This review suggests that table-top simulation is an effective educational tool. Nevertheless, it should not be considered as a replacement for high-fidelity simulation or other traditional education modalities but used as an alternative or an adjunct with its added benefits. Further studies are required to evaluate cost-effectiveness, investigate sustainability and to evaluate table-top simulation as an assessment method.

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Introduction

Healthcare professionals often encounter new clinical environments, roles, or responsibilities—particularly during rotations or transitions in training. These situations can be accompanied by uncertainty, reduced confidence, and a heightened sense of under-preparedness. Ensuring that learners feel confident and capable in unfamiliar settings is essential to both patient safety and professional development. Educational strategies that support the development of technical and non-technical skills in a safe, engaging way are therefore critical.

In recent years, there has been growing interest in simulation-based medical education (SBME) that blends experiential learning with elements of gamification to enhance learner engagement and improve outcomes.[1] Strategies such as serious games, gamified learning tasks, and table-top simulation (TTS) are increasingly used to bridge the gap between theoretical learning and real-world clinical application, particularly in scenarios requiring decision-making, interprofessional communication, and systems thinking.

However, despite their increased prominence in educational discourse, the terms gamification, serious games, and TTS are often conflated. Gamification refers to the incorporation of game design elements (e.g., point scoring, rules, storytelling) into non-game contexts to drive engagement. Importantly, gamification is not limited to digital technology.[2,3] Serious games are specifically designed interactive tools—often digital—that aim to educate while still being engaging.[4] In contrast, TTS refers to a low-fidelity, often analogue, simulation approach, rooted in experiential learning theory.[5] It commonly involves participants working through real or hypothetical clinical scenarios using physical or visual aids—such as whiteboards, paper-based prompts, or physical layouts—to simulate difficult-to-recreate events like mass casualty triage or incident response planning.

TTS is particularly effective in fostering decision-making, situational awareness, and the development of non-technical skills such as prioritisation, leadership, and interprofessional teamwork. It offers a psychologically safe space where learners can experiment, reflect, and learn through discussion and collaborative problem-solving. Notably, studies have shown that TTS can lead to knowledge gains comparable to high-fidelity simulation in certain contexts, such as emergency medicine and incident management.[1,2,3,4,6] Furthermore, knowledge retention is also high.[7] Importantly, TTS functions as one mode within the broader domain of simulation-based education, and its unique educational advantages are becoming increasingly recognised. Table 1 compares TTS to other common simulation modalities used in healthcare education.

Given its adaptability, low cost, and ability to meaningfully engage learners[8] in complex decision-making[9] and interprofessional collaboration,[10] TTS has been implemented in a growing range of clinical education contexts. These include emergency response preparedness,[11,12] clinical incident management,[13] systems-improvement initiatives,[14] and the onboarding of healthcare workers to new environments.[15] Its popularity surged during the COVID-19 pandemic,[16] when resource limitations required scalable, remote-friendly educational tools.

Despite this growing use, there is minimal evidence available in the literature on the effectiveness of TTS.

Frégeau et al.[17] summarised their findings on Tabletop Simulations in Medical Emergencies, however the majority of studies focused on management and logistics and not necessarily clinical decision making or improving clinical knowledge. The use of TTS outside disaster medicine is relatively novel, and its effectiveness in these contexts has not yet been fully investigated. This narrative review aims to fill that gap by evaluating whether TTS is an effective teaching method for scenarios requiring clinical decision making.

Using a realist-informed synthesis approach, we examined the context, mechanisms, and outcomes of TTS across published studies that focus on clinical decision-making transferring clinical knowledge, and assessed their educational effectiveness through the lens of Kirkpatrick's four-level model of evaluation.

Table 1. Comparison of simulation based education modalities in healthcare

Simulation modality	Key features	Advantages
Table-top simulation	Low-fidelity, scenario-based; uses physical/paper materials, small-group discussion	Cost-effective and easy to implement Encourages critical thinking and team-based problem-solving High learner engagement Useful for simulating complex systems and decision-making Demonstrated equivalence to high-fidelity in some learning outcomes
High-fidelity simulation	Uses advanced manikins or computer-based environments for realism	High realism Effective for practicing technical/procedural skills Useful for crisis resource management scenarios
Virtual reality (VR) simulation	Immersive, computer-generated environments	Allows safe exploration of rare or high-risk scenarios Scalable and repeatable Engaging for digital-native learners
In situ simulation	Conducted in real clinical settings with actual teams	Identifies latent safety threats Strengthens team dynamics and real-world systems Promotes interdisciplinary learning and safety culture
Traditional didactic education	Lectures, readings, passive classroom learning	Efficient for delivering large volumes of foundational knowledge Easily standardised across settings

Methods

This study adopted a realist-informed, narrative approach to synthesising the effectiveness of TTS in medical education, structured around the Context-Mechanism-Outcome (CMO) framework.[18] The CMO method facilitates an understanding not only of whether TTS works, but also how, for whom, and under what circumstances this method yields effective educational results.

- Context: Details of the educational setting, participant population (learners' professional backgrounds and levels of training), clinical scenarios, and resource environment were documented for each study.
- Mechanism: Core educational strategies were identified, including the design of the table-top exercise, its interactive features, integration of gamification, and facilitation style, to clarify how learning was catalysed.
- Outcomes: The educational and behavioural changes resulting from participation in TTS, as well as reported changes in knowledge, skills, attitudes, or system-level practice, were extracted.

Two leading frameworks for outcome evaluation in medical education — Kirkpatrick's Model[19] and Moore's Expanded Outcomes Framework[20] — were considered (see Table 2). Kirkpatrick's four-level model remains the most widely applied in health professions education research due to its clarity, feasibility, and longstanding use to assess outcomes ranging from learner reaction to impact on practice. Moore's model offers an expanded hierarchy, notably distinguishing between declarative and procedural knowledge, competence, and performance in clinical settings.

