

## Appendix 8.11 Characteristics, interventions and results of included studies (Review 2)

Authors (publication year), Country	Setting/sample	Design	Intervention	Name of instrument to measure safety culture/safety climate	Findings related to safety culture
Aaberg et al. (2019), Norway	Surgical unit Healthcare professionals	Quasi-experimental design with intervention unit and control unit and pre and post measurement after 12 months	TeamSTEPPS programme With 3 steps: Assessment and Planning: Potential sites were assessed, and ward leaders completed TeamSTEPPS instructor training. A joint plan for training and implementation was developed. Training and Implementation: A six-hour team training was conducted for 41 staff over three weeks, including simulations. A Change Team was formed to address patient safety issues, implementing one TeamSTEPPS tool per month with ongoing communication. Sustainment: The Change Team integrated tools into daily routines, with refresher training held at 5 and 11 months. The control group received no formal training	Hospital Survey on Patient Safety Culture  TeamSTEPPS Teamwork Perceptions Questionnaire	Safety culture (n participants intervention=25, n participants control=19) Significant improvement from baseline to follow up in 3 dimensions: Supervisor/Manager Expectations & Actions Promoting Patient Safety (mean change: 0.27, 95% CI: 0.07, 0.49, p:0.03), Communication openness (mean change: 0.26, 95% CI: 0.05, 0.47, p:0.02), and Teamwork within unit (mean change: 0.27, 95% CI: 0.04, 0.51, p:0.03)  Significant better outcome in intervention unit in 2 dimensions: Teamwork within unit (p:0.02), and Overall perception of patient safety (p:0.03) Significant better outcome in intervention unit in 1 single item: Patient safety grade (p:0.01)  Teamwork : Significant improvement in intervention group from baseline to follow up in 3 dimensions: Situation Monitoring (mean change: 0.40, 95% CI: 0.22, 0.48, p:0.001), Mutual Support (mean change: 0.21, 95% CI: 0.03, 0.39, p:0.03), and Communication (mean change: 0.26, 95% CI: 0.06, 0.47, p:0.02)
Aaberg et al. (2021), Norway	Surgical unit Healthcare professionals	Quasi-experimental design with pre and post measurement after 6 (T1) and 12 (T2) months	TeamSTEPPS program With 3 steps: Assessment and Planning: Site leaders approved the TeamSTEPPS program and developed an intervention plan after initial assessments and information sessions. Training and Implementation: A mandatory 6-hour training was conducted over three weeks, followed by the formation of a Change Team to implement five patient safety tools over six months, supported by newsletters and refresher training. Sustainment: Five additional tools were implemented in the second half of the 12-month period, with	Hospital Survey on Patient Safety Culture  TeamSTEPPS Teamwork Perceptions Questionnaire	Safety culture (n pre=35, n T1=28, n T2=25)  Significant improvements from baseline to T1 in 2 dimensions: Organizational learning (mean: 3.82, SD:0.51 to mean: 4.05, SD:0.61 p: 0.01) and Communication openness (mean: 3.83, SD:0.49 to mean: 4.07, SD:0.60, p:0.025)  Significant improvements from baseline to T2 in 3 dimensions: Teamwork within unit (mean: 3.78, SD:0.52 to mean: 4.05, SD:0.51 p: 0.25), Supervisor/Manager Expectations and Actions Promoting Patient Safety (mean: 4.11, SD:0.56 to mean: 4.39, SD:0.52, p:0.012), and Communication openness (mean: 3.77, SD:0.59 to mean: 3.97, SD:0.49, p:0.017)  Teamwork No significant changes from baseline to T1  Significant improvements from baseline to T2 in 3 dimensions: Situation monitoring (mean: 3.70, SD:0.43 to mean: 4.06, SD:0.54; p: 0.001), Mutual support (mean: 3.83, SD:0.44 to mean: 4.03, SD:0.50, p:0.027), and Communication (mean: 3.81, SD:0.39 to mean: 4.02, SD:0.53, p:0.015)

			successes celebrated and refresher training provided		
AbuAlRub and Abu Alhijaa (2014), Jordan	Hospital  Senior nurses	Quasi-experimental design with pre and post measurement after 4 months	Education program Including 7 online courses from the Institute for Healthcare Improvement (IHI). Topics included safety fundamentals, human factors, teamwork, communication, and safety culture. The researcher presented the material and encouraged active participation through assignments and group post-tests.	Hospital Survey on Patient Safety Culture	Safety culture (n pre=57, n post=57) Significant improvements in 2 dimensions: Frequency of event reporting (from 54.2 to 64.3, p:0.043), and Nonpunitive response to errors (from 16.9 to 26.2, p:0.041) Patient safety Adverse event rate decreased statistically (from 32.1 to 20.5, p:0.000) Hospital-acquired pressure ulcer and Patient falls did not change
Ahsan et al. (2021), Indonesia	2 hospitals  56 nurses	Quasi-experimental design with intervention group (n=28) and control group (n=28) and pre and post measurement time period not stated	TeamSTEPPS programme  4 components: leadership, mutual support, situation direction, effective communication between team members	TeamSTEPPS Teamwork Perceptions Questionnaire TeamSTEPPS Teamwork Attitude Questionnaire	No significant differences between groups or over time for both outcomes
Al-Surimi et al. (2021), Saudi Arabia	Hospital  Healthcare professionals	Quasi-experimental design with pre and 2 post measurement (time period not stated)	Accreditation program for healthcare institutions Meso-Level	Hospital survey on patient safety culture	Safety culture (n pre=100, n T1=100, n T2=100) Statistically significant improvement of Teamwork within hospital units (from m:4.1, SD:0.6 to m:4.0, SD:0.7 to m:3.8, SD:0.6, p:0.003), Feedback and communication about errors f(rom m:4.0, SD:0.7 to m:3.8, SD:0.7 to m:3.7, SD:0.9, p:0.011), and Hospital handoffs and transitions (from m:3.5, SD:0.6 to m:3.3, SD:0.9 to m:3.2, SD:0.7, p:0.013) Significant effect on Overall perceptions of safety, Frequency of event reporting, Staff awareness of grading safety culture, and Reporting behaviour
Alcântara de Moraes, Sales de Almeida, and Fontenele Lima de Carvalho (2023), Brazil	Hospital  Healthcare professionals	Quasi-experimental design with pre and post measurement after several months	Safety huddles from TeamSTEPPS programme  Quick encounters with various healthcare professionals and managers, generally lasting 5 to 15 minutes	Hospital Survey on Patient Safety Culture (Brazilian version)	Safety culture (n pre=176, n post=176) Improvement in 11 dimensions: Frequency of reported errors (increase by 7.7%), Perception of security (increase by 18.3, Organizational Learning (increase by 7.8%), Staffing (increase by 0.2%), Teamwork within Units (increase by 16.6%), Communication Openness (increase by 5.8%), Feedback and Communication about Error (increase by 17.7%), and Non-punitive Response to Error (increase by 33.8%) Decrease in dimension Teamwork between units (-0.3%) Patient safety Number of adverse events reported by participants between decrease significantly over time
Andreoli et al. (2010), Canada	Rehabilitation unit	Mixed methods Quasi-experimental design with pre and post measurement after 12 months (quant) and focus group interviews (n=18) (qual)	Situation Background-Assessment-Recommendation (SBAR) from TeamSTEPPS programme	Hospital Survey on Patient Safety Culture  Team Orientation Scale	Safety culture (n pre=74, n post=59) Significant improvement in 9 dimensions: Overall Perceptions of Safety (increase by 20%), Organizational Learning (increase by 14%), Staffing (increase by 16%), Teamwork across Units (increase by 17%), Handoffs and Transitions (increase by 28%), Teamwork within Units (increase by 9%), Communication Openness (increase by 13%), Feedback and Communication about Error (increase by 15%), and Non-punitive Response to Error (increase by 13%) Team Orientation Significant improvement in 4 items that emphasized effective and agreed-upon methods of communication, and a belief that participants' contributions were valued

					<p>Patient safety</p> <p>Falls incidence showed an increasing trend</p> <p>Fall severity and Near misses showed an overall decreasing trend</p>
Ansari et al. (2020), UK	<p>Maternity unit</p> <p>Healthcare professionals</p>	<p>Quasi-experimental design with pre and post measurement 2 months (T1) and 4 months (T2)</p>	<p>Multi-component quality improvement programme</p> <p>Including 5 key components:</p> <ol style="list-style-type: none"> <li>1. Curriculum Components: Focused on situational awareness, communication, decision-making, conflict resolution, teamwork, and leadership.</li> <li>2. Train-the-Trainer Model: Developed faculty to disseminate multidisciplinary training.</li> <li>3. Theoretical Foundations: Delivered through traditional classroom teaching, social media, and cognitive activities.</li> <li>4. Communication Training: Employed forum theater and behavioral simulations to address complex issues.</li> <li>5. Clinical Practice Integration: Utilized regular labor ward simulations to embed training into everyday clinical practice.</li> </ol>	<p>Hospital Survey of Patient Safety Culture</p>	<p>Hospital Survey of Patient Safety Culture (n pre=70, n T1=103, n T2=83)</p> <p>Significant improvement at unit level in 4 domains of Communication openness, Handover, Nonpunitive response to error, and Overall safety perception.</p> <p>Participants felt more empowered to challenge authority, with responses of “most of the time or always” increasing from 33% at pre measurement to 42% at T2 and a 50% drop in those answering “never” (p: 0.02).</p>
Benn et al. (2012), UK	<p>Hospitals</p> <p>19 teams</p>	<p>Quasi-experimental design with post-implementation and post measurement after 1 year</p>	<p>Multi-component quality improvement programme</p> <p>Including multidisciplinary teams focusing on specific care issues, implementing iterative process changes, and regularly reporting results to foster lasting cultural change and enhance patient outcomes.</p>	<p>Organisational patient safety climate and capability</p>	<p>Safety climate (n pre=635, n post=284)</p> <p>Significant improvement of overall score (from 3.04 to 3.18, <math>p&lt;0.001</math> effect size <math>d=-0.32</math>)</p> <p>No significant association between hospital size or type and overall score</p>
Berkowitz, Schreiber, and Paasche-Orlow (2012), US	<p>Rehabilitation unit</p> <p>Healthcare professionals</p>	<p>Quasi-experimental design with pre and post measurement after 6 months (T1) and 12 months (T2)</p>	<p>Multi-component quality improvement programme</p> <p>Including 6 key components:</p> <ol style="list-style-type: none"> <li>1. Biweekly Conferences: Held every two weeks to review cases of avoidable hospital transfers or adverse events.</li> <li>2. Broad Participation: Involvement of direct care staff, patients,</li> </ol>	<p>Nursing Home Survey on Patient Safety Culture</p>	<p>Safety culture (n pre=10, n T1=41, n T2=40)</p> <p>Significant improvement over time in patient safety culture mean score (from mean:3.3, to T1 mean:3.5, to T2 mean:3.9, <math>p &lt; 0.005</math>)</p>

			<p>families, and other relevant personnel.</p> <p>3. Facilitated Discussion: Led by the medical director, with group discussions focused on identifying solutions.</p> <p>4. Action Steps: Development of concrete action steps during the final part of the session.</p> <p>5. Inclusive Scheduling: Meetings held at varied times to allow participation from different shifts, with rotating staff covering essential duties.</p> <p>6. Follow-Up Communication: Lessons shared via email ("tips from TIPS") to ensure widespread learning across all shifts.</p>		
Bhayat, Birch, and Ganado (2020), UK	<p>Neonatal intensive care unit</p> <p>3 units</p> <p>Healthcare professionals</p>	Quasi-experimental design with pre and post measurement after 18 months	<p>TeamSTEPPS programme Including 7 key components:</p> <ol style="list-style-type: none"> <li>1. Team-building consultant session to improve team dynamics.</li> <li>2. TeamSTEPPS training to enhance communication and patient safety.</li> <li>3. Mid-shift huddles for real-time updates.</li> <li>4. Staff recognition awards to boost morale.</li> <li>5. A new team ethos to strengthen teamwork.</li> <li>6. Monthly team focus for continuous improvement.</li> <li>7. Conflict resolution tools to manage disputes effectively.</li> </ol>	TeamSTEPPS Teamwork Perceptions Questionnaire	<p>Teamwork (n pre=26, n post=31)</p> <p>Lowest scoring item: Staff monitor each other's performance, highest: Staff exchange relevant information as it becomes available (specific values not stated)</p> <p>Junior doctors tend to have the most positive ratings in all dimensions apart from "Staff exchanging relevant information as it becomes available" and "Staff advocate for patients even when their opinion conflicts with that of a senior member of the unit" (specific values not stated)</p> <p>Trainees scored "Staff advocate for patients even when their opinion conflicts with that of a senior member of the unit" low. (specific values not stated)</p>
Blegen et al. (2010), US	<p>Hospital</p> <p>3 units</p> <p>Healthcare professionals</p>	Quasi-experimental design with pre and post measurement after 1 year	<p>Multiprofessional team training Including 3 key components:</p> <ol style="list-style-type: none"> <li>1. Multidisciplinary teamwork training: Four-hour sessions combining safety culture education, discussions on medical errors, teamwork skills taught by an aviation safety consultant, role-playing scenarios, and group discussions.</li> <li>2. Unit-based safety teams (TrUSTs): Formed after training, these teams identified and</li> </ol>	Hospital Survey on Patient Safety Culture	<p>Safety culture (n pre=434, n post=368)</p> <p>Significant improvement in 5 dimension: Supervisor manager expectations (from 3.53 to 3.73, <math>p&lt;0.05</math>), Organisational learning (from 3.61 to 3.80, <math>p&lt;0.05</math>), Communication openness (from 3.45 to 3.56, <math>p&lt;0.05</math>), Hospital handoffs and transitions (from 2.71 to 2.87, <math>p&lt;0.05</math>), and Non-punitive response to error (from 2.88 to 3.08, <math>p&lt;0.05</math>)</p> <p>Nurses perceived a stronger safety culture than physicians or pharmacists</p>

