

### Additional file 3. Description of included studies.

First author, publication year, country	Study design, number of groups	Setting(s)	Sample	Intervention group(s)	Comparator group(s)	Extracted outcomes
Abraham, 2019 (1), Germany	cRCT, 3 groups	Nursing homes	<ul style="list-style-type: none"> <li>• Clusters: 120</li> <li>• Nurses: IGs 902 (NR for CG)</li> <li>• Patients: NA</li> </ul>	Intervention group 1 <ul style="list-style-type: none"> <li>• Individual Clinician Education (CPG + EMat)</li> <li>• Group Clinician Education (EMeet)</li> <li>• Local Opinion Leaders</li> </ul> Intervention group 2 <ul style="list-style-type: none"> <li>• Individual Clinician Education (CPG + EMat)</li> <li>• Local Opinion Leaders</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (CPG + EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Physical restraints</li> <li>• Patient Health</li> </ul>
Ahmed, 2019 (2), India	NRCCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>• Clusters: 319</li> <li>• Nurses: NR</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Local Opinion Leaders</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Assessment/examination</li> <li>• CP - Counseling/provision of advice</li> <li>• CP - Infection control</li> </ul>
Akande, 2019 (3), Nigeria	NRCT, 2 groups	Hospital, all units	<ul style="list-style-type: none"> <li>• Nurses: 200</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> <li>• Reminders</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Infection control</li> <li>• Knowledge</li> </ul>
Akrami, 2019 (4), Iran	NRCCT, 2 groups	Hospital, critical care, intensive care and emergency care units	<ul style="list-style-type: none"> <li>• Clusters: 2</li> <li>• Nurses: 130</li> <li>• Patients: 130</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Care coordination</li> </ul>
Alhalal, 2020 (5), Saudi Arabia	NRCT, 2 groups	Hospital, medical, surgical, pediatric, psychiatric, emergency care, gynecology, rehabilitation, family practice units	<ul style="list-style-type: none"> <li>• Nurses: 114</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Assessment/ examination</li> <li>• Attitude</li> <li>• Knowledge</li> <li>• Perceived control/self-efficacy</li> </ul>
Aloush, 2007 (6), Jordan	RCT, 2 groups	Hospital, intensive care unit	<ul style="list-style-type: none"> <li>• Nurses: 120</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Infection control</li> </ul>
Antonini, 2021 (7), Switzerland	cRCT, 2 groups	Hospital, haemodialysis care unit	<ul style="list-style-type: none"> <li>• Clusters: 10</li> <li>• Nurses: 126</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Counseling/provision of advice</li> </ul>
Arzani, 2020 (8), Iran	RCT, 2 groups	Hospital, pediatric care unit	<ul style="list-style-type: none"> <li>• Nurses: 120</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• Attitude</li> <li>• CP - Symptom management</li> </ul>
Bagherzadeh, 2021 (9), Iran	NRCT, 2 groups	Hospital, emergency care unit	<ul style="list-style-type: none"> <li>• Nurses: 140</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• Attitude</li> <li>• CP - Counseling/provision of advice</li> </ul>