Due to considerable diversity in TTS designs and reported outcomes, universal application of Moore's detailed categories was often unfeasible. Accordingly, studies were analysed using the CMO framework, and outcomes were then classified predominately according to Kirkpatrick's four levels. This pragmatic choice enabled consistent synthesis across heterogeneous studies, allowing for high-level comparison even when detailed patient or population-level data was unavailable.

Given that most included studies reported data up to changes in learner behaviour and, infrequently, on real-world patient outcomes, the Kirkpatrick

Table 2. Comparison of Kirkpatrick and Moore Evaluation frameworks in medical education

Kirkpatrick Model	Moore's Expanded Outcomes Framework	What it measures
Level 1: Reaction	Level 1: Participation	Learner engagement and satisfaction
Level 2: Learning	Level 2: Satisfaction	Learner satisfaction with the learning process
	Level 3a: Declarative knowledge	Knowledge acquisition (facts and concepts)
	Level 3b: Procedural knowledge	Knowledge of how to perform tasks/skills
	Level 4: Competence	Self-reported readiness to apply learning
Level 3: Behaviour	Level 5: Performance	Change in clinical practice/behaviour
Level 4: Results	Level 6: Patient health	Impact on patient outcomes
	Level 7: Community health	Impact on population health

Model was selected as the primary framework for outcome evaluation. This allowed for meaningful categorisation and comparison across the available literature, while remaining sensitive to the nuances of context and mechanism extracted through the CMO lens.

Search Strategy and Study Selection

A systematic literature search was conducted on 25 March 2024 and a second search on 2 September 2025, using EBSCO Information Services (EBSCO) (including CINAHL (Cumulative Index to Nursing and Allied Health Literature), E-Journals, MEDLINE), PubMed, Ovid, and ProQuest databases.
The search strategy used combinations of the terms "table-top", "tabletop", "table top", "boardgame", "board game", "simulation", "healthcare" and "education". No date restrictions were imposed. Additional articles were identified through hand-searching of references. Our detailed search strategy can be found in appendix 1.

Inclusion and exclusion criteria reflected the focus on the educational effectiveness of TTS used by and for healthcare professionals (Table 3). Both qualitative and quantitative study designs were eligible, provided that outcomes pertaining to learning or practice could be reasonably attributed to the table-top modality. Studies combining TTS with other teaching modalities were excluded if separate evaluation was not possible.

Study selection, data extraction, and quality appraisal followed Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA-ScR) guideline methodology,[21] and all records were managed in Zotero and Google Sheets.

Given the limited number of eligible studies identified, a pragmatic approach to data extraction was adopted. Variables were categorised as obligatory or optional to maximise data capture whilst ensuring sufficient information was available to describe and compare interventions. Optional variables were extracted where reported. Obligatory variables included: authors; title; year of publication; country of origin; type of educational game; target population (single specialty/interprofessional); results. Optional variables were: sample size; length of the game/session; if there a training needs assessment; if learning outcomes were identified; research method; research design/questions; research question/learning outcomes; outcome measures

Table 3. Eligibility Criteria for Study Inclusion

Inclusion criteria	Exclusion criteria
Studies published in English	Studies published in non-English language
TTS delivered to healthcare professionals or students	TTS delivered to non-healthcare professionals only
Table-top teaching simulating clinical work/decision-making	TTS for management/logistics only, not requiring clinical decisions
Includes physical board games, computer-assisted, VR apps	Hybrid or adjunct modalities where TTS effect cannot be isolated
Quantitative, qualitative, or mixed-method designs	Reviews or studies with no direct outcome evaluation, or outcomes not attributable to TTS

(questionnaires/improved performance); if change in practice/behaviour measured additional learning outcomes; comments.

A pragmatic quality appraisal framework was developed to assess methodological rigour across the diverse educational study designs included in this review. Traditional risk-of-bias tools were considered unsuitable due to the predominance of educational evaluations, pilot studies, innovation reports, and mixed-methods research. Therefore studies were assessed against six criteria: 1 - study design, defined as the presence of a comparative, controlled, randomised, crossover, or longitudinal design; 2 - sample description, including reporting of sample size and participant characteristics; 3 - learning outcomes, with explicit educational objectives or intended learning outcomes identified; 4 - outcome evaluation, including objective assessment of knowledge, performance, behaviour, or the use of validated evaluation instruments; 5 - methods transparency, defined as sufficient detail regarding the intervention and procedures to permit replication; and 6 - analysis, including statistical analysis or systematic qualitative analysis. Each criterion was scored as either present (1) or absent/not reported (0), resulting in a total quality score ranging from 0 to 6. Studies scoring 6 were classified as high quality, those scoring 3–5 as moderate quality, and those scoring 0–2 as low quality. No minimum quality threshold was used as an exclusion criterion because the review aimed to map the breadth of evidence relating to TTS and educational games in healthcare education. Quality ratings were therefore used to contextualise findings rather than determine eligibility.

Results

Following the identification and screening process, 32 studies were included in this narrative review (selection process summarised in Figure 1). The included literature spans diverse clinical contexts, learner groups, simulation designs, and evaluation approaches. Table 4 summarises the characteristics and key findings of all included studies, with synthesis below using the Context-Mechanism-Outcome (CMO) framework and mapped to Kirkpatrick's evaluation levels. The author is happy to provide the original data extraction sheet on request.

Study characteristics

The majority of studies were conducted in high-income countries: United States (n=16), Canada (n=9), Germany (n=2), United Kingdom (n=1), Saudi Arabia (n=1), Turkey (n=1), Taiwan (n=1) and Ghana (n=1). Most were published between 2016 and 2025, with only two predating this period. Quantitative methodology predominated (n=23); three studies used qualitative methods, three used mixed methods, and three were descriptive accounts of TTS use. Sample sizes varied widely

(8–276 participants). Many studies targeted interprofessional teams, while others focused on specialty groups (e.g., emergency medicine, paediatrics, nursing, paramedics, general practice).