			addressed safety issues, fostered collaboration, and led safety improvement activities. 3. Patient engagement: Nurses assisted patients in setting daily goals, which were shared with all care providers for better communication and patient-centered care.		
Brilli et al. (2013), US	Paediatric hospitals	Quasi-experimental design with pre and post measurement after 6 months	Monitoring and reflecting on adverse events Including 6 key components: 1. Error prevention training 2. Leadership Development: 3. Enhanced Root Cause Analysis: 4. Safety Coaching of front-line staff 5. Patient Harm Tracking 6. Technology Enhancements: Wireless communication and safety practices improved medication administration	Safety Attitudes Questionnaire	Safety culture (n not stated) Improvement in Overall safety climate score (from 72 to 76, $p < 0.05$ ) Patient safety Serious safety event Significant decrease of 83.3% ( $p < 0.001$ ) Preventable Harm Index Significant decrease of 53% ( $p < 0.01$ ) Hospital mortality Significant decrease from 1.0% to 0.75% ( $p < 0.001$ ) No significant change in Pressure ulcer Adverse drug event Hospital-acquired infection
Bronkhorst, Tummers, and Steijn (2018), Netherlands	Hospital, mental health care, home health care, and organization providing care for disabled people  Healthcare professionals	Quasi-experimental design with intervention group (n=46 teams) and control group (n=45 teams) and pre and post measurement after 1 year	Multifaceted safety climate intervention program Including 3 key components: 1. Introduction of senior management safety rounds 2. Safety-leadership (SSTL) training for supervisors 3. Use of an online discussion platform for team members followed by regular team-meetings to discuss the online results	PSC-12 four-factor scale	Safety culture (n participants intervention=258, n participants control=262) Significant improvement in intervention group compared to control group at post measurement in 3 dimensions: Senior management priority ( $F = 8.95$ , $p < .01$ , partial $\eta^2 = 0.02$ ), Group norms ( $F = 12.03$ , $p < .01$ , partial $\eta^2 = 0.02$ ), and Communication ( $F = 6.51$ , $p < .05$ , partial $\eta^2 = 0.01$ ). Safety behaviour Significant improvement in intervention group compared to control group at post measurement ( $F = 5.36$ , $p < .05$ , partial $\eta^2 = 0.01$ ) Positive changes in work procedures and positive attitudes and actions of supervisor towards the intervention were associated with higher post-intervention safety climate and safety behavior
Bryan Sexton et al. (2011), US	71 ICUs	Quasi-experimental design with pre and post measurement after 2 years	Comprehensive Unit-Based Safety Program Including 5 steps: 1. Educating teams on safety principles and providing training materials. 2. Identifying and prioritizing patient safety hazards. 3. Partnering with a senior leader for support and accountability. 4. Learning from one safety defect per month to improve risk reduction strategies.	Safety Attitudes Questionnaire	Safety culture (n units pre=71, n units post=71) Significant improvement in 5 items: Medical errors are handled appropriately in this clinical area (from 68.60 to 72.93, $p < 0.006$ ), I receive appropriate feedback about my performance (from 54.53 to 63.98, $p < 0.001$ ), I am encouraged by my colleagues to report any patient safety concerns I may have (from 72.60 to 79.78, $p < 0.001$ ), The culture in this clinical area makes it easy to learn from the errors of others (from 51.73 to 59.79, $p < 0.001$ ), and I know the proper channels to direct questions regarding patient safety in this clinical area (from 80.61 to 85.70, $p < 0.001$ )

			5. Implementing communication tools tailored to local needs.		
Burström et al. (2014), Sweden	Emergency department  2 units from 2 different hospitals (Hospital A and Hospital B)  Healthcare professionals	Quasi-experimental design with pre and post measurement after 2 years	Multi-component quality improvement programme	Hospital Survey On Patient Safety Culture (Swedish version)	Safety culture (n Hospital A: pre=172, n post=181, Hospital B: n pre=118, n post=149) Significant improvement in both hospitals in dimension Teamwork within hospital (from 56.9% to 63.3%, and from 71.7% to 80.1%) Hospital A Significant improvement in dimension Communication openness (from 51.2% to 57.9%). Significant decline in dimension Information and support to staff at adverse events (from 37.6% to 29.7%). Hospital B Significant improvement in dimension Team-work across hospital units (from 34.7% to 43.0%). Significant decline in 3 dimensions: Staffing (from 52.1% to 45.9%), Information and support to patients at adverse events (from 46.3% to 32.7%), and Patient safety grade (from 91.1% to 82.0%)
Campbell and Dontje (2019), US	Emergency department  Nurses	Quasi-experimental design with pre and post measurement after 2 months	Situation Background-Assessment-Recommendation (SBAR) from TeamSTEPPS programme	Hospital Survey on Patient Safety Culture (Handoff scale only)	Safety culture (n not stated) Significant improvement in both items: Important patient care information is often lost during shift change (from 50% to 62%), and Shift changes are problematic in this hospital (from 39% to 47%) Awareness of handoff practices (n not stated) Responses to 2 questions ("I believe all nurses on staff provide complete and accurate handoffs", "I have had a personal incidence of a poor patient outcome related to incomplete handoff"). No change between pre- and post-implementation for 5 of the 7 questions.
Caris et al. (2017), Netherlands	Hospital 8 units	Mixed-Methods Quasi-experimental design with pre and several post measurements over 2 years (quant) and interviews (qual)	Safety Checklist Hygiene checklist Units received a toolkit to create action plans and regular feedback on compliance. Preferred hand rubs were tested, and dispensers were installed at hospital beds for easier access.	Manchester Patient Safety Assessment Framework	Safety culture (n units pre=5, n units post=5) 3 units exhibited proactive or generative safety cultures, while 2 units had bureaucratic or pathological safety cultures. High-performing units had strong safety cultures, whereas low-performing units displayed weaker safety cultures.
Cavalcanti et al. (2016), Brazil	118 ICUs	Cluster randomized trial Intervention group (n= 59 ICUs), control group (n= 59 ICUs), with pre and post measurement after 3 months (T1) and 6 months (T2)	Multi-component quality improvement programme Including a daily checklist and goal setting during multidisciplinary rounds with follow-up clinician	Safety Attitudes Questionnaire	Safety culture (n intervention=3151, n control=3224) Significant difference in intervention group compared with control group in 2 dimensions: Safety climat (OR: 1.27, 95% CI: 1.02 -1.57 vs. OR: 5.4, 95% CI: 0.04 -10.5, p:0.03) and Team work climat (OR: 1.30, 95% CI: 1.08 -1.57 vs. OR: 6.5, 95% CI: 1.9 -11.2, p:0.01) Patient safety In-hospital mortality (n intervention=3327, n control=3434) No significant difference between groups
Chang et al. (2020), US	11 hospitals Cardiac surgery departments	Quasi-experimental design with pre and post measurement (pre July 2011 to October 2011), T1 (October	Comprehensive Unit-Based Safety Program	Hospital Survey on Patient Safety Culture	Safety culture (n pre=450, n T1=921, n T2=448) 1 dimension improved significant from baseline to T2: Hospital management support for patient safety (OR 2.01 95% CI: 1.39-2.92, p <.001)

	Healthcare professionals	2012 to March 2013), and T2 (April 2014 to October 2014)		Team Check-up Tool	<p>2 dimension declined significant from baseline to T2: Feedback and communication about error (OR 0.54 95% CI: 0.39-0.75, p &lt;.001), Staffing (OR 0.55 95% CI: 0.40-0.75, p &lt;.001)</p> <p>Patient safety central line-associated bloodstream infection rates declined from baseline to T1 but increased to T2 (from 1.38 to 0.67 and 0.9) Surgical site infection rates declined from baseline to T1 but increased to T2 (from 2.73 to 1.94 and 2) Ventilator-associated pneumonia rates remained at a median of zero throughout the project</p>
Chang et al. (2019), Malawi	Obstetrical unit  Quasi-experimental design with pre and post measurement after several months	Quasi-experimental design with pre and post measurement after 6 months (T1) and 16 months (T2)	Multi-component quality improvement programme Focusing on postpartum haemorrhage procedural interventions Including training in leadership, situational awareness, and SBAR communication techniques, as well as conflict resolution and huddles. Participants learn to quantify blood loss and manage postpartum hemorrhage, alongside hands-on training in procedures like B-Lynch sutures and uterine artery ligation. The program also features simulations of PPH scenarios, allowing participants to practice skills and engage in debriefing sessions for enhanced learning.	Hospital Survey on Patient Safety	<p>Safety culture (n pre=17, T1=117, T2=146) Significant improvement from pre to T2 in 4 domains: Patient safety grade (from 0% to 49.4% at T1, and 55.7% at T2), Teamwork (from 44.1% to 66.7% at T1 and 70.1% at T2), Communication (from 22.4% to 42.3% at T1 and 46.4% at T2), and Management support and continuous improvement (from 36.6% to 60.2% at T1 and 66.7% at T2) Patient safety (n pre=682, T1=682, T2=953) Significant decrease in Rate of maternal mortality from obstetric hemorrhage (from 8 to 3 at T2, relative change of -82.1%, p: 0.02)</p>
Chu-Weininger et al. (2010), US	ICU  3 units	Quasi-experimental design with pre and post measurement after 4 months	Monitoring and reflecting on adverse events Implementation of tele-ICU technology	Teamwork and Safety Climate survey	<p>Safety culture (n pre=84, n post=71) Significant improvement of Teamwork climate (from 69.7 SD:25.3 to 78.8, SD:17.2, p:0.009) Significant improvement of Safety Climate (from 66.4 SD:24.6 to 78.3.4, SD:18.5, p:0.045) Items related to tele-ICU Significant improvement in 3 items: "Others interrupt my work to tell me something about my patient that I already know" (from 2.5, SD:1.2 to 1.6, SD:1.3), "I am confident that my patients are adequately covered when I am off the unit" (from 3.2, SD:1.3 to 4.2, SD:1.1), and "I can reach a physician in an urgent situation in a timely manner" (from 3.8 SD: 1.2 to 4.6, SD:0.6)</p>
Colón-Emeric et al. (2017), US	24 Nursing homes (intervention group n=12, control group n=12)  Healthcare professionals  Resident data	Cluster-randomized trial	Multi-component quality improvement programme CONNECT (strategies to increase connections, information flow, and cognitive diversity in managing complex clinical problems) FALLS (Falls Management Program) The interventions included two	Safety Organizing Scale	<p>Safety culture (n intervention group=658, n control group=743) Safety climate did not change significant in intervention group (mean:5.08, SE:0.22 to 4.91, SE:0.14)</p> <p>Resident safety (n intervention group=887, n control group=907) Number of fall risk reduction activities: no change in Fall rates: not different between intervention and control facilities (4.06, IQR, 2.03-8.11, vs 4.06, IQR, 2.04-8.11 falls/resident/y)</p>

			classroom sessions, relationship mapping, and self-monitoring.		
Colon-Emeric et al. (2013), US	Nursing homes  Healthcare professionals  Resident data	Cluster-randomized trial Intervention group (n=4 nursing homes), control group (n=4 nursing homes), with pre and post measurement after 3 months (T1) and 6 months (T2)	Multi-component quality improvement programme CONNECT (strategies to increase connections, information flow, and cognitive diversity in managing complex clinical problems) FALLS (Falls Management Program) The interventions included two classroom sessions, relationship mapping, and self-monitoring.	Safety Organizing Scale	Safety culture (n intervention group pre=185, T1=119, T2=100, n control group pre=188, T1=129, T2=118) Significant improvements in safety climate from pre to T2 in intervention group (from mean:4.26, SE:1.31 to 4.40, SE:1.37) and control group (from mean:4.62, SE:1.33 to 4.93, SE:1.33) Communication openness Significant improvement in intervention group from pre to T2 (from mean:3.33, SE:0.72 to 3.44, SE:0.7) Resident safety Fall rates decreased by 12% in intervention group (falls/bed per year: from 2.34 to 2.06) and increased by 1% in control group (falls/bed per year from 2.61 to 2.64)
Cooke (2016), US	Healthcare society  Healthcare professionals	Quasi-experimental design with pre and post measurement after education on intervention	TeamSTEPPS programme	TeamSTEPPS Teamwork Attitudes Questionnaire	Teamwork (n pre=15 n post=15) Significant improvement in Overall attitude scores (from M = 4.305, SD = 0.209 to M = 4.477, SD = 0.184, p:0.005) Learning in relation to teamwork and communication: Significant improvement in Overall knowledge (from M = 90.7, SD = 5.92 to M = 95.7, SD = 4.44, p:0.001)
Damery et al. (2021), UK	29 nursing homes	Mixed methods Quasi-experimental design with pre and 2 post measurement T1= after 1 year, T2=after 2 years) (quant) Interviews in 4 nursing homes at T1 and T2 (qual)	Multi-component quality improvement programme  SPACE intervention with 3 key elements 1. Training: Staff and managers received training in quality improvement (QI) methods, focusing on specific avoidable harms. 2. Tracking and Project Design: Facilitators helped care homes track trends in harms using QI tools and co-designed projects to address identified issues. 3. Community Building: Manager forums, events, and newsletters highlighted achievements and fostered a culture of continuous improvement across homes	Safety Attitudes Questionnaire	Safety culture (n pre=566, n post=565) Significant improvement in item "The culture here makes it easy to learn from the mistakes of others" (from 80.7 to 85.1 at T2, p:0.005) Higher safety climate scores were significantly associated with several factors: job role, full-time employment, qualifications beyond school level, and participation in intervention training. Scores were higher in smaller care homes, homes with lower staff turnover rates, and those with a higher organisational quality rating. Resident safety Significant reductions in falls (from 10.5 to 8.4, p:0.0006), Severe pressure ulcers (0.3 to 0.2, p:0.014), UTIs (0.6 to 0.3, p:0.001) and 'any' events (from 13 to 11, p:0.0003)
Deraniyagala et al. (2015), US	Radiation oncology department  Healthcare professionals	Quasi-experimental design with pre and post measurement after 3 months	Monitoring and reflecting on adverse events  Event-reporting program implementation	Hospital Survey on Patient Safety Culture	Safety culture (n pre and post not stated) Significant increase in item "You know how to report an error you observed in the radiation oncology department" (p:0.04), and "The current error-reporting system should help reduce errors in the future" (p:0.03) (Value per item not reported)