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Bano, 2022 (10), Pakistan	RCT, 2 groups	Hospital, neonatal intensive care unit	<ul style="list-style-type: none"> <li>Nurses: 72</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Infection control</li> <li>Knowledge</li> </ul>
Behzadi, 2019 (11), Iran	cRCT, 2 groups	Hospital, pediatric intensive care unit	<ul style="list-style-type: none"> <li>Clusters: 5</li> <li>Nurses: 121</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> <li>Reminders</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Infection control</li> </ul>
Bernbug, 2019 (12), Germany	RCT, 2 groups	Hospital, psychiatric unit	<ul style="list-style-type: none"> <li>Nurses: 86</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Counseling/Provision of advice</li> <li>Perceived control/self-efficacy</li> </ul>
Berry, 2022 (13), USA	cRCT, 2 groups	Skilled nursing facility	<ul style="list-style-type: none"> <li>Clusters: 133</li> <li>Nurses: 4479</li> <li>Patients: 7496</li> </ul>	<ul style="list-style-type: none"> <li>Local Opinion Leaders</li> <li>Patient-Mediated Interventions</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP – Immunization</li> </ul>
Bittner, 2002 (14), USA	NRCT, 2 groups	Hospital, intensive care unit	<ul style="list-style-type: none"> <li>Clusters: 2</li> <li>Nurses: NR</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (monitoring the performance of the delivery of healthcare)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Infection control</li> </ul>
Blanco-Mavillard, 2021 (15), Spain	cRCT, 2 groups	Hospital	<ul style="list-style-type: none"> <li>Clusters: 22</li> <li>Nurses: 269</li> <li>Patients: 4,478</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Individual Clinician Education (CPG + EMat)</li> <li>Group Clinician Education (EMeet)</li> <li>Patient-Mediated Interventions</li> <li>Reminders</li> <li>Tailored interventions (TI)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Equipment Management</li> <li>Patient Health</li> </ul>
Boumans, 2005 (16), Netherlands	NRCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>Clusters: 12</li> <li>Nurses: 210</li> <li>Patients: 134 (includes family members)</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (CPG)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Care coordination</li> <li>CP - Documentation</li> <li>Patient Health</li> </ul>
Brady, 2020 (17), UK	Pragmatic, stepped wedge, pilot cRCT, 2 groups	Hospital, stroke rehabilitation unit	<ul style="list-style-type: none"> <li>Clusters: 4</li> <li>Nurses: 112</li> <li>Patients: 325</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Care coordination</li> </ul>
Brennan, 2022 (18), Australia	Stepped wedge, pilot cRCT, 2 groups	Hospital, intensive care unit	<ul style="list-style-type: none"> <li>Clusters: 4</li> <li>Nurses: NR</li> <li>Patients: 2566</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (CPG)</li> <li>Tailored Intervention (TI)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP – Testing/Screening</li> <li>CP – Medication Administration</li> <li>Patient Health</li> </ul>
Bruce, 2007 (19), USA	RCT, 3 groups	Homecare	<ul style="list-style-type: none"> <li>Nurses: 53</li> <li>Patients: 256</li> </ul>	<ul style="list-style-type: none"> <li>Intervention group 1</li> <li>Individual Clinician Education (CPG + EMat)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Care coordination</li> </ul>

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				Intervention group 2 <ul style="list-style-type: none"> <li>Individual Clinician Education (CPG + EMat)</li> <li>Group Clinician Education (EMeet)</li> </ul>		
Bucknall, 2022 (20), Australia	cRCT, 2 groups	Hospital, intensive care units	<ul style="list-style-type: none"> <li>Clusters: 36</li> <li>Nurses: NR</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat)</li> <li>Local Opinion Leaders</li> <li>Reminders</li> <li>Tailored Intervention (TI)</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (CPG + EMat)</li> </ul>	<ul style="list-style-type: none"> <li>CP – Documentation</li> <li>Patient Health</li> </ul>
Carrico, 2007 (21), USA	RCT, 2 groups	Hospital, emergency care unit	<ul style="list-style-type: none"> <li>Nurses: 20</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet), including visual demonstration with a biosimulator (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Infection control</li> <li>Knowledge</li> </ul>
Carroll, 2012 (22), USA	cRCT, 2 groups	Hospital, medical care units	<ul style="list-style-type: none"> <li>Clusters: 8</li> <li>Nurses: NR</li> <li>Patients: 10,383</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (CPG + EMat)</li> <li>Reminders</li> <li>Patient-Mediated Interventions</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Care coordination</li> <li>CP - Documentation</li> </ul>
Chambers, 2022 (23), Canada	cRCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>Clusters: 45</li> <li>Nurses: NR</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (monitoring the performance of the delivery of healthcare)</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat)</li> <li>Local Opinion leaders</li> <li>Reminders</li> <li>Tailored Intervention (TI)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP – Prescription</li> <li>CP – Testing/Screening</li> <li>Patient Health</li> </ul>
Chan, 2013 (24), Canada	cRCT, 2 groups	Public health unit	<ul style="list-style-type: none"> <li>Clusters: 4</li> <li>Nurses: 53</li> <li>Patients: 516</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Symptom management</li> <li>Intention</li> <li>Perceived control/self-efficacy</li> </ul>
Chang, 2016 (25), Taiwan	cRCT, 2 groups	Hospital, intensive care unit	<ul style="list-style-type: none"> <li>Clusters: 4</li> <li>Nurses: 136</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Physical restraints</li> <li>Knowledge</li> </ul>
Charrier, 2008 (26), Italy	cRCT, 2 groups	Hospital, surgery, reanimation, urology-nephrology, emergency care, orthopedics, cardiology, and gynecology–obstetrics units	<ul style="list-style-type: none"> <li>Clusters: 10</li> <li>Nurses: 160</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (monitoring the performance of the delivery of healthcare)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Documentation</li> <li>CP - Infection control</li> <li>CP - Medication administration</li> </ul>
Cheater, 2006 (27), UK	Factorial, cRCT, 4 groups	Community health centres	<ul style="list-style-type: none"> <li>Clusters: 157</li> <li>Nurses: 176</li> </ul>	Intervention group 1 <ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Care coordination</li> </ul>