Quality considerations

Quality appraisal demonstrated that 8 of the 32 included studies (25.0%) met all predefined quality criteria and were classified as high quality. Twenty-two studies (68.8%) were classified as moderate quality, typically due to the absence of comparative designs or objective outcome measures. Two studies (6.2%) were classified as low quality because of limited methodological reporting and lack of formal outcome evaluation. Overall, the evidence base was characterised by a predominance of moderate-quality educational evaluations, with relatively few randomised, controlled, or longitudinal studies. The summary of quality appraisal ratings can be found in Table 5.

Typology and purpose of TTS

The review identified several forms of TTS:

- Non-gamified low-fidelity group work[22,23,26-28,38,39,40,43,46-49]: Small-group scenario discussion at a table.
- Gamified and physical board games[9,10,25,32,34-36,44,45,50]: Utilised for emergency medicine, paediatrics, and disaster medicine.
- Card-based scenario simulations.[24,29]
- Computer-simulated/virtual/tablet games.[30,31,33,37,41,42]
- Actual or virtual whiteboard simulations.[16]

Common educational purposes included:

- Identifying clinical and systems gaps.
- Knowledge transfer of clinical and non-technical skills.
- Team-based learning focused on communication and decision-making.
- Assessment of skills or preparedness (sometimes in formative or summative frameworks).
- Reinforcing interprofessional collaboration and system readiness, particularly in disaster and emergency contexts.