					<p>Patient safety (n=194)</p> <p>Increase in average number of events reported (from 0.9 per month to 8.6 per month)</p>
Desai, Fiumara, and Kachalia (2021), US	<p>Ambulatory care</p> <p>135 ambulatory practices</p>	<p>Quasi-experimental design with pre and 2 post measurement for head nurses after 2 years (T1) and after 4 years (T2)</p>	<p>Ambulatory Safety Program</p> <p>Including creation of a toolkit for managers including the option of personalized training on how to use the safety reporting system to document feedback. We used a mnemonic S-A-F-E-T-Y to help remind managers on how to provide feedback: S = summarize event, A = actions taken, F = follow-up needed, E = educate staff on lessons learned, T = thank the reporter, and Y = remind staff that "you are the key to patient safety." Option for feedback request was added to ambulatory safety reports</p>	<p>Hospital Survey on Patient Safety Culture</p>	<p>Safety culture (n pre &amp; post not stated)</p> <p>2 specific domains:</p> <p>Communication openness decreased (from 65% to 64% at T2), and Communication about error increased (from 63% to 64% at T2)</p> <p>Improvement in dimension Patient care tracking/Follow-up (from 71% to 72% at T2)</p> <p>Decline in all other 7 dimensions from pre to T2 measurement</p>
Dirik and Intepeler (2024), Turkey	<p>Hospital</p> <p>Head nurses and followers</p>	<p>Quasi-experimental design with pre and 2 post measurement for head nurses (T1=after 6 months, T2=after 1 year), and 1 post measurement for fowlowers after 6 months</p>	<p>Educational program on authentic leadership</p> <p>Including 10 sessions and 3 follow-ups over 3 month. It covered authentic leadership, empowerment, and patient safety through exercises, group work, and case studies. Six months later, follow-up sessions reinforced learning with on-site visits. A booklet and keychain were provided to maintain engagement.</p>	<p>Safety Climate Survey</p> <p>Authentic Leadership Questionnaire</p>	<p>Safety climate (n head nurses pre=36, n post=36)</p> <p>Significant improvement from pre to T2 (3.68 to 3.94, p:0.026)</p> <p>(n followers pre=153, n post=153)</p> <p>Significant improvement from pre to pos (3.40 to 3.58, p:0.008)</p> <p>Authentic Leadership</p> <p>Head nurses</p> <p>Significant improvement from pre to T2 (3.44 to 3.45, p:0.002)</p> <p>Followers</p> <p>Significant improvement from pre to pos (2.77 to 2.95, p:0.024)</p> <p>Structural emowerment</p> <p>Head nurses</p> <p>No significant improvement</p> <p>Followers</p> <p>Significant improvement from pre to post (3.03 to 3,32, p:0.000)</p> <p>Significant associaton of Authentic leadership and Structural empowerment with Safety climate</p>
Dodge et al. (2019), US	<p>Ambulatory reproductive care</p> <p>14 sites</p> <p>Healthcare professionals</p>	<p>Mixed methods</p> <p>Quasi-experimental design with pre and 2 post measurement T1= after 6 months, T2=after 1 years) (quant) Interviews (qual)</p>	<p>TeamSTEPPS programme</p> <p>Focusing on 4 tools: Brief, Huddle, Debrife, SBAR</p>	<p>TeamSTEPPS Teamwork Perceptions Questionnaire</p>	<p>Safety culture (10 sites with pre and post measurement, n healthcare professionals = 85 paired at pre and post measurement)</p> <p>Reported findings on item level only</p> <p>No significant improvement for all items after 1 year</p> <p>Item "Leaders inform staff of situations affecting patient care," significantly worse after 1 year (p:0.04)</p>
Donnelly et al. (2009), US	<p>Radiology department</p>	<p>Quasi-experimental design with pre and post measurement after 1 year</p>	<p>Comprehensive Unit-based Safety Program</p>	<p>Hospital Survey on Patient Safety Culture</p>	<p>Safety culture (n= not stated)</p>

			Including error prevention training for all employees, a safety coach program, safety awards, Crucial Conversations training, and operational rounds with radiology leaders. The number of serious safety events (events with deviation from best practice, patient harm, and causation)		Statistical improvement in 9 dimensions: Teamwork within hospital units, Organizational learning, Hospital management support for patient safety, Supervisor and manager expectations and actions promoting safety, Overall perceptions of safety, Communication openness, Feedback and communication about error, and Teamwork across hospital units (Value per dimension not reported) Serious safety events Improvement from every 200 days a serious safety event to every 780 days
Dubois et al. (2017), Sweden	Hospital 2 endoscopy units  Healthcare professionals	Quasi-experimental design with pre and post measurement after 10 months	Safety Checklist Endoscopy safety checklist A multi-professional team developed an endoscopy checklist, incorporating local safety concerns and a person-centred approach. Mandatory training for all staff included presentations on safety culture, a motivational film, and scenario-based team exercises focused on checklist use, communication, and patient involvement.	Safety Attitudes Questionnaire, adapted	Safety culture (n pre=21, n post=21)  No significant change in any dimension from pre to post measurement
Dunn et al. (2017), US	Hospital 2 units (1 intervention, 1 control)  Physicians, nurses Patients	Quasi-experimental design with intervention unit (n=1) and control unit (n=1) and pre and post measurement after 1 year	Internal audits and safety walks Bedside interdisciplinary rounds	Hospital Survey on Patient Safety Culture	Safety culture (n pre=47 (17 physicians, 30 nurses), n post= 52 (22 physicians 30 nurses))  Significant improvement for hospitalists and nurses in 3 dimensions: Teamwork within units (physicians from 4.0 to 4.4, p<0.01, nurses from 3.5 to 3.9, p<0.01), Overall perception of patient safety (h physicians from 3.4 to 4.1, p<0.01, nurses from 3.2 to 3.96 p<0.01), and Patient safety grade (physicians from 3.6 to 4.4, p<0.05, nurses from 3.5 to 3.9, p<0.01) Significant improvement for physicians only in Communication Openness (from 3.7 to 4.3, p<0.01) Patient safety Length of stay (n intervention=1089, n control=916) Reduced for patients transferred to the study units (10.4 vs 14.0 days, p:0.02)  Patient satisfaction (n intervention=175, n control=140) Higher agreement in intervention units than in control units in item "Doctors, nurses, or other hospital staff talk with you about whether you would have the help you needed when you left the hospital" (88% vs 78%, p:0.01).
Edwards et al. (2008), US	2 paediatric hospitals  Healthcare professionals	Quasi-experimental design with pre and post measurement after 15 months	Multi-component quality improvement programme Implementation of Safety rounds, Enhanced self-reporting system, SBAR Training, Transfer of care	Hospital Survey on Patient Safety Culture	Safety culture (n pre=394, n post=428) Significant improvement in 6 dimensions: Frequency of event reporting (from 3.47 to 3.62, p: 0.008), Supervisor/manager expectations and actions (from 3.60 to 3.85, p< 0.001), Organizational learning (from 3.77 to 3.88, p:0.011), Teamwork within units (from 3.98 to 4.14,

			checklists, Electronic medical records		p:0.001), Feedback and communication regarding error (from 3.42 to 3.59, p:0.002), and Nonpunitive response to error (from 3.09 to 3.24, p:0.015) Decrease in 2 dimensions: Teamwork across hospital units (from 3.28 to 3.23), and Hospital handoffs and transitions (from 3.29 to 3.09)
Etemadifar et al. (2021), Iran	ICU 60 nurses	Quasi-experimental design with intervention group (n=30) and control group (n=30) and pre and post measurement after 1 month	Situation Background-Assessment-Recommendation (SBAR) from TeamSTEPPS programme Including 5 educational sessions focusing on enhancing communication about patient issues, medical history, and clinical assessments through discussions and role-playing	Hospital Survey on Patient Safety Culture	Safety culture (n intervention group: pre=30, post=30, n control group pre=30, post=30) Total score for patient safety culture improved significantly in the intervention group (48.6±22.37 vs 30.85±23.26, p < 0.001) Significant higher ratings in intervention group than control group after implementation in 8 dimensions: Overall understanding of patient safety (59.5±19.4 vs 39.2±30.6, p:0.004), Organizational learning (62.1±21.3 vs 21±50, p:0.033), Intradepartmental teamwork (43.1±18.8 vs 31.7±20.7, p:0.03), Openness of communication (52.9±26 vs 17.8±19, p<0.001), Communication and giving feedback on errors feedback (64.4±21.7 vs 27.8±24.9, p<0.001), Staffing (33.6±20.3 vs 20.8±17.5, p:0.012), Interdepartmental teamwork (48.3±30.3 vs 20±18.8, p<0.001), and Hospital handoffs and transitions (52.4±18.8 vs 26.2±20.8, p<0.001)
Etheridge et al. (2024), Singapore	2 Hospitals Operations performed (sample size not stated) Operating room staff (sample size not stated)	Type 2 hybrid implementation-effectiveness Observation period spanned from November 2019 to May 2022, with a significant pause due to the pandemic, affecting the continuity of data collection Survey: baseline from November to December 2019, follow-up from April to July 2022	Safety Checklist Reimplementation of Surgical Safety Checklist based on Exploration, Preparation, Implementation, Sustainment framework	Safety culture outcome Hospital Survey on Patient Safety Culture Oxford Non-Technical Skills	Safety culture (n pre=93, n post= 259 for survey, n pre=161, n post = 91 for observations)  Overall patient safety increased (59.1% to 70.8% , p < .001) Significant improvement in 3 dimensions: Managerial support for patient safety (70.7% to 77.0%; P = .01), Interdisciplinary teamwork (62.7% to 68.8%; P = .02), and Communication openness (44.9% to 50.7%; P = .05)  Oxford Non-Technical Skills scores increasing from 37.1 to 42.4 Device-Related Interruptions improved by decreased of 86.5%, from 21.7 to 2.2 per 100 cases
Frankel et al. (2008), US	2 hospitals	Quasi-experimental design with pre and post measurement after 18 months	Internal audits and safety walks Including 6 key components: 1. Training Sessions: On-site half-day training sessions were held for senior leaders, quality and patient safety personnel, and clinical area managers/directors, featuring a 2-hour presentation on the WalkRounds project. 2. Leadership Orientation: Interested leaders were oriented on WalkRounds concepts, implementation frameworks, and data management processes to ensure program advancement. 3. Linking Safety Concerns: Recommendations were made to connect safety issues identified during WalkRounds to the	Safety Attitudes Questionnaire	Safety culture (n pre=741, n post=702) Significant improvement of Safety culture in one of the two hospitals (from 62% to 77%, p:0.03). Significant improvement in 4 items in both one of the two hospitals: Feeling encouraged by colleagues to report patient safety concerns (Hospital A from 81.23% to 88.04%, p:0.032; Hospital B from 67.85% to 80.62%, p: 0.004), Knowing proper channels to direct patient safety questions (Hospital A from 81.22% to 90.04%, p:0.020; Hospital B from 74.38% to 84.59%, p: 0.002), Easily learning from the errors of others (Hospital A from 64.38% to 78.98%, p:0.031) and Easily discussing errors that occur in their clinical area (Hospital B from 41.88% to 52.08%, p: 0.019) Patient safety issues elicited through WalkRounds Main safety issues by category were Equipment, such as availability or functionality; and Communication, such as incomplete documentation or communication between units