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			<ul style="list-style-type: none"> <li>Patients: 1078</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> </ul>		<ul style="list-style-type: none"> <li>CP - Counseling/provision of advice</li> <li>CP - Documentation</li> <li>Patient Health</li> </ul>
				<ul style="list-style-type: none"> <li>Intervention group 2</li> <li>Individual Clinician Education (EMat + EO)</li> </ul>		
				<ul style="list-style-type: none"> <li>Intervention group 3</li> <li>Individual Clinician Education (EMat + EO)</li> <li>Audit and feedback (A&amp;F)</li> </ul>		
Chen, 2016 (28), Taiwan	cRCT, 2 groups	Nursing homes, dementia special-care units	<ul style="list-style-type: none"> <li>Clusters: 6</li> <li>Nurses: 37</li> <li>Patients: 195</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG)</li> </ul>	Group Clinician Education (EMeet)	<ul style="list-style-type: none"> <li>CP - Symptom management</li> <li>Patient Health</li> </ul>
Chenoweth, 2022 (29), Australia	NRCT, 2 groups	Hospital, acute aged care, surgical and medical units	<ul style="list-style-type: none"> <li>Nurses: 56</li> <li>Patients: 47</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat)</li> <li>Local Opinion Leaders</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Counseling/provision of advice</li> <li>Patient Health</li> </ul>
Cleland, 2007 (30), UK	cRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>Clusters: 13</li> <li>Nurses: NR</li> <li>Patients: 96400</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>Patient Health</li> <li>CP - Prescription</li> </ul>
Collins, 2021 (31), Tajikistan	cRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>Clusters: 19</li> <li>Nurses: 105</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat + EO)</li> <li>Tailored Intervention (TI)</li> <li>Audit and Feedback (A&amp;F)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Documentation</li> <li>CP - Prescription</li> <li>CP - Testing/Screening</li> <li>Patient Health</li> </ul>
Cone, 1996 (32), USA	NRCT, 2 groups	Hospital, emergency care unit	<ul style="list-style-type: none"> <li>Nurses: 40</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	Usual care	CP - Documentation
Cortez, 2016 (33), USA	cRCT, 2 groups	Hospital, outpatient	<ul style="list-style-type: none"> <li>Clusters: 4</li> <li>Nurses: 50</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG)</li> <li>Reminders</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Documentation</li> <li>Patient Health</li> </ul>
Curtis, 2011 (34), USA	cRCT, 2 groups	Hospital, intensive care unit	<ul style="list-style-type: none"> <li>Clusters: 12</li> <li>Nurses: 309</li> <li>Patients: 1239</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EO)</li> <li>Local Opinion Leaders</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Care coordination</li> <li>Patient Health</li> </ul>
Daly, 2009 (35), Australia	NRCCT, 2 groups	Hospital	<ul style="list-style-type: none"> <li>Clusters: 11</li> <li>Nurses: 308</li> <li>Patients: NA</li> </ul>	Individual Clinician Education (EMat)	Group Clinician Education (EMeet)	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Medication administration</li> </ul>
Davies, 2002 (36), Canada	cRCT, 2 groups	Hospital, maternity unit	<ul style="list-style-type: none"> <li>Clusters: 4</li> <li>Nurses: 1,536</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Counseling/provision of advice</li> </ul>