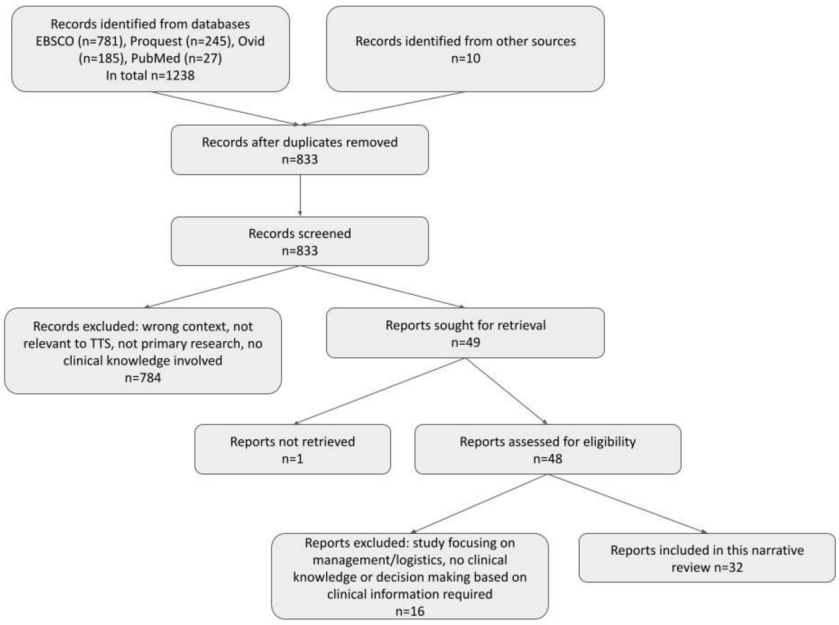


Figure 1. Prisma diagram for selection of sources of evidence

Table 4 CMO analysis and mapping to Kirkpatrick's Evaluation

Study Example	Context (C)	Mechanism (M)	Outcome (O)	Kirkpatrick Level(s) Achieved
Achatz et. al.[10] Terror and disaster surgical care	Interprofessional team of medical doctors	Board game	Multifaceted, interactive, narrative, and entertaining experience. Participants are enthusiastic and satisfied. The training is effective.	Level 1
Achatz et. al.[9] Decision-making process within Terror and disaster surgical care course	Interprofessional team of medical doctors	Board game	Better learning effect and easier to explain comparing to previous version of the game.	Level 1
Alakrawi et al.[22] Evaluating the efficacy of full-scale and tabletop exercises	Paramedic students	Tabletop exercise (TTE) compared to full-scale exercise (FSE)	High levels of perceived learning, TTE vs FSE not statistically significant.	Level 1
Behar et al.[23] Training medical staff for pediatric disaster victims: a comparison of different teaching methods	Paediatric and nurses	Table-top scenario	There was no statistically significant difference between intervention types. No difference in knowledge scores between intervention types.	Level 2
Blaak et. al.[16] Primary care pandemic preparedness and response	Interprofessional team in primary care	In person + virtual TTS	TTS sessions were seen as effective at both cementing existing practice and introducing new policies and procedures.	Level 1
Bonney et al.[24] Low-cost tabletop simulation for disaster triage	Ambulance service trainees in disaster medicine training	Card game	The use of a low-cost tabletop is acceptable and feasible. Interest in replicating the exercises.	Level 1
Bridges et al.[25] Learning to beat the shock clock: pediatric board game	Paediatric and emergency medical residents	Board game	Increase in overall knowledge of pediatric septic shock diagnosis and care. Improvement in participants' comfort with diagnosis and management of pediatric septic shock. As effective as bedside teaching and high-fidelity simulation and more effective than lectures or reading.	Level 1, 2
Brydges et al.[26] Identification of 'latent social threats' through interprofessional tabletop simulation	Interprofessional teams	Table-top scenario	Ability to identify latent social threats.	N/A
Chou et al.[27] Mass casualty incident management	Medical students	Three-dimensional tabletop exercise	Improvement pre post training in different competencies including triaging patients.	Level 1, 2
Chung et al.[28] Addressing children's needs in disasters: a regional pediatric tabletop exercise	Interprofessional teams	Table-top exercise	Significant improvement knowledge and performance before and after tabletop simulation. Collaboration continued after 6 months.	Level 1, 3
Cosimini et al. (29) A card game for guideline-based antibiotic prescribing	Interprofessional teams	Card game	High engagement and enjoyment ("helpful" & "fun"); participants reported intention to change practice; no objective knowledge gain data.	Level 1
Cutumisu et al.[30] RETAIN: A neonatal resuscitation board game	Interprofessional teams	Computer role playing game and board game	Increase in performance between the pre- and post-simulation.	Level 2
Cutumisu and Schmölzer[31] Digital game simulator vs traditional intervention on paramedics' neonatal resuscitation performance	Paramedics	Computer simulation game	No statistical difference between traditional and digital game simulator.	Level 1, 2
Demiray et al.[32] Board game to learn a physical assessment	Nursing students	board game compared with traditional lecture-based instruction	Better knowledge scores than lecture based teaching, higher engagement and positive perceptions than control group.	Level 1, 2
Dubovsky et al.[33] Emergency department nursing triage simulation	ED nurses performing triage	Computer simulation game	Opinion that simulation task reflected their real world experience.	Level 1
Fusco et al.[34] Principles ofinterprofessional collaboration to students	Interprofessional team	Board game	Enjoyed collaboration with other students. The experience improved teamwork, communication, and creative problem solving of interprofessional teams.	Level 1
Ghoman et al.[35] Summative assessment using the RETAIN board game	Interprofessional paediatric team	Board game	Participants enjoyed the simulation. HCPs demonstrated improved performance on the RETAIN board game, compared to their performance on the open-answer summative assessment.	N/A
Ghoman et al.[36] RETAIN tabletop simulator as a summative assessment	Interprofessional paediatric team	Board game	The years of board game experience influenced performance on the written test if participants' have less than 21.5 years of board game experience.	N/A
Ghoman et al.[37] Digital simulation and neonatal resuscitation knowledge.	Interprofessional paediatric team	Computer simulation game + board game	Digital simulator used for training, board game used for summative assessment.	Level 2
Johnson et al.[38] TTS on disaster planning for nursing students	Nursing students	TTS	Description of TTS and their debriefing sessions.	N/A
Liggett et al.[39] Triage tabletop: clinical decision-making in acute care	Nurse practitioner students	TTS	Engaging, realistic, and practically useful. critical thinking, peer learning, and clinical prioritization skills.	Level 1
Liggett et al.[40] Enhance the triage skills of nurse practitioner students	Nurse practitioner students	TTS	Improved realism and adaptive decision-making.	Level 1
Lu et al.[41] Perceptions and longitudinal performance in a digital neonatal resuscitation simulator	Interprofessional paediatric team	Computer simulation	Tabletop simulator picks up participants' knowledge that may not have been captured by the tests in the digital simulator.	Level 1, 2
Lu et al.[42] Mindset moderates longitudinal performance in a digital neonatal resuscitation simulator.	Interprofessional paediatric team	Computer simulation	Growth mindset did not moderate the gain in performance from the pretest to the immediate posttest. However, on the 2-month delayed posttest, a growth mindset was significantly associated with better performance.	Level 2
Ma et al.[43] Tabletop simulation to assess teamwork competency in OB/GYN resident candidates	Applicants for obs and gynae residency training	TTS	The activity provided a unique experience reflecting the value of the programme places on teamwork.	N/A
Offenbacher et al.[44] High-fidelity vs table-top simulation in undergraduate emergency medicine education	Fourth-year medical students	Teddy bears as patient models	Learning outcomes were equivalent between high-fidelity and low-fidelity cohorts across all topics. Knowledge gain between the study arms was equivalent.	Level 2
Ogershok and Cotrell[45] The pediatric board game	Medical students and residents	Board game	The game was an entertaining way to learn foundational knowledge of pediatric medicine. The game provided a challenging learning experience and a practical educational tool.	Level 1
Ozkara San et al.[46] inclusion of disability content in simulation	Nursing students	TTS	Improved critical thinking collaboration and communication between teams.	Level 1
Skaltsis et al.[47] Learner perception of disaster simulation modalities	Pre-licence nursing students	TTS	Better understanding of pathophysiology. Participants felt empowered to make clinical decisions. Greater confidence in triaging.	Level 1
Walter et al.[48] Opioid use disorder tabletop simulation: an immersion experience to increase empathy and awareness of stigma	Emergency Medicine residents	TTS	The simulation was meaningful and it increased awareness of stigmatizing attitudes and actions in opioid use disorder. The simulation decreased prevalence of stigmatising beliefs.	Level 1
Walter et al.[49] Opioid use disorder tabletop simulation	Emergency Medicine residents	TTS	The 'OUD Tabletop Simulation' helps learners to understand that opioid use disorder is a chronic disease for which there is treatment and recovery.	Level 1
Woodier et al.[50] "Playing games" - using tactical decision games to enhance non-technical skills	Interprofessional team	Tactical decision game/ TTS	Improved individual non-technical skills	Level 1