			<p>hospital's operations committee for actionable follow-up.</p> <p>4. Conducting Rounds: Leaders were trained to conduct weekly rounds, integrating this practice into their routines to identify and address patient safety concerns.</p> <p>5. Ongoing Support: Investigators conducted debriefings with leaders and provided coaching calls every two months over two years.</p> <p>6. Database Management: Quality and patient safety personnel organized the WalkRounds and managed a database to track safety concerns, recommendations, and actions taken.</p>		
Gaston et al. (2016), US	<p>Oncological department</p> <p>3 units with total 95 RNs, 35 clinical nurses assistants (CNAs)/healthcare technicians (HCTs), and 14 physicians</p> <p>Total 72 beds</p>	<p>Mixed-methods</p> <p>Quasi-experimental design with pre and post measurement after 1 month (quant) and focus group interviews (qual)</p>	TeamSTEPPS programme	<p>Hospital Survey on Patient Safety Culture</p> <p>TeamSTEPPS Teamwork Perceptions Questionnaire</p>	<p>Safety culture (n pre=109, n post=73)</p> <p>Significant improvements in 2 dimensions: Teamwork within unit (from 74% to 91% after training, <math>t=-3.66</math>; <math>p:0.001</math>), Communication openness (from 58% to 79% after training, <math>t=-4.43</math>; <math>p:0.001</math>)</p> <p>TeamSTEPPS Teamwork Perceptions Questionnaire (n pre=107, n post=73)</p> <p>Significant improvement from baseline to follow up in both dimensions: Team structure (mean: 3.89 to 4.43 (<math>t=-5.62</math>, <math>p:0.000</math>), Communication (mean: 4.08 to 4.58 (<math>t=-6.22</math>, <math>p:0.000</math>))</p>
Gillespie et al. (2017), Australia	<p>4 surgical units</p> <p>Healthcare professionals</p>	<p>Mixed-methods</p> <p>Quasi-experimental design with pre and post measurement after 2 years (quant) and observations and interviews(qual)</p>	<p>Crew Resource Management</p> <p>Focusing on 6 steps:</p> <p>1. Program Overview: Introduction to the aims and structure of the training.</p> <p>2. Situational Awareness Theories:</p> <ul style="list-style-type: none"> <li>- Individual SA: Explanation of Endsley's three levels (perception, understanding, comprehension).</li> <li>- Shared SA: Understanding team members' roles and collective goals.</li> </ul> <p>3. Filmed Simulations: Two scenarios showcasing environmental factors affecting situational awareness and practical use of the WHO Surgical Safety Checklist.</p> <p>4. Discussion: Reflection on simulations and personal</p>	Teamwork and Safety Climate Survey	<p>Safety culture (n pre &amp; post not stated)</p> <p>Nonsignificant increase in perceived safety climate, no improvements teamwork</p> <p>Significant improvements in non-technical skills in all 4 units over time (<math>t_{705} = 11.97</math>, <math>p&lt;0.001</math>).</p> <p>Use of WHO Surgical Safety Checklist improved significantly (<math>p&lt;0.001</math>).</p>

			<p>experiences related to situational awareness.</p> <p>5. Practical Strategies: Enhancing individual and shared situational awareness in surgical settings.</p> <p>6. Conclusion Summary of key insights and encouragement for ongoing application in clinical practice.</p>		
Ginsburg L et al. (2005), Canada	2 hospitals  Nurses in leadership roles	Quasi-experimental design with intervention group and control group and pre and post measurement after 4 months	<p>Educational training Including 2 workshops: Workshop 1: Presented evidence on adverse events, safety theories, and tools for preventing errors and learning from near misses. Workshop 2: Emphasized teamwork, leadership, and using incident reports for safety improvements.</p>	Self-developed questionnaire 3 dimensions: Valuing safety, Fear of negative repercussions, Perceived state of safety	<p>Safety culture (n intervention group: pre=150, post=150, n control group pre=93, post=39) Significant improvement in dimension Valuing safety in intervention group (p:0.001) Significant decline in dimension Perceived state of safety in control group (p:0.05) Leadership support for improvement was found to explain significant amounts of variance in all three patient safety culture measures Workshop attendance explained significant amounts of variance in one of the three safety culture measures.</p>
González-Formoso et al. (2019), Spain	Family and community medicine units	Randomised controlled trial Intervention group 27 tutors/26 residents, control group 23 tutors/ 23 residents Pre and post measurement after 4 months	<p>Multiprofessional team training  With 3 key components Training Workshops: Conducted in 7 areas, each 2-hour workshop covered patient safety concepts, types of errors, and the use of an incident reporting form. Incident Recording: Participants recorded observed incidents and related data for 15 days. Feedback: Participants received an emailed report analysing their submitted data</p>	Hospital Survey on Patient Safety Culture	<p>Safety culture (n intervention group tutors=24, residents=21, n control group tutors=36, residents=2; for both groups n pre=n post) Patient Safety Grade showed a small, non-significant effect of the intervention 3 dimensions had a significant association with Patient safety grade: Management support (estimate -0.66, SD:0.11), Staffing (estimate -0.32, SD:0p12), and Supervisor/manager expectations &amp; actions promoting Patient safety (estimate 0.23, SD:0.14) Patient safety Event reporting increased, particularly in the odds of reporting 3 or more events (OR 13.75) In the adjusted analysis, group and initial values didn't impact Patient safety grade, but did affect Number of events reported.</p>
Gu et al. (2021), China	Emergency department Healthcare professionals	Quasi-experimental design with intervention unit and control unit and pre and post measurement after 3 months	<p>Comprehensive Unit-Based Safety Program Training included theoretical instruction and practical demonstrations. Staff participated in an objective structured assessment, which encompassed a theory test, cardiopulmonary resuscitation operation test, and simulation exercises focused on the inter-hospital transfer of critically ill patients.</p>	Safety Attitudes Questionnaire	<p>Safety culture (n intervention=108 n control=106)</p> <p>Significant improvements in intervention group over all domains after implementation: Job satisfaction (mean:3.91, SD:0.26 to mean:4.27, SD:0.31, p:&lt; 0.05), Teamwork climate (mean:4.06, SD:0.34 to mean:4.36, SD:0.46, p:&lt; 0.05), Working conditions (mean:3.97, SD:0.27 to mean:4.32, SD:0.36, p:&lt; 0.05), Stress recognition (mean:4.15, SD:0.33 to mean:4.45, SD:0.41, p:&lt; 0.05), Safety climate (mean:3.43, SD:0.88 to mean:4.78, SD:1.31, p:&lt; 0.05), and Perception of management (mean:3.96, SD:0.34 to mean:4.29, SD:0.36, p:&lt; 0.05)</p> <p>Non-significant improvements in control group.</p> <p>Patient safety</p>

					<p>(n adverse events intervention=202, n adverse events=224)</p> <p>Significant lower in intervention group vs control group (18.30% vs 37.62%)</p> <p>Causes of adverse events</p> <p>Adverse events related to staff, equipment, and environment significantly lower in intervention group vs control group (<math>P &lt; 0.05</math>)</p>
Haerkens et al. (2018), Netherlands	Emergency department	Quasi-experimental design with pre and 2 post measurement T1= after 1 year, T2=after 2 years)	Crew Resource Management The CRM training covered situational awareness, communication, stress management, and leadership. Each session generated action points, like briefings and checklists, for clinical use. A multidisciplinary CRM Core Group was formed to oversee the implementation of these improvements	Safety Attitudes Questionnaire	<p>Safety culture (n not stated)</p> <p>Safety climate improved significantly in 3 domains, at T1 and T2: Teamwork climate, Safety climate, and Stress recognition (specific values not stated)</p> <p>Patient safety</p> <p>ED length of stay in minutes increased from baseline (141, 102–192) to T1 (161, 116–211) and T2 (170, 128–223)</p> <p>Hospital length of stay was prolonged by 1 day in the implementation and clinical effect years (<math>P &lt; 0.05</math> vs. baseline), whereas mortality was unaltered.</p>
Haller et al. (2008), Switzerland	Obstetrical units Healthcare professionals	Quasi-experimental design with pre and 2 post measurement over 1 year	<p>Crew Resource Management</p> <p>The intervention involved a 2-day mandatory seminar for healthcare professionals.</p> <p>Day 1 featured a film on critical delivery unit situations, discussions on patient safety, and lectures on professional roles and communication.</p> <p>Day 2 focused on workshops and role-playing to improve interprofessional collaboration and stress management.</p> <p>The program was evaluated using Kirkpatrick's framework, assessing satisfaction, learning, behaviour changes, and organizational impact.</p>	Safety Attitudes Questionnaire	<p>Safety culture (n not stated)</p> <p>After 1 year positive change in the team and safety climate in items Exploring the use of briefing and coordination methods and Improvement initiatives following the use of incident reports [OR 2.9, 95% CI (1.3 – 6.3) to OR 4.7, 95% CI (1.2 – 17.2)].</p> <p>Stress recognition improved [OR 2.4, 95% CI (1.2 – 4.8) to OR 3.0, 95% CI (1.0 – 8.8)], improved availability of information [OR 2.4, 95% CI (1.0-5.7)] and the feeling of being part of a big family [OR 2.1, 95% CI (1.0-4.4)].</p> <p>A negative change was observed during the second period in the dimension of perception of management of the questionnaire, in items exploring support and information provision [OR 0.2, 95% CI (0.1–0.6) to OR 0.4, 95% CI (0.1–0.8)]. This change disappeared during the third period.</p>
Hanskamp-Sebregts et al. (2019), Netherlands	Hospital 8 departments Healthcare professionals	Quantitative part of a mixed-methods study Quasi-experimental design with pre and post measurement after 15 months (quant)	Internal audits and safety walks	Hospital Survey on Patient Safety Culture (Dutch version)	<p>Safety culture (n pre=408, n post=423)</p> <p>No dimensions changed significantly</p> <p>Patient safety</p> <p>Adverse event rate decreased non-significantly (36.1% to 31.3%) and preventable Adverse event rate (5.5% to 3.6%)</p> <p>Standardized mortality rate</p> <p>No significant change</p>

					<p>Patient-reported experience measures regarding patient safety Significant improved over time (p &lt;0.001)</p> <p>Safety Walk rounds Medication safety and information security improved significant (p &lt;0.05)</p>
Hassan et al. (2024), Egypt	Hospital  Newly graduated nurses	Quasi-experimental design with pre and 2 post measurement (T1=right after implementation, T2=after 2 months)	TeamSTEPPS programme	Hospital Survey on Patient Safety Culture TeamSTEPPS teamwork perceptions questionnaire	<p>Safety Culture (n pre=132, n T1=132, n T2=132) Significant improvement in teamwork perception from pre (91.02 ± 31.10 ) to T1 (145.27± 12.87) and T2 (142.30 ± 15.74) and patient safety culture from pre (98.42 ± 38.00) to T1 (150.50± 10.68) and T2 (151.11 ± 14.49)</p>
Haugen et al. (2013), Norway	3 operating theatres	Quasi-experimental design with intervention group and control group and pre and post measurement after 9 months	Safety Checklist  Surgical Safety Checklist	Hospital Survey on Patient Safety Culture (Norwegian version)	<p>Safety Culture (n intervention group pre=146, post=140 and n control group pre=203, n post=152)</p> <p>Significant group differences in favour of intervention group in dimensions: Overall patient safety (intervention from 3.63 to 3.69 vs control from 3.51 to 3.57), Organizational learning (intervention from 3.43 to 3.50 vs control from 3.27 to 3.33)</p>
Haugen et al. (2020), Norway	Operating rooms	Quasi-experimental design with pre and two post measurement after 1 year (T1) and 8 years (T2) months	Safety Checklist  Surgical Safety Checklist	Hospital Survey on Patient Safety Culture (Norwegian version)	<p>Safety Culture (n pre=349, n post T1=569, n post T2=610) Significant improvement in 8 dimensions from pre to T2 measurement: Unit managers' support to patient safety (f, Continuous improvement, Teamwork in unit, Error feedback, Nonpunitive, Hospital managers support to patient safety, Teamwork across units, and Information handoffs and transitions Perceptions of safety culture dimensions in 2009 and in 2017 correlated significantly though weakly with fidelity (r=0.07–0.21)</p>
Haynes et al. (2011), US	8 hospitals  Operating rooms	Quasi-experimental design with pre and post measurement after several months	Safety Checklist  Surgical Safety Checklist	Safety Attitudes Questionnaire (Operating room version)	<p>Safety culture (n pre=281, n post=257) Significant improvement in overall score (from 3.91 to 4.01, p:0.013) Degree of improvement in mean Safety attitude score at each site correlated with a reduction in postoperative complication rate (r:0.7143, p:0.0381)</p>
Hefner et al. (2017), US	6 hospitals 8 departments	Quasi-experimental design with pre and post measurement after 2 years	Crew Resource Management  Including training staff to develop and use CRM safety tools, role-playing for conflict management, and setting up a system-wide monitoring process with facilitators and a Steering Committee to ensure compliance.	Hospital Survey on Patient Safety Culture	<p>Safety Culture (n pre=784, n post=667) Significant improvement in 9 dimensions: Teamwork within units (from 72% to 78%), Organizational learning (from 57% to 66%), Management support for patient safety (from 53% to 56%), Overall perceptions of patient safety (from 48% to 56%), Feedback &amp; communication about errors (from 45% to 51%), Communication openness (from 49% to 57%), Teamwork across units (from 40% to 44%), Handoffs &amp; transitions (from 35% to 42%), and Nonpunitive response to errors (from 28% to 35%)</p>
Henkin et al. (2016), US	Hospital  4 medicine teams	Quasi-experimental design with pre and post measurement after 5 months	Internal audits and safety walks  Involved the inclusion of nurses in morning rounds with the medicine teams at the patients' bedside. Based on stakeholder analysis and feedback, a checklist for key	Safety Attitudes Questionnaire	<p>Safety Culture (n pre=182, n post=181) Nurses had lower ratings than residents and attendings in all 11 Dimensions At follow-up the difference remained significant for 1 dimension (Speaking up about patient care (64% of nurses agreeing compared to 79% of residents and 94% of attendings, p:0.02). Resident agreement on nurse input being well received increased from 62% to 82% (p:0.01)</p>