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Day, 2001 (37), UK	RCT, 2 groups	Hospital, intensive care unit	<ul style="list-style-type: none"> <li>Nurses: 16</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG)</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Other Knowledge</li> </ul>
De Barbieri, 2020 (38), Italy	RCT, 2 groups	Hospital, medical units	<ul style="list-style-type: none"> <li>Nurses: 40</li> <li>Patients: 210</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Counseling/provision of advice</li> <li>Patient Health</li> </ul>
deRond, 2000a (39), Netherlands	NRCCT, 2 groups	Hospital, surgical and medical units	<ul style="list-style-type: none"> <li>Clusters: 2</li> <li>Nurses: 216</li> <li>Patients: 703</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Medication administration</li> <li>CP - Assessment/examination</li> <li>CP - Counseling/provision of advice</li> <li>CP - Documentation</li> </ul>
Delvaux, 2004 (40), Belgium	RCT, 2 groups	Hospital, oncology unit	<ul style="list-style-type: none"> <li>Nurses: 116</li> <li>Patients: 114</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Counseling/Provision of advice</li> </ul>
DeRuijter, 2018 (41), Netherlands	RCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>Nurses: 269</li> <li>Patients: 753</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat + CPG)</li> <li>Group Clinician Education (COP)</li> <li>Tailored interventions (TI)</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Counseling/provision of advice</li> <li>CP - Documentation</li> <li>Knowledge</li> <li>Intention</li> <li>Perceived control/self-efficacy</li> <li>Social norms</li> </ul>
Donati, 2020 (42), Italy	cRCT, 2 groups	Hospital, medical and surgical units	<ul style="list-style-type: none"> <li>Clusters: 6</li> <li>Nurses: 126</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Group Clinician Education (EMeet)</li> <li>Local Opinion Leaders</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Infection control</li> </ul>
Dudener, 2023 (43), Turkey	RCT, 2 groups	Hospital, oncology unit	<ul style="list-style-type: none"> <li>Nurses: 53</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Counseling/provision of advice</li> </ul>
Edwards, 2007 (44), Australia	NRCCT, 2 groups	Hospital, pediatric units	<ul style="list-style-type: none"> <li>Clusters: 2</li> <li>Nurses: 60</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Medication administration</li> <li>Intention</li> <li>Perceived control/self-efficacy</li> <li>Social norms</li> </ul>
Elahi, 2021 (45), Iran	RCT, 2 groups	Hospital, intensive care unit	<ul style="list-style-type: none"> <li>Nurses: 110</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual Care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Counseling/provision of advice</li> </ul>
Elzeky, 2022 (46), Egypt	RCT, 2 groups	Hospital, cardiac units	<ul style="list-style-type: none"> <li>Nurses: 70</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat + CPG)</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>Knowledge</li> </ul>
Emamgholi, 2020 (47), Iran	cRCT, 2 groups	Hospital, neonatal intensive care unit	<ul style="list-style-type: none"> <li>Clusters: 4</li> <li>Nurses: 80</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Other</li> </ul>
Esche, 2015 (48), USA	cRCT, 2 groups	Hospital, acute care units	<ul style="list-style-type: none"> <li>Clusters: 4</li> <li>Nurses: 141</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat), online modules</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Documentation</li> <li>Knowledge</li> </ul>