Table 5 Quality appraisal of included studies

Study Example	Design	Sample	Learning Outcomes	Outcome Evaluation	Transparency of Method	Analysis	Score	Rating
Achatz et. al.[10] Terror and disaster surgical care	0	1	1	1	1	1	5	Moderate
Achatz et. al.[9] Decision-making process within terror and disaster surgical care course	0	1	1	1	1	1	5	Moderate
Alakrawi et al.[22] Evaluating the efficacy of full-scale and tabletop exercises	1	1	1	1	1	1	6	High
Behar et al.[23] Training medical staff for pediatric disaster victims: a comparison of different teaching methods.	1	1	1	1	1	1	6	High
Blaak et. al.[16] Primary care pandemic preparedness and response	0	1	1	0	1	1	4	Moderate
Bonney et al.[24] Low-Cost tabletop simulation for disaster triage	0	1	1	0	1	0	3	Moderate
Bridges et al.[25] Learning to beat the shock clock: pediatric board game	0	1	1	0	1	1	4	Moderate
Brydges et al.[26] Identification of 'latent social threats' through interprofessional tabletop simulation	0	1	1	0	1	1	4	Moderate
Chou et al.[27] Mass casualty incident management	1	1	1	1	1	1	6	High
Chung et al.[28] Addressing children's needs in disasters: a regional pediatric tabletop exercise	0	1	1	0	1	1	4	Moderate
Cosimini et al.[29] A card game for guideline-based antibiotic prescribing	0	1	1	0	1	1	4	Moderate
Cutumisu et al.[30] RETAIN: a neonatal resuscitation board game	0	1	1	1	1	1	5	Moderate
Cutumisu and Schmölzer[31] Digital game simulator vs traditional intervention on paramedics' neonatal resuscitation performance	1	1	1	1	1	1	6	High
Demiray et al.[32] Board game to learn a physical assessment	1	1	1	1	1	1	6	High
Dubovsky et al.[33] Emergency department nursing triage simulation	0	1	1	1	1	1	5	Moderate
Fusco et al.[34] Principles of interprofessional collaboration to students	0	1	1	0	1	1	4	Moderate
Ghoman et al.[35] Summative assessment using the RETAIN board game	0	1	1	1	1	1	5	Moderate
Ghoman et al.[36] RETAIN tabletop simulator as a summative assessment	0	1	1	1	1	1	5	Moderate
Ghoman et al.[37] Digital simulation and neonatal resuscitation knowledge.	1	1	1	1	1	1	6	High
Johnson et al.[38] Tabletop simulation on disaster planning for nursing students	0	1	1	0	1	0	3	Moderate
Liggett et al.[39] Triage tabletop: clinical decision-making in acute care	0	1	1	0	1	0	3	Moderate
Liggett et al.[40] Enhance the triage skills of nurse practitioner students	0	0	1	0	1	0	2	Low
Lu et al.[41] Perceptions and longitudinal performance in a digital neonatal resuscitation simulator	1	1	1	1	1	1	6	High
Lu et al.[42] Mindset moderates longitudinal performance in a digital neonatal resuscitation simulator	1	1	1	1	1	1	6	High
Ma et al.[43] Tabletop simulation to assess teamwork competency in OB/GYN resident candidates	0	1	1	0	1	0	3	Moderate
Offenbacher et al.[44] High-fidelity vs table-top simulation in undergraduate emergency medicine education	1	1	1	1	1	1	6	High
Ogershok and Cotrell[45] The pediatric board game	0	1	1	0	1	0	3	Moderate
Ozkara San et al.[46] Inclusion of disability content in simulation	0	1	1	0	1	1	4	Moderate
Skaltsis et al.[47] Learner perception of disaster simulation modalities	0	1	1	0	1	1	4	Moderate
Walter et al.[48] Opioid use disorder tabletop simulation: an immersion experience to increase empathy and awareness of stigma	0	1	1	0	1	1	4	Moderate
Walter et al.[49] Opioid use disorder tabletop simulation	0	1	1	1	1	1	5	Moderate
Woodier et al.[50] "Playing games" - using tactical decision games to enhance non-technical skills	0	0	1	0	1	0	2	Low

Summary of results against CMO framework

- Contexts: most of the studies (21 of 32) were conducted in disaster preparedness, emergency medicine, acute care, or other system-readiness contexts.[9,10,16,22-28,33,38-40,43,44,46-49]

- Mechanisms: across the included studies, TTS operated through facilitated small-group scenario discussions (13 of 32 studies)[22,23,26-28,38-40,43,46-49], gamified board or card-based activities (12 of 32 studies),[9,10,24,25,29,32,34-36,44,45,50] computer-based simulations (6 of 32 studies),[30,31,33,37,41,42] and whiteboard-based exercises (1 of 32 studies).[16] Learning was facilitated through role allocation, collaborative problem-solving, prioritisation of tasks, peer interaction, structured debriefing, and reflective discussion.

- Outcome: in those cases where knowledge was tested pre- and post- intervention (n=8) results showed improved knowledge.[23,27,30,32,37,41,44,47] Only a few studies (n=5) compared TTS as a teaching modality to other education modalities[22,23,32,44,47] and all of them suggested that knowledge gains in TTS was equivalent to other education modalities. Enhanced teamwork, risk awareness, and communication behaviours also emerged, especially in studies using explicit interprofessional scenarios.

Patterns in Kirkpatrick level achievement

- Level 1 (Reaction):
almost all studies measuring satisfaction[9,24,29,34,47] or engagement[29,45] reported positive reactions. Participants widely described TTS as engaging, enjoyable, and confidence-building. Only one study[47] reported that the full-scale simulation provided more opportunities to express their feelings and receive constructive feedback during the debriefing.

- Level 2 (Learning):
Among the studies that measured pre- and post-intervention knowledge scores (n=8), significant knowledge gains were demonstrated.[2,27,30,32,37,41,44,47] Comparative studies (n =5) including randomised trials[22,23,32,44,47] and longitudinal designs (n=5)[23,30,37,42,42] repeatedly indicated that TTS produced knowledge outcomes at least equivalent to those of high-fidelity simulation or other active modalities.

- Level 3 (Behaviour):
only one study examined change in behaviour or practice, which found that following the intervention collaboration between different members of the interprofessional team continued even 6 months after the event.[28]

- Level 4 (Results):
direct clinical or patient-outcome effects have not been robustly studied with TTS alone.

Other Features

- Session length and frequency:
Sessions ranged from brief (20 minutes) to extensive (up to 8 hours), but none of the studies included systematically evaluated optimal duration or the effects of repeating a session.

- Training needs and learning outcomes:
While 21/32 studies conducted formal training needs assessment and 22/32 specified learning outcomes, substantial heterogeneity precluded meta-analysis.

- Comparison to other modalities:
Evidence from comparative studies (n=5)[22,23,32,44,47] consistently indicates that TTS offers knowledge acquisition and participant satisfaction equivalent to high-fidelity and more resource-intensive simulation methods. TTS remains particularly valued where flexibility, scalability, cost, or logistics limit traditional simulation options.