			patient care issues was created and utilized during bedside rounds.		
Hinde et al. (2016), UK	Hospital  Members of theatre teams	Quasi-experimental design with pre and post measurement after 6-12 months	Care simulation training from TeamSTEPPS programme	Safety Attitudes Questionnaire (Operating room version)	Safety Culture (n pre=64, n post=64) Safety climate improved significantly from 65.8 to 73.9 (p:0.001, Cohen's d:0.604) Teamwork climate improved significantly from 73.6 to 78.9 (p:0.013, Cohen's d:0.382)
Hoffmann et al. (2014), Germany	Primary health care	Randomised controlled trial Intervention group n=28 general practices, control group n=32 general practices Pre and post measurement after 12 months	Multi-component quality improvement programme Frankfurt Patient Safety Matrix 2 core elements: Team sessions under the guidance of an external facilitator using A matrix of five safety culture grades (from 'generative' as the most mature, through 'proactive', 'bureaucratic' and 'reactive' to 'dismissive' as the least mature grade) and safety dimensions.  During the team sessions, practice teams reflected on their safety culture and decided on about 10 actions per practice to improve it.	Frankfurt Patient Safety Climate Questionnaire for General Practices	Safety culture (n pre=46, n post=59) No significant differences between intervention and control groups in all 11 dimensions of Safety Climate No significant differences between intervention and control groups in error management (competing probability=0.48, 95% CI 0.34 to 0.63, p=0.823) Intervention group with higher number of incident reports (mean (SD) 4.85 (4.94) vs 3.10 (5.42), p=0.045) and higher quality of incident reports (scoring 2.27 (1.93) vs 1.49 (1.67), p=0.038) than control group.
Hwang and Kim (2022), South Korea	Hospital 3 units 89 nurses	Quasi-experimental design with pre and post measurement after 1 month	National Early Warning Score 2 (NEWS2) system  Training of nurses in early warning scores (EWSs)	Self-developed questionnaire With 4 dimensions patient safety competency, handover quality, teamwork, safety climate	Safety culture (n pre=90, n post=89) Significant improvement in 1 month in 3 dimensions: Handover quality (t = 4.42, p < 0.001), Teamwork (z = 2.68, p:0.004), and Safety climate (t = 2.42, p:0.018)  Patient safety No statistical change in adverse event rates
Isaak et al. (2017), Israel	Psychiatric hospital  4 forensic units  Healthcare professionals	Quasi-experimental design with pre and post measurement after 6 months	Monitoring and reflecting on adverse events  Training program based on Zero tolerance approach	Offshore Safety Questionnaire	Safety culture (n pre=112, n post=85) Significant improvement in Management's commitment to safety (from m:3.85, SD:0.99 to m:4.14, SD:0.88) Decrease in the number of aggressive incidents Decrease in the number of employees injured due to patient violence
Je et al. (2014), South Korea	Hospital  Healthcare professionals	Quasi-experimental design with pre and post measurement after 2 years	Multi-component quality improvement programme  Focusing on cardiopulmonary resuscitation (CPR) Including Communication, equipment standardization, training, and reporting system	Safety Attitudes Questionnaire	Safety culture (n pre=489, n post=575) Significant improvement in all seven domains: Sharing information (from 3.91±0.61 to 4.00±0.50, p=0.006) Training (from 3.46±0.74 to 3.63±0.66, p<0.001) Medical Error Reporting: (from 3.21±0.42 to 3.37±0.37, p<0.001) Safety Climate (from 3.76±0.53 to 3.87±0.42, p<0.001) Job Satisfaction (from 3.50±0.49 to 3.61±0.52, p=0.001) Communication (from 2.96±0.45 to 3.57±0.61, p<0.001) Hospital Management Quality (from 3.12±0.63 to 3.32±0.56, p<0.001)



					Patient safety CPR rates No significant change
Jing Miao et al. (2023), Singapore	Pharmacy 112 pharmacy staff	Quasi-experimental design with pre and post measurement 4 years	Medication Safety Team implementation Focusing on preventing errors through improved labelling, tracking drug-related problems, preventing mix-ups with similar-sounding drugs, and enhancing communication	Pharmacy Survey on Patient Safety Culture	Culture (n pre=46, n post=59) Improvement in all 11 dimensions, highest change in Communication about mistakes (28%), Overall perceptions of patient safety (18%), and Physical space and environment' 16%) Significant improvement in overall patient safety rating at follow-up (p:0.015)
Johnson et al. (2021), India	4 neonatal intensive care unit 144 healthcare professionals	Quasi-experimental design with pre and post measurement (time between measurements not stated)	Comprehensive Unit-Based Safety Program  5 phases (educate staff on the science of safety, engage staff in identifying defects, partner with a senior executive, identify and learn from defects, and implement teamwork tools)	Hospital Survey on Patient Safety Culture	Safety Culture (n pre=182, n post=212) Highest improvement for Management support for patient safety (+7.6%), Teamwork within units (+5.3%), and Organizational learning (+4.7%) Patient safety Hand hygiene compliance odds increased 6% per month [odds ratio (OR 1.06, 95% CI 1.03–1.10) 83% of checklists were fully completed All-cause mortality and HA-BSI rate did not change significantly after CUSP implementation.
Jones et al. (2013), US	37 hospitals Healthcare professionals	Quasi-experimental design with intervention units (n=24) and control units (n=13) pre and post measurement after 12 months	TeamSTEPPS programme Including 5 key components: 1. Baseline Assessment: Evaluating safety culture to identify teamwork and communication weaknesses. 2. TeamSTEPPS Tool Alignment: Matching identified weaknesses with appropriate TeamSTEPPS tools. 3. Train-the-Trainer Course: Training master trainers in April 2008 for implementation in hospitals. 4. Workshops: Addressing disruptive behavior and training coaches in October 2008. 5. Conference Calls: Conducting 17 calls to share strategies for sustaining improvements, with summaries emailed to hospitals	Hospital Survey on Patient Safety Culture	Safety Culture (n pre=/post not stated) Intervention group had significantly greater positive scores than control group in 3 dimensions: Organisational learning (76% vs 71%), Teamwork within departments (82% vs 80%), and Teamwork across hospital departments (67% vs 62%)
Källman et al. (2022), Sweden	Hospital 62 units Healthcare professionals	Quasi-experimental design with intervention units (n=46) and control units (n=16)	Multi-component quality improvement programme  Green Cross (GC) method	Hospital Survey on Patient Safety Culture (Swedish version)	Safety Culture (n participants intervention=1221, n participants control=255)  5 dimension scored significant higher on intervention units: Feedback and communication about error (mean:69.6, SD:17.9 vs mean:50.0, SD:16.9, p <0.001), Nonpunitive response to errors (mean:61.3, SD:14.5 vs mean:50.4, SD:18.4, p :0.04), Organizational learning (mean:65.1, SD:14.5 vs mean:48.4, SD:18.7, p:0.002), Handoffs and transitions between units

					<p>and shifts (mean:42.6, SD:13.1 vs mean:28.9, SD:12.5, <math>p &lt; 0.001</math>), and Teamwork within units (mean:87.7, SD:8.4 vs mean:79.4, SD:12.4, <math>p:0.005</math>)</p> <p>Patient safety Intervention units reported more risks of PAEs per 100 employees than control units (mean: 108.5s vs 59.1: <math>p:0.02</math>) No significant difference in number of PAEs reported between groups</p>
Kemper et al. (2016), Netherlands	6 ICUs  Healthcare professionals	Mixed-methods Quasi-experimental design with intervention units (n=3) and control units (n=3) pre, mid and post measurement after 3 months (T1) and 12 (T2) months (quant) and observation (qual)	Crew Resource Management  The CRM training was a two-day session for ICU staff. It focused on teamwork, communication, and leadership. During the training, participants developed safety initiatives tailored to each ICU. Afterward, the ICUs began implementing these initiatives, with the vendor offering follow-up consultation.	Hospital Survey on Patient Safety Culture (Dutch version)	<p>Safety Culture (n not stated) Improvement in both groups: intervention (from M=3.44, SD=0.29; to M=3.61, SD=0.32) and control (from M=3.55, SD=0.27; to M=3.67, SD=0.33) Significant improvement in intervention group in 2 dimensions: Supervisor/manager expectations and actions promoting patient safety (from M=3.38, SD=0.58 to M=3.66, SD=0.47), and Adequate staffing (from M=3.45, SD=0.79 to M=3.85, SD=0.54) while the control group did not change Error Culture Questionnaire Significant improvement in intervention group in 3 dimensions (Social orientation (from M=3.35, SD=0.57 to M=3.62, SD=0.57), Awareness (from M=2.49, SD=0.46 to M=2.60, SD=0.55), and Mastery (from M=3.56, SD=0.47 to M=3.71, SD=0.44) Job satisfaction and affective commitment Both improved in intervention group but not in control group Patient safety No significant change in Length of stay, Readmissions within 24 h, and ICU mortality</p>
Khan et al. (2024), US	21 paediatric hospitals Nurses, patients, families	Hybrid Type II effectiveness-implementation study with baseline and postimplementation measurement after 12 months  Including surveys and observations	Multi-component quality improvement programme  I-PASS framework (Patient summary-Action items-Situational awareness-Synthesis)  Including Bedside rounding, written rounds summaries, Family and nurse engagement, and Plain language	Children Hospital Safety Climate Questionnaire	<p>Safety cultur (n pre=410, n post=235) Significantly improvement for all 12 items (<math>P &lt; .05</math>), including Working together as a team (90.4% to 93.1% to 94.4%), Staff freely speaking up (83.1% to 84.5% to 89.0%), and Overall safety grade (80.5% to 86.3% to 88.0%) Resident safety No significant change overall, but significant decrease in large hospitals, high adherence to intervention, and if nurse engagement is high Patient and family experience No significant change Family engagement (70.9% to 87.6%), nurse engagement (33.4% to 63.0%), and plain language (50.2% to 60.6%), no change in teaching</p>
Kuy and Romero (2017), US	Veterans Health Administration services Surgical department	Quasi-experimental design with pre and post measurement after 6 and 12 months	Crew Resource Management Including mandatory clinical team training, didactic sessions on situational awareness tools like the "1-2-3 Rule" and communication strategies such as the "3W's" and a "4-step assertive tool"	Safety climate questionnaires	<p>Safety culture (n not stated) Improvement in all 27 items after 6 months, at 12 months sustained improvement in 23 of the 27 items (85%) 4 items (Difficulty speaking up, Expressing disagreement, Staffing levels, Discussing errors) improved after 6 months but deteriorated after 12 months to a worse level than at baseline</p>
Kwon and Duzyj (2024), US	Obstetrical unit Healthcare professionals	Quasi-experimental design with pre and post measurement after 6 months	TeamSTEPPS programme	Hospital Survey of Patient Safety Culture Questionnaire	<p>Safety Culture (n pre=35, n post=29)  No significant improvement over time</p>

				TeamSTEPPS Teamwork Perceptions Questionnaire 2 dimensions (Team structure and Situation monitoring)	Physicians and nurses differed significantly in their perceptions of team dynamics and patient safety behaviours, with nurses expressing more negative views on safety behaviours post-training TeamSTEPPS Teamwork Perceptions Questionnaire 2 dimensions (Team structure and Situation monitoring) No significant improvement found Patient safety Physician attendees had a nonsignificant lower rate of PPH-VD and PPH-CS with unchanged blood loss, but a higher rate of SD compared to nonattenders.
Lai et al. (2023), Taiwan	Hospital 1 unit	Quasi-experimental design with pre and post measurement after 3 days	Safety huddles from TeamSTEPPS programme	Safety Attitudes Questionnaire	Safety culture (n pre=109, n post=109) Improvement in 5 dimensions: Teamwork climate (76.49±16.13 vs 83.26±13.39, p < 0.001), Safety climate (75.07±16.07 vs 82.63±13.72, p < 0.001), Job satisfaction (73.67±19.84 vs 83.39±17.21, p < 0.001), Perceptions of management (77.87±19.99 vs 84.86±16.03, p < 0.001), and Sorking conditions (78.96±18.16 vs 86.18±14.90, p < 0.001) Number of times to participate in a huddle had a significant correlation with teamwork climate (r = 0.33, p < .001), safety climate (r = 0.30, p = 0.002), job satisfaction (r = 0.19, p = 0.043), and work conditions (r = 0.28, p = 0.003)
Lamming et al. (2021), UK	5 Hospitals 92 units Healthcare professionals	Quasi-experimental design with pre and post measurement after 1 year	Safety huddles from TeamSTEPPS programme	Teamwork and Safety Climate survey	Safety culture (n pre=1477, n post=1373)  Positive change all but one of the 27 items (Hospital management does not knowingly compromise the safety of patients) and the overall safety grade of the unit
Lefebvre et al. (2020), Canada	Hospital  Obstetrical unit	Quasi-experimental design with pre and post measurement, follow-up period not stated	Education program including a Workplace Culture Assessment, education and a "Code OB" protocol for emergencies, a "term PROM" protocol, and daily interprofessional morning briefings, all supported by regular coaching and improvement cycles	Safety, communication, operational reliability, and engagement survey	Safety culture (n pre=153, n post=157) Improvements Teamwork, Learning environment, and Safety climate Program effectiveness was highly rated, and most projects showed qualitative improvements
Lemos and Poveda (2022), Brazil	Hospital Operating room	Quasi-experimental design with pre and post measurement after 18 months	Safety Checklist  Patient Safety Checklist: Nursing in Anaesthetic Procedure (PSC/NAP)	Safety Attitudes Questionnaire (Operating room version) Team Climate Inventory	Safety culture (n pre=63 n post=63) Overall score changed significant from 62.5 to 69.2 Team Climate Inventory Score increased after the intervention (p = 0.01) Significant negative relationship between completed PSC/NAP items and SAQ scores (higher task completion may not directly improve safety attitudes)
Lin et al. (2018), US	12 hospitals  Healthcare professionals	Quasi-experimental design with pre and post measurement after 18 months	Comprehensive Unit-Based Safety Program  Hospitals adopted various elements for their intervention bundles, with the most common being preoperative use of chlorhexidine gluconate (87%),	Hospital Survey on Patient Safety Culture	Safety Culture (n not stated) Improvement in 10 of 12 domains: Overall Perception/Patient Safety (from 49% to 53%); Teamwork Across Units (from 49% to 54%); Management-Support Patient Safety (from 53% to 60%); Nonpunitive Response to Error (from 36% to 40%); Communication Openness (from 50% to 55%); Frequency of Events Reported (from 51% to 60%); Feedback/Communication about Error (from 52% to 59%); Organizational Learning/Continuous Improvement (from 59% to