### Additional file 3. Description of included studies.

					<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> </ul>	
Evans, 1997 (49), USA	cRCT, 2 groups	Public health clinics	<ul style="list-style-type: none"> <li>Clusters: 22</li> <li>Nurses: 42</li> <li>Patients: 61 652</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (CPG + EO)</li> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (CPG)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Care coordination</li> <li>CP - Counseling/provision of advice</li> </ul>
Evans, 2007 (50), Australia	NRCCT, 2 groups	Hospital, medical, surgical, intensive care and emergency care units	<ul style="list-style-type: none"> <li>Clusters: 20</li> <li>Nurses: NR</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F + clinical incident reporting)</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Incident reporting</li> </ul>
Fabre, 2020 (51), USA	NRCT, 2 groups	Hospital, medicine units	<ul style="list-style-type: none"> <li>Nurses: 37</li> <li>Patients: 302</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat)</li> <li>Local Opinion Leaders</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Testing/screening</li> </ul>
Fairall, 2005 (52), South Africa	Pragmatic cRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>Clusters: 40</li> <li>Nurses: NR</li> <li>Patients: 1 999</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EO)</li> <li>Reminders</li> <li>Tailored interventions (Local Consensus Processes)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Care coordination</li> <li>CP - Prescription</li> <li>CP - Testing/screening</li> </ul>
Fakih, 2012 (53), USA	cRCT, 2 groups	Hospital, medical and surgical units	<ul style="list-style-type: none"> <li>Clusters: 10</li> <li>Nurses: 180</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Documentation</li> <li>CP - Equipment management</li> </ul>
Feldman, 2004 (54), USA	RCT, 2 groups	Homecare	<ul style="list-style-type: none"> <li>Nurses: 205</li> <li>Patients: 530</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP – Care coordination</li> </ul>
Filmer, 2020 (55), Germany	NRCT, 2 groups	Homecare	<ul style="list-style-type: none"> <li>Nurses: 214</li> <li>Patients NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Counseling/provision of advice</li> <li>Knowledge</li> </ul>
Forberg, 2016 (56), Sweden	cRCT, 2 groups	Hospital, pediatric care	<ul style="list-style-type: none"> <li>Clusters: 12</li> <li>Nurses: 212</li> <li>Patients: 1 810</li> </ul>	<ul style="list-style-type: none"> <li>Reminders</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Infection control</li> <li>Patient Health</li> </ul>
Francke, 1996 (57), Netherlands	cRCT, 2 groups	Hospital, surgical units	<ul style="list-style-type: none"> <li>Clusters: 10</li> <li>Nurses: 134</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Counseling/provision of advice</li> <li>CP - Symptom management</li> <li>CP - Assessment/examination</li> </ul>
Francke, 1997 (58), Netherlands	cRCT, 2 groups	Hospital, surgical units	<ul style="list-style-type: none"> <li>Clusters: 10</li> <li>Nurses: 134</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> </ul>

### Additional file 3. Description of included studies.

Friese, 2019 (59), USA	cRCT, 2 groups	Hospital, outpatient oncology clinics	<ul style="list-style-type: none"> <li>• Clusters: 12</li> <li>• Nurses: 415</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat)</li> <li>• Reminders</li> <li>• Audit and feedback (A&amp;F + clinical incident reporting)</li> <li>• Tailored interventions (TI)</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat)</li> <li>• Reminders</li> </ul>	<ul style="list-style-type: none"> <li>• Attitude</li> <li>• CP - Infection control</li> <li>• Knowledge</li> </ul>
Funk, 2017 (60), USA	cRCT, 2 groups	Hospital, cardiac care units	<ul style="list-style-type: none"> <li>• Clusters: 17</li> <li>• Nurses: 3,013</li> <li>• Patients: 4,587</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat)</li> <li>• Local Opinion Leaders</li> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat)</li> <li>• Local opinion leaders</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Assessment/examination</li> <li>• Knowledge</li> <li>• Patient Health</li> </ul>
Galfin, 2011 (61), UK	cRCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>• Clusters: 2</li> <li>• Nurses: 10</li> <li>• Patients: 71</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Counseling/provision of advice</li> <li>• Patient Health</li> <li>• Perceived control/self-efficacy</li> </ul>
Gao, 2022 (62), China	RCT, 2 groups	Hospitals, surgical care units	<ul style="list-style-type: none"> <li>• Nurses: NR</li> <li>• Patients: 312</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (CPG)</li> <li>• Tailored Intervention (Local Consensus Processes)</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (CPG)</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Symptom Management</li> <li>• Patient Health</li> </ul>
Gengiah, 2021 (63), South Africa	cRCT, 2 groups	Primary health clinics	<ul style="list-style-type: none"> <li>• Clusters: 40</li> <li>• Nurses: 16 (nurse supervisors, but number of nurses is probably higher)</li> <li>• Patients: 13 347</li> </ul>	<ul style="list-style-type: none"> <li>• Audit and feedback (A&amp;F + monitoring the performance of the delivery of healthcare + CQI)</li> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (CPG + EMat + EO)</li> <li>• Local Opinion Leaders</li> <li>• Tailored Intervention (Local Consensus Processes)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP – Testing/Screening</li> </ul>
Ghazali, 2020 (64), Malaysia	RCT, 2 groups	Hospital, emergency care unit	<ul style="list-style-type: none"> <li>• Nurses: 143</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Tailored interventions (TI)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Assessment/examination</li> <li>• Skills</li> </ul>
Gomarverdi, 2019 (65), Iran	cRCT, 2 groups	Hospital, intensive care units	<ul style="list-style-type: none"> <li>• Clusters: 2</li> <li>• Nurses: 30</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat + CPG)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Infection control</li> <li>• Knowledge</li> </ul>
Gould, 1997 (66), UK	NRCT, 2 groups	Hospital, surgical care units	<ul style="list-style-type: none"> <li>• Nurses: 50</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Infection control</li> </ul>
Grommi, 2021 (67), Finland	RCT, 2 groups	Hospitals, surgical care units	<ul style="list-style-type: none"> <li>• Nurses: 50</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (CPG)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP – Documentation</li> <li>• Knowledge</li> </ul>
Hammersley, 2014 (68), UK	cRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>• Clusters: 38</li> <li>• Nurses and physicians: 38</li> <li>• Patients: 341</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat + CPG)</li> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat + CPG)</li> </ul>	<ul style="list-style-type: none"> <li>• Patient Health</li> <li>• CP - Prescription</li> </ul>
Happ, 2014 (69), USA	NRCCT, 3 groups	Hospital, intensive care unit	<ul style="list-style-type: none"> <li>• Clusters: 6</li> <li>• Nurses: 42</li> <li>• Patients: 127</li> </ul>	<ul style="list-style-type: none"> <li>Intervention group 1</li> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Counseling/provision of advice</li> </ul>