Analysis using the Context-Mechanism-Outcome (CMO) framework shows that TTS operates effectively in a variety of contexts, from undergraduate to postgraduate training in high-acuity and system-preparedness settings. The primary mechanisms driving learning include small-group scenario discussions, gamification, and structured debriefings that foster collaborative or competitive dynamics. The reported outcomes

consistently point to increased knowledge, confidence, and high learner engagement. Several studies note that TTS yields knowledge gains equivalent to those of high-fidelity simulations.[22,23,32,44,47] highlighting its value as a resource-efficient alternative.

Evaluation using Kirkpatrick's model further substantiates these findings. At Level 1 (Reaction), participants almost universally report TTS as a positive, engaging, and enjoyable experience that builds confidence. At Level 2 (Learning), many studies documented significant knowledge gains through pre- and post-intervention tests. Comparative studies found that TTS produced learning outcomes at least equivalent to high-fidelity simulation and other active learning modalities. Evidence at Level 3 (Behaviour) is limited, though one study demonstrated that the collaboration fostered during a TTS session persisted for several months. No studies have yet robustly measured Level 4 (Results) outcomes, such as direct clinical or patient effects.

Overall, the synthesis of results shows TTS is a highly adaptable, cost-effective, and scalable educational tool that effectively achieves key learning outcomes, particularly in fostering teamwork, communication, and system-level thinking. While the evidence for its impact on long-term behavioural change and patient outcomes is in its infancy, the existing data firmly establish TTS as a valuable and compelling alternative to more resource-intensive simulation methods, meriting its broader integration into medical curricula. Further research is warranted to explore its long-term effects.

Discussion

Generally, TTS was used for three main reasons. Firstly, to identify a clinical or operational gap and to help find solutions to that gap. Across the included studies, these gaps were most commonly identified in contexts involving infrequent, high-risk, or operationally complex situations, such as disaster medicine, neonatal resuscitation, emergency care, and opioid use disorder management. In these contexts, TTS provided a psychologically safe environment in which participants could rehearse decision-making, prioritisation, communication, and teamwork. These mechanisms appeared to facilitate improvements in knowledge, confidence, preparedness, and non-technical skills.

Secondly, to transfer knowledge. TTS provides an opportunity to improve clinical knowledge and to enhance non-technical skills simultaneously. Additional advantages described by candidates participating in TTS sessions include: improved critical thinking[46]; an increased sense of comfort when managing an emergency scenario[23]; positive effects on problem-solving skills[34]; increasing empathy[48]; enhancing teamwork[43]; feeling more empowered to make clinical decisions with increased confidence[47]; and potentially providing an opportunity to practise leadership roles. One study claimed that TTS was perceived as less effective than traditional simulation when expressing their feelings and receiving constructive feedback during debriefing sessions.[47] Although this might be related to one particular session and could be corrected with the training of the facilitators delivering the debriefing.

Thirdly as a summative assessment or a method to evaluate teamwork skills - for example during an interview for residency programme. Deciding what assessment methods to use to provide candidates with a valid and reliable assessment method is complex. Weekley et al.[51] anticipated nearly 10 years ago that low-fidelity simulation games would be used as assessments in the future. As predicted, there were a small number of studies describing TTS used as an enjoyable alternative to traditional assessment methods.[35,43] This potentially needs further investigation before TTS can be deemed a valid and reliable assessment form. Examiners have to be trained meticulously to ensure validity and reliability while avoiding different sources of bias. Discussing the appropriateness of TTS as an assessment method is beyond the scope of this review.

Although TTS has been described in a wide range of areas including terror and disaster medicine, paediatrics, primary care, paediatric disasters, labour ward, neonatal resuscitation, emergency medicine, obstetrics and gynaecology, disability and opioid use, opportunities for further application remain. One relatively unexplored area is residency or foundation training. Priest et al.[52] suggest using a TTS format for on-call

simulations for final year medical students and postgraduate doctors to manage their feeling of under preparedness.

Intensive care units and operating theatres work with interprofessional teams with a wide variety of challenges and potential emergency scenarios. Anaesthesia, pain management and critical care have numerous subspecialties that could utilise gamified TTS as envisaged by Cascella et al..[53] Further specialties that advocate the use of gamification or TTS are radiology[54] and histology.[55]

Advantages and disadvantages of table-top simulation

TTS is claimed to be beneficial for multiple reasons (figure 2). Across the included studies, these benefits appeared to arise through mechanisms such as collaborative discussion, active participation, role allocation, prioritisation of tasks, and structured reflection during debriefing. Supposedly, it is a low stress learning strategy[56] that helps to develop teamwork and improve communication skills.[34] Although some TTS seem to increase engagement via gaming elements, emotional engagement also shows positive correlation with achieving learning outcomes.[57] TTS is thought to be cost-effective[24] easily accessible[31] and not only delivers clinical knowledge but also improves non-technical skills.[50] It is ideal to deliver content that otherwise would be difficult to simulate. Engagement and knowledge retention is also claimed to be high.[58] One of the possible disadvantages could be the cost of development and maintenance of the gamified learning tools[54] although the authors only refer to digital tools.

Context–Mechanism–Outcome configurations identified

Three recurring Context–Mechanism–Outcome (CMO) configurations were identified across the included studies (Table 6). Despite considerable variation in intervention design, recurring mechanisms included decision-making rehearsal, collaborative discussion, role clarification, and active participation. These mechanisms appeared to underpin the positive educational outcomes reported across a range of clinical and educational contexts.