			appropriate antibiotic selection and dosing (73%), standardized debriefing (73%), and separate instrumentation for closing (67%).		70%); Supervisor/Manager Expectations and Actions Promoting Safety (from 58% to 64%); and Teamwork Within Units (from 68% to 75%) (all $p < 0.05$ ) Patient safety Colorectal surgical site infections rate decreased (from 12.08% to 4.63%; $p < 0.01$ )
Magill et al. (2017), US	Department of neurosurgery	Quasi-experimental design with pre and post measurement after 18 months	Safety Checklist  Postoperative debriefing initiative	Safety Attitudes Questionnaire (Operating room version)	Safety culture (n surgeons pre/post=20, n anesthesia pre/post=19, n nurses pre/post=18) Overall safety attitudes improved significant for surgeons (from 4.25 to 4.55), anaesthesia (from 3.46 to 3.89), and nurses (from 3.74 to 4.22) Patient safety Debriefing rate increased from 51% to 86% Debriefing identified OR efficiency concerns in 26.9% Prevention of potential adverse events/ near misses was reported in 8% of cases
Mahoney et al. (2012), US	Psychiatric hospital Healthcare professionals	Quasi-experimental design with pre and post measurement after 1 year	TeamSTEPPS programme	TeamSTEPPS Teamwork Perceptions Questionnaire	Safety culture (n pre=108, n post=147) Significant improvement in 5 dimensions: Team foundation (from 3.76 (0.81) to 4.10 (0.68), $p:0.001$ ), Team functioning from (3.88 (0.81) to 4.16 (0.66), $p:0.003$ ), Team performance (from 3.78 (0.81) to 4.10 (0.64), $p:0.001$ ), Team skills (from 3.76 (0.79) to 4.08 (0.68), $p:0.001$ ), and Climate and atmosphere (from 3.68 (0.87) to 3.97 (0.72), $p:0.004$ )
Mascherek et al. (2016), Switzerland	10 hospitals Members of the Operating Room (OR) teams	Quasi-experimental design with pre and post measurement after 15 months	Safety Checklist  Surgical safety checklists	Teamwork and Safety Climate survey	Safety culture (n pre=742, n post=660) Teamwork and Safety climate improved significant but with small effects Use of surgical checklists, Satisfaction with using the checklist and Subjective knowledge all 3 improved significant Attitudes towards checklist use Dimensions Norms and Intentions improved significant with small effects, no significant change for Attitudes
Mayer et al. (2011), US	ICUs (1 paediatric unit and 1 surgical unit) Healthcare professionals	Mixed-methods Quasi-experimental design with pre, mid and post measurement after 24 (T1) and 42 (T2) months (quant) and interviews (qual)	TeamSTEPPS programme	Hospital Survey on Patient Safety Culture	Safety culture (n pre=36, n T1=72, n T2=87) Teamwork within units improved significant in surgical unit from baseline to T2 Overall perceptions of safety improved significant in paediatric unit and surgical unit from baseline to T2 Communication openness improved significant in paediatric unit and surgical unit from baseline to T2 Observations of Teamwork 6 months postimplementation, observed team performance for leadership, mutual support, and overall leadership remained significantly improved from baseline Average time for placing patients on extracorporeal membrane oxygenation (ECMO) decrease significant
Mazur et al. (2015), US	Radiation oncology department Healthcare professionals	Quasi-experimental design with pre and post measurement after 18 months (T1) and 38 months (T2)	Monitoring and reflecting on adverse events  Implementation of an event learning program Including event analysis and monthly quality assurance (QA) meeting	Hospital Survey on Patient Safety Culture	Safety Culture (n pre=20, n T1=20, n T2=20) Increased on all 11 dimensions significant Overall improvement from 67% to 76% at T1 and 85% at T2 Therapists and physicists reported highest number of events (24% each) 46% of events were caused by performance issues (e.g., not following standardized processes, including suboptimal communications).

McLean et al. (2006), Canada	ICU 112 healthcare professionals	Quasi-experimental design with pre and post measurement after 1 year	Safety Checklist  Model for Accelerating Improvement Reimplementation of weaning protocol	Teamwork and Safety Climate survey	Safety culture (n pre=112, n post=31) No significant improvement from before to after intervention Patient safety Duration of mechanical ventilation (n pre=63, n post=66) Rate of unsuccessful extubations decreased Rate of ventilator-associated pneumonia did not change significantly Duration of mechanical ventilation did not change significantly
Mohsen et al. (2021), Egypt	Primary health care Healthcare professionals	Quasi-experimental design with intervention unit and control unit and pre and post measurement after 3 months	TeamSTEPPS programme	Hospital Survey on Patient Safety Culture  TeamSTEPPS Teamwork Perceptions Questionnaire	Safety culture (n=114)  Significant improvements in 6 month in 11 dimensions: Overall perception of safety ( $\chi^2$ : 89.31, p: <0.001), Organizational learning ( $\chi^2$ : 145.15, p: <0.001), Teamwork within departments ( $\chi^2$ : 175.5, p: <0.001), Communication Openness ( $\chi^2$ : 144.5, p: <0.001), Supervisor/Manager Expectations and Actions Promoting Patient Safety ( $\chi^2$ : 127.5, p: <0.001), Feedback and communication about error ( $\chi^2$ : 142.77, p: <0.001), Nonpunitive response to error ( $\chi^2$ : 15.3, p: <0.001), Hospital management support for patient safety ( $\chi^2$ : 4.98, p: <0.001), Teamwork across departments ( $\chi^2$ : 10.95, p: <0.001), and Hospital handoffs transition ( $\chi^2$ : 35.88, p: <0.001)  Perception of Teamwork Questionnaire (n=114) Significant improvements in 6 month in 5 dimensions: Team structure (t: 17.4, p: <0.001), Leadership (t: 8.96, p: 0.01), Situation monitoring (t: 11.09, p: 0.003), Mutual support (t: 15.17, p: 0.001), and Communication (t: 6.37, p: 0.04) Patient safety (n=108) Patient reported events related to: Diagnosis errors ( $\chi^2$ : 10.77, p: 0.005), Treatment errors ( $\chi^2$ : 6.91, p: 0.03), preventive services errors ( $\chi^2$ : 7.60, p: 0.02), and communication errors ( $\chi^2$ : 6.18, p: 0.046)
Occelli et al. (2019), France	Hospital Intervention group: 9 units; control group: 9 units	Cluster randomized controlled trial with pre and post measurement after 5 months	Monitoring and reflecting on adverse events  Vignette-based analyses of adverse events, focusing on real cases from other hospitals	Hospital Survey on Patient Safety Culture (French version)	Safety Culture (Intervention group pre n=210 and post n=141, control group pre n=191 and post n=148)  Significant higher score in intervention group 1 dimension: Organisational learning (+10.2 points, SD:8.8 vs -3.0 points, SD:8.5) No significant change in other dimensions
Molina et al. (2016), US	13 Hospitals	Quasi-experimental design with pre and post measurements after 1 and 2 years	Safety Checklist  Surgical Safety Checklist	Hospital Survey on Patient Safety Culture, adapted version	Safety Culture (n pre=929 n post=815) Improvement in teamwork (overall teamwork score improvement from mean: 0.291, SD: 0.049, p<0.001)
Müller et al. (2024), Germany	Ambulatory care 184 ambulatory care practices Healthcare professionals	Mixed-methods Quasi-experimental design with pre and post measurement after 16 months (quant) and interviews (qual)	Multi-component quality improvement programme  Frankfurt Patient Safety matrix	Frankfurt Patient Safety Climate Questionnaire for General Practices	Safety Culture (n pre=129, n post=129) Safety climate and safety climate strength improved significantly Psychological behavioural improved in categories "action/coping planning" and "action control."

			Including workshop on error management, safety climate, structured error management, monthly newsletter		Exchange of information between practices also increased over time
O'Leary et al. (2015), US	Hospital 5 general medical units Healthcare professionals	Quasi-experimental design with pre and post measurement after 1 year	Multi-component quality improvement programme  INTERACT intervention Two key components: prepared nurse-physician co-leadership and Structured Interdisciplinary Rounds (SIDR)	Safety Attitudes Questionnaire	Safety Culture (n pre=165, post=222) Teamwork climate improved no significant after 1 year (mean 76.2, SD:14.2 vs 78.3, SD:14.2; p:0.15)  (n pre & post=82, paired sample) Teamwork climate improved significant after 1 year (mean 76.8, SD:14.3 vs 80.5, SD: 11.6; p:0.02), which was driven mainly by improved ratings by nurses (76.4, SD:14.1 vs 80.8, SD:10.4; p:0 .009) Patient safety Adverse event rates Similar at pre and post measurement after 1 year (3.90 vs 4.07 per 100 patient days)
Ohrn, Rutberg, and Nilsen (2011), Sweden	3 hospitals, 50 units (37 medical and 13 psychiatric)	Quasi-experimental design with pre and post measurement after 16, and 36 months	Internal audits and safety walks  Patient Safety Dialogue 3 cycles each with 5 phases (preparation, meeting, assessment, reporting, improvement)	Manchester Patient Safety Assessment Framework	Safety Culture Over two-thirds of the units achieved higher scores in round 3 compared to round, being categorized as either continuously improving or developing units Average scores in medical units were higher than for psychiatric units in all rounds
Pannick et al. (2017), UK	2 Hospitals 7 units Healthcare professionals	Stepped wedge, non-randomised, cluster controlled trial with pre and post measurement after 6 months	Monitoring and reflecting on adverse events  Clinical Team Surveillance Including structured daily interdisciplinary briefings to capture staff concerns, with organisational facilitation and feedback	Safety Attitudes Questionnaire	Safety Culture (n intervention group: pre=61, post=54, n control group pre=85, post=83) Teamwork climate and Safety climate both were non-significantly higher after intervention Patient safety Excess length of stay increased overall with intervention (1714/6518 (26.3%) for intervention admissions vs 1279/4927 (26.0%) control admissions) but was reduced by high-fidelity intervention implementation
Pettker et al. (2009), US	Obstetrical unit Sample size not stated	Quasi-experimental design with pre and post measurement after 1, 2 and 3 years	Crew Resource Management  Focus on outside expert review, protocol standardization, the creation of a patient safety nurse position, and training in team skills and fatal heart monitoring interpretation	Safety Attitudes Questionnaire	Safety culture (n not stated) Teamwork climate of all participants improved from baseline to 3 year follow-up (38.5% to 55.4%) Safety climate of all participants improved from baseline to 3 year follow-up (33.3% to 55.4%)  Teamwork climate of physicians improved from baseline to 3 year follow-up (16.4% to 88.7%) Safety climate of nurses improved from baseline to 3 year follow-up (33.3% to 55.4%)
Picard et al. (2022), France	Operating room 194 healthcare professionals	Mixed-methods Quasi-experimental design with pre and post measurement after one year (quant) and interviews (qual)	Interprofessional simulation-based training course to non-technical skills such as communication, teamwork, leadership, checklist adherence, and safety culture	Hospital Survey on Patient Safety Culture  Teamwork assessment scores	Safety Culture (n pre=516, n post=549)  No significant improvement in all dimension from baseline to follow-up measurement Physicians with significant higher ratings than other healthcare staff Patient safety No significant difference in the rate of procedures with at least one communication failure