### Additional file 3. Description of included studies.

				Intervention group 2 <ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat + EO)</li> </ul>		
Happ, 2015 (70), USA	Pragmatic, stepped-wedge, cRCT, 2 groups	Hospital, intensive care unit	<ul style="list-style-type: none"> <li>Clusters: 8</li> <li>Nurses: 383</li> <li>Patients: 1440</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> <li>Local Opinion Leaders</li> <li>Reminders</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Documentation</li> <li>CP - Physical restraints</li> <li>Knowledge</li> <li>Patient Health</li> </ul>
Harrison, 2000 (71), South Africa	cRCT, 2 groups	Primary care clinics	<ul style="list-style-type: none"> <li>Clusters: 10</li> <li>Nurses: NR</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat + EO)</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (CP)</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP – Care coordination</li> <li>CP - Counseling/provision of advice</li> </ul>
Hasnain, 2019 (72), Australia	cRCT, 2 groups	Hospital, stroke units	<ul style="list-style-type: none"> <li>Clusters: 20</li> <li>Nurses: 344</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F + monitoring the performance of the delivery of healthcare)</li> <li>Group Clinician Education (EMeet + IPE)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Medication administration</li> <li>Skills</li> </ul>
Hasselblad, 2022 (73), USA	cRCT, 2 groups	Hospital, medical care, surgical care units	<ul style="list-style-type: none"> <li>Clusters: 2</li> <li>Nurses: 82</li> <li>Patients: 3800</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Medication administration</li> <li>Patient Health</li> </ul>
Hendryx, 1998 (74), USA	cRCT, 2 groups	Hospital, intensive care units	<ul style="list-style-type: none"> <li>Clusters: 20</li> <li>Nurses: NR</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Individual Clinician Education (EO)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Medication administration</li> <li>CP - Testing/screening</li> <li>Patient Health</li> </ul>
Hessig, 2004 (75), USA	NRCT, 3 groups	Hospital, hematology and oncology units	<ul style="list-style-type: none"> <li>Nurses: 47</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Control group 1</li> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Symptom management</li> <li>Knowledge</li> </ul>
					<ul style="list-style-type: none"> <li>Control group 2</li> <li>Usual care</li> </ul>	
Hlungwane, 2021 (76), South Africa	NRCT, 3 groups	Hospital, intensive care units	<ul style="list-style-type: none"> <li>Nurses: 127</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Intervention group 1</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat + EO)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Equipment Management</li> <li>Knowledge</li> </ul>
				<ul style="list-style-type: none"> <li>Intervention group 2</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat)</li> </ul>		
Hödl, 2019 (77), Netherlands	cRCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>Clusters: 12</li> <li>Nurses: NR</li> <li>Patients: 381</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat)</li> <li>Reminders</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP – Infection control</li> <li>Patient Health</li> </ul>
				Intervention group 1		