Effectiveness of table-top simulation

Determining the effectiveness of a teaching modality and comparing it with others is challenging. Multiple studies tried comparing different teaching modalities within and outside medical education. Carrol and Burke[59] found no difference in the effectiveness of online versus face-to-face education. Didactic lectures, animation and simulation sessions seem to be

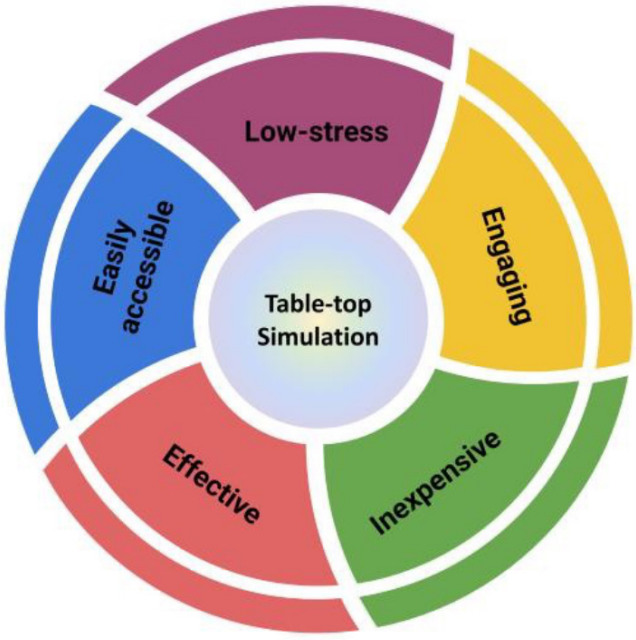


Figure 2. Benefits of table-top simulation

equally good at developing cognitive knowledge although simulation is felt to be a better choice when it comes to practising psychomotor skills.[60] During the Covid-19 pandemic when face-to-face teaching was forced online the efficacy of different teaching methods gained increased interest. Confirming previous findings, no significant correlation was found between the perceived effects of teaching modalities and academic performance.[61] Shirani Bidabadi et al.[62] suggest that the quality of teaching is the most important factor in determining the effectiveness of a teaching modality.

Interpretation of the effectiveness of TTS is complicated by inconsistent terminology within the literature. While some studies used TTS to describe discussion-based exercises[22,23,26-28,38-40,43,46-49] focused on planning, prioritisation, and coordination, others incorporated explicit game mechanics, competition, scoring systems,[25,29,30,32,34,45] or digital interfaces.[31,37,41,42] Consequently, interventions grouped under the term 'table-top simulation' may represent substantially different educational approaches. The positive outcomes reported across studies therefore reflect the effectiveness of a broad family of low-fidelity simulation and game-based educational strategies rather than a single, standardised intervention. Despite differences in format, common mechanisms included collaborative problem-solving, discussion-based decision-making, peer interaction, and reflection, which may explain the consistent improvements in knowledge, confidence, teamwork, and communication reported across studies. Future studies should provide clearer descriptions of intervention characteristics to facilitate comparison between educational formats.

Educational outcomes stratified by Kirkpatrick levels

The majority of studies appraised Level 1 and Level 2 outcomes and one study appraised Level 3 outcomes, as seen in figure 3. Demonstrating translational patient outcomes at Level 4 could prove difficult as the topics of the included studies such as mass casualty incidents, pandemic related topics or neonatal resuscitation are rarely encountered in practice. One of the main reasons TTS was chosen to deliver these education sessions was the rarity of these situations. Cahapay[63] claims that Kirkpatrick's evaluation model is rigid and has limitations especially in higher education. It fails to suggest connections between the different levels which would be extremely difficult to measure in rare situations such as those described above.

Table 6. Recurring Context–Mechanism–Outcome (CMO) configurations identified

Context (C)	Mechanism (M)	Outcome (O)	Example studies
Rare, high-stakes, or infrequently encountered clinical situations (disasters, neonatal emergencies, opioid use disorder)	Rehearsal of decision-making, prioritisation, resource allocation, and management of uncertainty in a psychologically safe environment	Increased knowledge, confidence, preparedness, and perceived ability to manage similar situations	Achatz et al., Alakrawi et al., Behar et al., Chou et al., Chung et al., Johnson et al., Walter et al.
Interprofessional or multidisciplinary learning environments	Collaborative discussion, role clarification, communication, and shared decision-making	Improved teamwork, communication, situational awareness, and understanding of professional roles	Brydges et al., Fusco et al., Ma M et al., Ozkara San et al.
Gamified educational interventions	Competition, scoring systems, progression through scenarios, active participation, and immediate feedback	Increased engagement, motivation, learner satisfaction, and knowledge retention	Bridges et al., Cosimini et al., Cutumisu et al., Demiray et al., Ogershok et al.

As described in Neil Fleming's VARK theory, students have different learning preferences.[64] One education tool will not fit all learners. Educators should adapt their teaching strategies to the situation and students. TTS is a technique that encourages experiential and reflective learning.[3] It increases the motivation[3] and engagement[57] of the learners. It is an effective tool to transfer clinical knowledge[25,44] and to improve non-technical skills such as critical thinking, teamwork, collaboration and communication between teams[46] prioritising jobs[50] and creative problem solving[34] Participants feel empowered to make clinical decisions,[47] report increased sense of comfort when managing emergency scenarios[23] and better understanding of complex interprofessional team dynamics.[26] Based on the findings of this review, TTS as a teaching modality is effective and not inferior compared to high fidelity simulation in medical education.

Ideal length and frequency of table-top simulation sessions

Based on the available information it remains difficult to determine if there is an ideal length of TTS teaching session. That would also depend on factors such as: aim of the session and available resources. If a simulation session is to be delivered during working hours a short 20-minute simulation is more likely to happen, however on a dedicated training day a few hours long session might provide the participants with more additional learning outcomes.

The ideal frequency of delivering TTS sessions was not feasible to determine in this review. All of the studies included in this review described a single simulation session without examining the benefits of repeated sessions.

High-fidelity simulation requires a low learner-to-faculty teaching ratio that increases both faculty workload and cost of a simulation session.[65] Due to these factors, accessibility of high-fidelity simulation sessions are often limited. On the contrary, commercially available TTS are more cost-effective, and furthermore can help to decrease burnout as a creative educational programme.[65] It is important though to distinguish between board games and digital or VR table-top simulations. Board games can be widely accessible and facilitators can easily be trained from a distance; which makes them ideal for low- and middle- income countries. However, online or virtual reality simulations might actually be less accessible to low-income countries due to the additional costs of maintenance. Further studies are required to determine the relationship between the cost of different simulation methods.