					associated with adverse events between the two periods (38% to 43% ) Overall rate of communication failures significantly decreased (29% to 21%, $p < 0.01$ ) Teamwork scores improved significantly (8.1 to 8.6, $p < 0.01$ ) after the intervention
Pitts et al. (2017), US	Primary health care  26 healthcare professionals	Quasi-experimental design with pre and post measurement after 6 months	Comprehensive Unit-Based Safety Program	Safety Attitudes Questionnaire	Safety culture (n pre=23, n post=25) Improved overall from 57% to 64% Safety Climate Scale Improved overall from 83% to 84%
Pronovost PJ et al. (2008), US	99 ICU  Healthcare professionals	Quasi-experimental design with pre and post measurement after 1 year	Comprehensive Unit-Based Safety Program	Safety Attitudes Questionnaire	Safety culture (n pre=72 units, n post=72 units) Improved significant (from 46.5% to 50.5% ( $t = -2.921$ , $p < 0.005$ ))
Reszel et al. (2019), Canada	26 hospitals  Healthcare professionals	Mixed-methods Quasi-experimental design with repeated measurement (1 pre and 3 post measurement (quant) and interviews (qual))	Multi-component quality improvement programme  Managing Obstetrical Risk Efficiently (MORE <sup>OB</sup> )	MORE <sup>OB</sup> Culture Assessment Survey MORE <sup>OB</sup> knowledge test	Safety culture (n pre=773, n 3. post=499) Increased by mean 0.45 (on a scale of 1 to 5, 95% CI: 0.38 to 0.52) MORE <sup>OB</sup> knowledge test (n pre=757, n 3. post=486) Knowledge scores increased by a mean of 7.9 percentage points (95% CI: 7.1 to 8.8) from baseline to 3. post measurement
Riley et al. (2011), US	3 Hospitals Healthcare professionals	Cluster randomized clinical trial With 2 intervention hospitals, 1 control hospital and a pre and post measurement	TeamSTEPPS programme  Intervention I TeamSTEPPS didactic training  Intervention II TeamSTEPPS didactic training and in-situ simulation  No intervention for control group	Safety Attitudes Questionnaire	Safety culture (n not stated) Intervention II Persistent improvement from pre- and postintervention of 37% No significant differences in Intervention I and control group Patient safety Weighted Adverse Outcomes Score Intervention II Improvement from pre- and postintervention of 37.4% Intervention I Improvement from pre- and postintervention of 1% Control group Decrease from pre- and postintervention of 42.7%
Ross, Wolf, and Reece (2014), US	Radiology department  4 units  Healthcare professionals	Quasi-experimental design with pre and post measurement after 18 months	Multi-component quality improvement programme  Human factors training for surgical suites to their workflows. Time-out posters, use of whiteboards, "glitch books," and regular audits provided structure to overcome the risks that human factors present	Safety Attitudes Questionnaire	Safety culture (n not stated) Teamwork climate and Safety climate Improvement in 2 units (from 50.0% to 75.0% and 42.9% to 47.4%) and Decrease in 2 units (from 92.2% to 87.5% and 42.9% to 26.3%)
Savage et al. (2017), Sweden	Paediatric surgical unit  Healthcare professionals	Quasi-experimental design with pre and post measurement after 2 and 4 years	Crew Resource Management  Including systematic risk assessments, and the redesign of work practices captured and reinforced through the	Hospital Survey on Patient Safety Culture (Swedish version)  Team behaviours in clinical practice	Safety Culture (n not stated) Significant improvements over time for 4 dimensions: Non-punitive response to errors (mean from 3.59 to 3.89 ( $F [2.245] = 3.66$ , $p: 0.027$ ), Overall safety perception (mean from 3.27 to 3.70, $F [2.264] = 7.33$ , $p: 0.001$ ), Teamwork across units

			development, implementation and refinement of SOPs		(mean from 3.65 to 4.01, F [2.232] = 5.56, p:0.004), and Supervisors expectations and actions (mean from 3.14 to 3.36, F [2.264] = 4.12, p:0.017) Significant improvement for all teamwork competencies Improved from 0% to 60% immediately after the tool was implemented ( $\chi^2$ for trend = 33.563, $p > \chi^2 = 0.0000$ ).
Schepper et al. (2021), Belgium	Hospital 14 units (8 emergency rooms, 1 intensive care unit and 5 obstetric units)	Mixed-methods Quasi-experimental design with pre and post measurement after 1 month (quant) and interviews (qual)	Crew Resource Management  Including theoretical part and a simulation-based multidisciplinary team training including debriefing	Safety Attitudes Questionnaire	Safety culture (n pre=57, n post=57) Significant improvement in 1 dimension: Perceptions of management (mean difference pre/post: 0.076, p:0.004)
Schmidt et al. (2021), Germany	Hospital Healthcare professionals	Quasi-experimental design with pre and post measurement after 12 months	Multiprofessional team training  Training was conducted in two modules covering the communication practices and providing a set of communication tools that could support local implementations of actions.	Hospital Survey on Patient Safety Culture Self-developed Communication questionnaire With 3 dimensions: 2-Way-Communication Briefing Feedback	Safety Culture (n pre=528, n post=366) Higher scores for participants of training than non-participants in all 3 items, significant improvement for physician in Psychological safety Self-developed Communication questionnaire Higher scores for participants of training than non-participants in all 3 domains, except decrease for nurses in 2-Way Communication Significant improvement for physician in domains Briefing and Feedback
Schwartz et al. (2018), US	33 Veterans Health Administration services	Quasi-experimental design with pre and post measurement after 12 months	Crew Resource Management  Focus on: Shared beliefs and values about the health care delivery system; An organizational commitment to detecting and analysing patient injuries and close calls; Open communication regarding patient injury results, both within and outside the organizations; The establishment of a just culture	Teamwork and Safety Climate survey	Safety Culture (n pre=668, n post=1039) 27 items increased from baseline to 12 months, and 11 of those increases were statistically significant
Sculli et al. (2022), US	Veterans Health Administration service	Quasi-experimental design with pre and post measurement after 6 months (n=20) or 12 months (n=17)	Multi-component quality improvement programme  High-reliability hospital (HRH) model  Including annual patient safety (PS) assessment, annual PS culture survey, annual root cause analysis training, daily leadership walk-arounds, monthly PS forum, annual processes standardization review, Just Culture training, unit-based Clinical Team Training, unit-based continuous improvement projects,	Patient Safety Culture Survey  Teamwork and Safety Climate survey	Safety (n pre=232, n post=1138) Patient Safety Culture Survey Improvement in 12 from 15 items Teamwork and Safety Climate Questionnaire Positive unit-based change from baseline at 6 and 12 months Patient safety Low-harm event reporting increased ( $p < 0.001$ )



			and annual Clinical Team Training simulation education		
Sheth et al. (2016), US	ICU Acute care unit	Quasi-experimental design with pre and post measurement after 2 years	Multi-component quality improvement programme  I-PASS–supported handoff process	Hospital Survey on Patient Safety Culture  2 items: “Things “fall between the cracks” when transferring patients from 1 unit to another” and “Problems often occur in the exchange of information across hospital units”	Safety Culture (n pre = 46, n post = 83) Significant improvement in both items Things “fall between the cracks” when transferring patients from 1 unit to another: from 15.2% to 39.8%, p:0.005 Problems often occur in the exchange of information across hospital units: from 19.6% to 39.8%, p:0.031 Patient safety Transfer latency time Significant reduction from 378 ± 167 minutes to 24 ± 21 minutes
Sim et al. (2022), Singapore	Hospital	Quasi-experimental design with pre and post measurement after 2 and 4 years	Multi-component quality improvement programme Patient Safety Strategy (PSS) Top-down, bottom-up approach to enhance safety culture, involving leadership, departments, and individual staff. Phase 1 established patient safety as key goal. In Phase 2 SWOT analysis identified strengths, weaknesses, opportunities, and threats that contributed to adverse events (AEs) and potential harm. Findings informed strategies to address department-specific threats and weaknesses.	Hospital Survey on Patient Safety Culture	Safety culture (n=15,960 over 4 years) Hospital-wide patient safety improved from 46.5% to 58.3% Improvement in the 10 safety culture domains  Patient safety  AE rate per 100 charts reviewed decreased from 11.6% in 2012 and 5.4% in 2018 (R2 = 0.71, p:0.017). The percentage of admissions with AEs also significantly decreased by more than half from 9.4% to 5.0% (R2 = 0.71, p:0.017). The incidence of preventable AEs displayed a similar decreasing trend from 5.7% in 2012 to 2.0% per 100 charts sampled (R2 = 0.8, p:0.06).
Slater et al. (2012), UK	Various 4 teams general hospital 4 teams mental health service 3 individual general practices	Mixed-methods Quasi-experimental design with pre and post measurement after several months (quant) and interviews (qual)	Multiprofessional team training	Hospital Survey of Patient Safety Culture	Safety culture (n pre=24, n post=24)  Significant improvement in 1 dimension: Communication openness (from mean:3.6 to mean:3.9, t = 3.25, p < 0.01)
St.Pierre et al. (2017), Germany	Anaesthesia department Healthcare staff	Quasi-experimental design with pre and repeated post measurement up to 4 years	Crew Resource Management	Safety Attitudes Questionnaire	Safety culture (n=99 over 4 years) Teamwork climate was significantly higher rated by physicians (mean: 70.6, SD:12.3 (+8.7 points; 95%CI = [4.7; 12.7]; p < 0.001) than nurses at baseline. The average yearly improvement was 3.11 points for the Teamwork climate (p < 0.001) and 2.73 points for the Safety climate (p = 0.001), no change over time for Stress recognition. Participants with longer clinical experience (>10 years) showed the most positive changes

					<p>across all three dimensions.</p> <p>No significant change over time in Speaking-up</p>
Staines et al. (2020), Switzerland	Maternity unit Healthcare professionals	Quasi-experimental design with intervention unit and control unit and pre and post measurement after 12 months	<p>TeamSTEPPS programme Including 4 key components:</p> <ol style="list-style-type: none"> <li>1. Communication* Ensures that critical information is shared clearly and understood by all team members.</li> <li>2. Leadership: Promotes effective communication, monitors the team's situation, manages resources, and fosters mutual support.</li> <li>3. Situation Monitoring: Involves identifying and communicating new or changing information about the patient and environment for informed decision-making.</li> <li>4. Mutual Support: Encourages task assistance, feedback, conflict management, and speaking up within the team.</li> </ol>	Hospital Survey on Patient Safety Culture	<p>Safety culture (n pre=90, n post=99)</p> <p>Significant improvement from baseline to follow up in intervention unit in 3 dimensions: Supervisor/Manager Expectations and Actions Promoting Safety (from 48.7% to 70.8%, <math>p &lt; 0.005</math>); Teamwork Within Unit (from 35.5%, to 54.5%, <math>p &lt; 0.005</math>); Nonpunitive Response to Errors (from 16.7%, to 32.3%, <math>p &lt; 0.005</math>)</p> <p>No significant improvement in control unit</p>
Stead K et al. (2009), Australia	Psychiatric hospital Healthcare professionals	Mixed-methods Quasi-experimental design with pre and post measurement after 8 month (quant) and observations (qual)	<p>TeamSTEPPS programme Staff attended a 2.5-day train-the-trainer workshop on teamwork and communication. These staff then trained colleagues in a condensed 4-hour course.</p> <p>A change team was formed to oversee the implementation, with a focus on sustaining improvements over a 5-month post-training period</p>	<p>Hospital Survey on Patient Safety Culture</p> <p>TeamSTEPPS Teamwork Perceptions Questionnaire</p>	<p>Safety Culture (n pre=45, n post=34)</p> <p>Significant improvements in 2 dimensions: Frequency of event reporting (from 28% to 53% after training, <math>z=2.02</math>; <math>p:0.04</math>), Organisational learning (from 49% to 79% after training, <math>z=2.49</math>; <math>p:0.01</math>)</p> <p>Teamwork Perceptions Questionnaire adapted version (n pre=23, n post=34)</p> <p>Non-significant improvement from baseline in overall score by 7%</p> <p>Patient safety</p> <p>Seclusion rates</p> <p>Significant higher before implementation (<math>z=-4.1</math>, <math>p&lt;0.001</math>)</p>
Teigné et al. (2022), France	Nursing homes Healthcare professionals	Randomised controlled trial Intervention group n=31 nursing homes, control group n=30 nursing homes Pre and post measurement after 18 month	<p>Monitoring and reflecting on adverse events</p> <p>The support system was implemented over nine months, during which two facilitators from the research team worked with each nursing home (NH). Their role was to provide training and coaching throughout the first four sessions of the process. Two staff members from each NH were</p>	Nursing Home Survey on Patient Safety Culture	<p>Safety culture (n intervention group: pre=31, post=28, n control group pre=30, post=30)</p> <p>Significant increase in intervention group from pre to post measurement in 1 dimension: Feedback and communication about incidents (<math>p = 0.044</math>)</p> <p>No significant change in control group</p> <p>Teamwork scores improved when the nursing home had a policy of continuous quality improvement and risk management (<math>\beta = -12.42</math>; 95% CI = [0.71; 24.12]).</p> <p>Supervisor expectations and actions promoting resident safety scores were higher in hospital-based nursing homes but not in independent ones, and when fewer steering group members</p>

			designated as the primary contacts for the project.		intended to apply the knowledge from training ( $\beta = 15.53/-0.49$ ; 95% CI = [2.91; 28.15]/ [-0.87; -0.11]). Resident safety Overall perceptions significantly improved with a higher percentage of steering group members showing leadership and in nursing homes with an active quality improvement approach ( $\beta = 0.14/9.58$ ; 95% CI = [0.01; 0.28]/ [0.89; 18.27]).
Thomas and Galla (2013), US	14 Hospital 2 Long Term Care Facilities Outpatient areas Approximately 2,150 employees	Quasi-experimental design with pre and post measurement after 2 years (T1) and 3 years (T2)	TeamSTEPPS programme Including 3 steps: Implementation Planning: Senior leadership committed to a system-wide rollout, guided by a corporate team with expertise in research and evidence-based practice. Training and Engagement: Objectives aligned with organizational goals, with safety as a core value. A multidisciplinary Change Team ensured sustained engagement. Training included courses for both clinical and nonclinical staff, and a pilot unit tested TeamSTEPPS tools like Briefs, Huddles, and Debriefs. Sustainment and Spread: Sustainment was integrated from the start, and after the pilot's success, TeamSTEPPS expanded to 13 more hospitals and care settings.	Hospital Survey on Patient Safety Culture	Safety Culture (n not stated) Improvement in the dimensions: Feedback and communication about error (9.3% from pre to T2), Frequency of events reported (2.6% from pre to T2), Hospital handoff and transitions (11.3% from pre to T2), Staffing (15.8% from pre to T2), Teamwork across the units (914.1% from pre to T2), Organizational learning (11.7% from pre to T2), and Teamwork within units (11.9% from pre to T2)
Tietschert et al. (2024), US	Hospital 42 hospitals, surgical team members	Quasi-experimental design with pre and post measurement after 1 year	Safety Checklist  Surgical Safety Checklist	Safe Surgical Practice Survey	Safety Culture (n pre=2380, n post=1433) Change in perceptions of overall safety culture by 0.07 on a 6-point scale after the intervention Teamwork culture and the perceived impact of safe practice showed positive changes, with increases of 0.03 and 0.025 Perceived management practices among managers (n managers = 99) Associations were strongest between change in management practice and change in teamwork (b 5 1.26, p , 0.01), followed by change in the overall culture score (b 5 0.83, p , 0.01)
Timmel J et al. (2010), US	Hospital 1 unit Healthcare professionals	Quasi-experimental design with pre and post measurement after 8 months	Comprehensive Unit-Based Safety Program  Based on annual safety culture surveys the CUSP team and the unit staff developed an action plan	Teamwork and Safety Climate survey	Safety culture (n pre=25, n post=28)  Significant improvements in 6 dimensions: Teamwork climate (from 65% to 71%), Safety climate(from 61% to 66%), Job satisfaction (from 61% to 66%), Working conditions (from 48% to 55%) Perceptions of management (from 39% to 47%), Perceptions of unit management (from 62% to 68%)