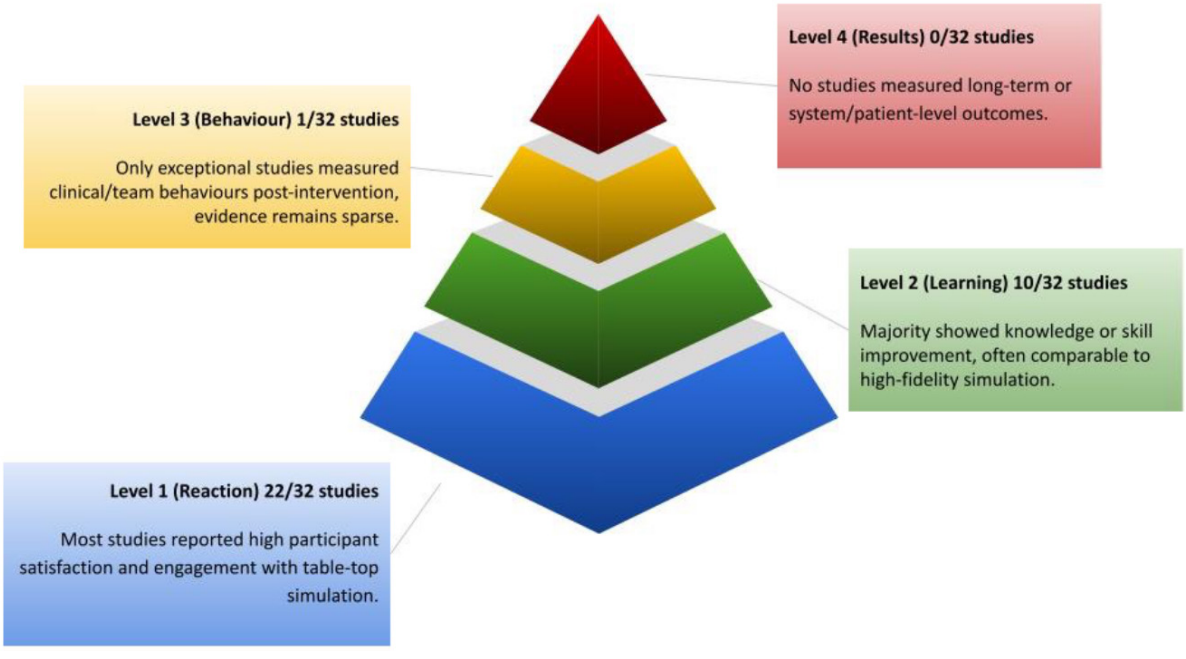


Figure 3. Summary of Kirkpatrick level achievements

Sustainability

Despite the fact that embedding sustainability principles in medical education is crucial,[66] none of the included studies discussed the potential implications of TTS on sustainability.

Limitations and suggestions for further research

There is inconsistency of the terminology in the literature: gamification, serious games and TTS might have influenced the ability to identify all the available evidence. Unified definitions need to be followed to avoid using gamification, serious games and TTS interchangeably.

Although PRISMA-ScR guidelines[21] were used, narrative reviews by nature are not as strict as systematic reviews. There was only a low number of available studies on the effectiveness of TTS. This may be the result of TTS being a relatively novel educational modality or that, potentially, publication bias is distorting the list of available evidence. Furthermore, the high variety of types of TTS methods made it impossible to use a standardised tool during the review.

Further studies are required to prove cost-effectiveness of TTS. Studies need to be designed to investigate sustainability of different educational modalities including TTS. Effectiveness of TTS should be measured on the higher levels of Kirkpatrick's model of evaluation and Moore's expanded framework. Further studies are required to decide if there is an ideal length or frequency when delivering TTS. Further research is required to evaluate TTS as an assessment method.

Conclusion

This review identified a diverse range of TTS approaches, including discussion-based exercises, board games, card games, computer simulations, and whiteboard-based activities. TTS was most frequently used in contexts involving rare, high-risk, or operationally complex situations where learners were required to develop clinical decision-making, teamwork, and systems awareness. Across these contexts, recurring mechanisms included collaborative discussion, prioritisation, role clarification, active participation, and structured reflection. These mechanisms were associated with improvements in knowledge, confidence, communication, teamwork, and learner engagement.

Based on the available evidence TTS is effective at levels 1, 2 and 3 of Kirkpatrick's evaluation model and is not inferior when compared with high-fidelity simulation. However the evidence base remains heterogeneous and is characterised predominantly by moderate-quality studies.

This review highlights the impact of TTS in medical education. While it should not be viewed as a replacement for high-fidelity simulation or traditional educational modalities, it represents a valuable alternative or adjunct that can support both clinical knowledge acquisition and non-technical skill development across a range of healthcare contexts.

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Declarations

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Appendix 1. Search strategy

Search strategies were adapted to the syntax and indexing characteristics of individual databases. Preliminary searches on 25th March 2024 using identical terms yielded variable sensitivity across platforms, necessitating database-specific modifications to optimise retrieval of relevant studies. Therefore the final search performed on 2nd September 2025 used the following search strategy.

EBSCO

TI("tabletop") OR TI("table-top") OR TI("table top") OR TI("board game") OR TI("boardgame") AND TX ("simulation") AND TX ("healthcare") AND TX ("education")

Narrow by language: - english

ProQuest

title("tabletop") OR title("table-top") OR title("table top") OR title("board game") OR title("boardgame") AND fulltext ("simulation") AND fulltext ("healthcare") AND fulltext ("education")

Ovid

(("tabletop" or "table-top" or "table top" or "board game" or "boardgame") and "simulation" and "healthcare" and "education")

Limit 1 to abstracts

Limit 2 to english

PubMed

"tabletop" or "table-top" or "table top" or "board game" or "boardgame" and "simulation" and "healthcare" and "education"

No advanced options were used