			to address safety issues (learn from defects).		
van der Nelson et al. (2014), UK	Surgical ward 3 units	Quasi-experimental design with pre and post measurement after 4 months	Situation Background-Assessment-Recommendation (SBAR) from TeamSTEPPS programme	Teamwork and Safety Climate survey	Safety culture (n pre=57, n post=54)  Significant improvements in 1 dimension: Safety climate (p:0.036) Significant deterioration in 2 dimensions: Perceptions of management (p:0.03), Staffing (p:0.17)
Verbakel, de Bont, et al. (2015), Netherlands	Primary health care Healthcare professionals	Accompanying interview study for a three-arm RCT (Verbakel, Langelaan, et al. (2015))	Multiprofessional team training Intervention I: This involved administering the Dutch version Hospital Survey on Patient Safety Culture (SCOPE) questionnaire to general practices. Practices received feedback on their results through an online system.  Intervention II: In addition to the questionnaire, this intervention included a patient safety workshop. The workshop covered education on patient safety concepts, culture, and human factor engineering. It facilitated discussions on the practice's own safety culture using their SCOPE results and aimed to develop an action plan for improvements guided by The Manchester Patient Safety Framework (MaPSaF).	n.a.	Findings reported in Table 7: Barriers, facilitators, implementation strategies and implementation outcomes of included studies Review 2
Verbakel, Langelaan, et al. (2015), Netherlands	Primary health care Healthcare professionals	Three-armed cluster randomized trial (arm 1: control group, arm 2: Intervention I, arm 3: Intervention I & Intervention II) Baseline measurement and follow-up after 12 months	Multiprofessional team training Intervention I: This involved administering the Dutch version Hospital Survey on Patient Safety Culture (SCOPE) questionnaire to general practices. Practices received feedback on their results through an online system.  Intervention II: In addition to the questionnaire, this intervention included a patient safety workshop. The workshop covered education on patient safety concepts, culture, and human factor engineering. It facilitated discussions on the practice's own	Hospital Survey on Patient Safety Culture (Dutch version)	Safety Culture Intervention I (n=57) Improvement from baseline to follow up in dimensions: Handover and teamwork (63.4% vs 74.8%); Communication openness (73.6% vs 80.9%); Feedback about and learning from error (69.8% vs 75.6%); Intention to report events (62.7% vs 68.9%); Adequate procedures and adequate staffing (70.1% vs 80.4%); Overall perception of patient safety management (64.0% vs 69.2%); Patient safety grade (61.0% vs 69.1%) Increase in incident reports from 15 to 82  Intervention II (n=61) Improvement from baseline to follow up in dimensions: Feedback about and learning from error (69.5% vs 75.0%); Overall perception of patient safety management (61.5% vs 84.7%); Expectations and actions of managers (70.2% vs 75.9%); Patient safety grade (54.9% vs 85.2%) Increase in incident reports from 70 to 224  Control group (n=50) Decrease in incident reports from 18 to 4

			safety culture using their SCOPE results and aimed to develop an action plan for improvements guided by The Manchester Patient Safety Framework (MaPSaF).		No significant difference between groups at follow up
Verbeek-van Noord et al. (2019), Netherlands	Hospital 45 hospitals with 171 departments	Quasi-experimental design with pre and post measurement after 5-7 years	Nation-wide patient safety program (PSP)  The program was structured around two key components: the implementation of a Safety Management System and a focus on 10 areas where preventing patient harm was most feasible. These areas included postoperative pain management, postoperative wound infections, acute coronary syndrome, and the care of vulnerable elderly patients.	Hospital Survey on Patient Safety Culture (Dutch version)	Safety Culture (n pre=,779, n post=6,605)  Except Staffing all other dimensions improved significant: Teamwork across departments (from 2.87 to 3.11, $\chi^2 = 39.4$ , $p < 0.001$ ), Teamwork within department (from 3.90 to 3.99, $\chi^2 = 15.0$ , $p < 0.001$ ), Hospital Handoffs and Transitions (from 3.46 to 3.61, $\chi^2 = 26.9$ , $p < 0.001$ ), Frequency of event reporting (from 3.05 to 3.33, $\chi^2 = 40.3$ , $p < 0.001$ ), Non-punitive response to error (from 3.63 to 3.72, $\chi^2 = 5.4$ , $p < 0.05$ ), Communication openness: (from 3.76 to 3.83, $\chi^2 = 4.9$ , $p < 0.05$ ), Feedback and Learning from Errors ( from 3.37 to 3.58 $\chi^2 = 25.7$ , $p < 0.001$ ), Supervisor/Manager expectations and actions promoting safety (rom 3.51 to 3.60, $\chi^2 = 8.1$ , $p < 0.01$ ), Hospital management support for patient safety (from 3.00 to 3.38, $\chi^2 = 44.2$ , $p < 0.001$ ), Overall perception of patient safety (from 3.33 to 3.52, $\chi^2 = 18.1$ , $p < 0.001$ ) Significant between-department variance in 4 dimensions: Frequency of event reporting, Non-punitive response to error, Communication openness, Supervisor/manager expectations and actions No significant changes in between-hospital variances
Vigorito et al. (2011), US	ICU 23 ICUs from 11 hospitals	Quasi-experimental design with pre and post measurement after 12 months	Multi-component quality improvement programme  Unit Safety Attitudes Questionnaire Action Plan toolkit	Safety Attitudes Questionnaire	Safety Culture (n pre=841, n post=918)  Improvements were close to statistical significance for teamwork climate (+18.4% in SAQAP units versus -6.4% , $p = .07$ ) and job satisfaction (+25.9% increase in SAQAP units versus +7.3%, $p = .07$ )  Patient safety Central line-associated blood stream infections rate decreased from 2007 to 2008 by 10.2% on intervention units vs. 2.2% on control units Ventilator-associated pneumonia rate decreased from 2007 to 2008 by 15.2% on intervention units vs. 4.8% on control units
Walther et al. (2022), Switzerland	Anaesthesia department Health care professionals	Quasi-experimental design with pre and post measurement after 22 months	National Speak-up program Various elements including an awareness campaign, an on-line course, simulation-based team training, and explicit invitation to speak-up incorporated into daily practice.	Safety Attitudes Questionnaire	Safety culture (n pre=57, n post=34) Significant improvement in 3 items: In this clinical area, it is difficult to speak up if I perceive a problem with patient care (from median (IQR): 4.0 (4.0 - 4.75) to median (IQR): 5.0 (4.0 - 5.0); $p: 0.0002$ ) In this clinical area, it is difficult to discuss errors: from median (IQR): 4.0 (4.0 - 4.00) to median (IQR): 5.0 (4.0 - 5.0); $p: 0.0022$ , I am encouraged by my colleagues to report any patient safety concerns I may have from: median (IQR): 4.0 (3.0 - 4.00) to median (IQR): 4.0 (3.0 - 5.0); $p: 0.7220$ ) Speaking-Up About Patient Safety Questionnaire (n=65; benchmark n=360): Higher levels in study sample vs. benchmark in psychological safety (mean: 6.2 (SD: 0.6) vs. mean: 5.5 (SD: 1.1), $p<0.001$ ); a more positive encouraging environment(mean: 5.9 (SD: 0.9)

					vs. mean: 4.9 (SD: 1.4), p:<0.001); and resignation toward speaking-up (mean: 2.5 (SD: 1.5) vs. mean: 3.2 (SD: 1.4), p:<0.001).
Watts et al. (2010), US	Veterans Affairs service 63 VA Medical centers	Quasi-experimental design with pre and post measurement after 8 month	Multiprofessional team training  Medical team training (MTT)	Safety Attitudes Questionnaire	Safety culture (n pre=2575, n post=1025) All 6 domains increased significant from baseline to follow-up after 8 month: Teamwork climate (mean: 65.84 (SD:20.58) to mean:72.09 (SD:22.44), p:0.001; Safety climate (mean: 67.40 (SD:19.07) to mean:72.94 (SD:20.88), Job satisfaction (mean: 72.09 (SD:22.15) to mean:73.46 (SD:24.14), p:0.05, Stress recognition: (mean: 68.22 (SD:24.79) to mean:69.74 (SD:25.40), p:0.05, Perception of management: (mean: 56.09 (SD:24.88) to mean:63.72 (SD:28.05), p:0.001, Work conditions: (mean: 60.06 (SD:23.72) to mean:64.31 (SD:24.67)
Weaver et al. (2010), US	Operating theatre	Quasi-experimental design with intervention group (n=112 beds) and control unit (n=297 beds) and pre and post measurement after 1 month	TeamSTEPPS programme  Focusing on 5 key teamwork competences: 1. Communication: Utilizes structured tools and behaviors for effective information exchange among team members, including briefings, time-outs, and debriefings. 2. Leadership: Focuses on maintaining situational awareness through huddles, clearly communicating changes, and delegating tasks effectively. 3. Mutual Support: Encourages respectful feedback, assistance among team members, and assertive communication for escalating safety concerns and resolving conflicts. 4. Situation Monitoring: Involves actively observing team members and the environment to ensure safety and goal progress.	Hospital Survey on Patient Safety Culture	Safety Culture (n not stated) Intervention group and control group increased the percentage of positive responses on all four dimensions from pre to post measurement (Teamwork within unit, Feedback and communication about Error, Communication openness, and Overall patient safety grade. Teamwork within unit improved in both groups from pre to post measurement significant (intervention group: from 75% to 88%, control group from 52% to 72%)
Wong et al. (2021), China	Hospital Approximately 230 staff members and 300 beds	Quasi-experimental design with pre and post measurement after 2 years (T1) and 4 years (T2)	Multi-component quality improvement programme Focusing on Leadership commitment at all levels, Promote culture of trust, reporting and learning, Commit to and communicate priority of patient and workforce safety.	Safety Attitudes Questionnaire	Safety culture (n per time point not stated) Management perception improved from baseline to 4 year post measurement (3.8%) All other dimensions decreased over the same time: Teamwork climate (-6.6%), Safety climate (-36.6%), Job satisfaction (-9.6%), and Working conditions (-4.2%) Non-clinical staff (management or administrative) had higher improvement than clinical staff in Teamwork (mean score >6; p=0.04) Safety culture (mean score >5.8, p=0.019).
Youssef et al. (2017), UK	Haemodialysis department	Quasi-experimental design with intervention group (n=4 units) and control group (n=1)	Multi-component quality improvement programme Including multi-professional teams of 3-4 frontline staff members	Hospital Survey on Patient Safety Culture	Safety Culture (n not stated) Improvements across all domains in intervention units after 12 month, lower improvements or decline in control unit.

		unit) with pre and post measurement after 12 month	were formed, meeting weekly to design and perform plan-do-study-act (PDSA) cycles. The design was flexible, allowing units to focus on their specific clinical indicators while working towards a common goal of excellence in dialysis care.		<p>Patient safety</p> <p>Significant improvement of targeted clinical outcome in all 4 intervention units (unit A catheter-related bloodstream infection from 2.65 to 0.5 per 1,000 catheter days (<math>p = 0.02</math>). Unit B improved attainment of target pre-dialysis blood pressure from 37.5 to 67.2% (<math>p = 0.003</math>). Unit C improved attainment of target urea reduction ratio from 75.8 to 91.4% (<math>p = 0.04</math>). Peritoneal dialysis unit D improved attainment of target haemoglobin from 45.5 to 62.7% (<math>p = 0.01</math>))</p>
Zohar et al. (2017), Israel	Hospital	Randomized control trial with intervention group (n=1 unit) and control group (n=1 unit), with pre measurement and post measurement after 2 months	Head nurses in the intervention group received feedback on their communication with staff nurses, while those in the control group did not. Feedback included departmental ratings, benchmarks, and self-set goals	<p>Teamwork and Safety</p> <p>Climate survey</p> <p>Supervisory leadership questionnaire</p>	<p>Safety culture</p> <p>(n intervention group: pre=141, post=141, n control group pre=144, post=144)</p> <p>Significant increase in intervention group in 4 dimensions: safety climate (13%), teamwork (9%), and supervisory leadership quality (18%) and patient care behaviours (17%)</p>