### Additional file 3. Description of included studies.

Hong, 1990 (78), Hong Kong	cRCT, 3 groups	Hospital, surgical care units	<ul style="list-style-type: none"> <li>• Clusters: 6</li> <li>• Nurses: 220</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Local Opinion Leaders</li> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Infection control</li> <li>• Knowledge</li> </ul>
				Intervention group 2 <ul style="list-style-type: none"> <li>• Local Opinion Leaders</li> </ul>		
Huang, 2009 (79), Taiwan	cRCT, 2 groups	Hospital, medical care, surgical care, intensive care units	<ul style="list-style-type: none"> <li>• Clusters: 2</li> <li>• Nurses: 128</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (CPG)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• Attitude</li> <li>• CP - Physical restraints</li> <li>• Knowledge</li> </ul>
Huis, 2013 (80), Netherlands	cRCT, 2 groups	Hospital	<ul style="list-style-type: none"> <li>• Clusters: 67</li> <li>• Nurses: 905</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Audit and feedback (A&amp;F)</li> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> <li>• Reminders</li> <li>• Local Opinion Leaders</li> <li>• Tailored interventions (TI)</li> </ul>	<ul style="list-style-type: none"> <li>• Audit and feedback (A&amp;F)</li> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> <li>• Reminders</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Infection control</li> </ul>
Huizing, 2006 (81), Netherlands	cRCT, 2 groups	Nursing home	<ul style="list-style-type: none"> <li>• Clusters: 5</li> <li>• Nurses: 23</li> <li>• Patients: 157</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat + EO)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP – Physical restraints</li> </ul>
Huizing, 2009 (82), Netherlands	cRCT, 2 groups	Nursing home	<ul style="list-style-type: none"> <li>• Clusters: 14</li> <li>• Nurses: 48</li> <li>• Patients: 138</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (CPG + EMat + EO)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP – Physical restraints</li> </ul>
Hutchinson, 2020 (83), Australia	cRCT, 2 groups	Hospital, medical care, surgical care units	<ul style="list-style-type: none"> <li>• Clusters: 4</li> <li>• Nurses: 106</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Audit and feedback (A&amp;F)</li> </ul>	<ul style="list-style-type: none"> <li>• Audit without feedback</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Medication administration</li> </ul>
Jansink, 2013 (84), Netherlands	cRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>• Clusters: 58</li> <li>• Nurses: 65</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (CPG + EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Counseling/provision of advice</li> <li>• Skills</li> </ul>
Jansson, 2014 (85), Finland	RCT, 2 groups	Hospital, intensive care units	<ul style="list-style-type: none"> <li>• Nurses: 40</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet), simulation with feedback and debriefing</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet), simulation</li> </ul>	<ul style="list-style-type: none"> <li>• CP – Assessment/examination</li> <li>• CP – Infection control</li> <li>• Knowledge</li> </ul>
Jansson, 2016 (86), Finland	RCT, 2 groups	Hospital, intensive care units	<ul style="list-style-type: none"> <li>• Nurses: 40</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet), simulation with feedback and debriefing</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet), simulation</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Infection control</li> <li>• Knowledge</li> </ul>
Jansson, 2017 (87), Finland	RCT, 2 groups	Hospital, intensive care units	<ul style="list-style-type: none"> <li>• Nurses: 40</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Equipment management</li> <li>• Knowledge</li> </ul>
Jeihooni, 2018 (88), Iran	RCT, 2 groups	Hospital	<ul style="list-style-type: none"> <li>• Nurses: 120</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> <li>• Reminders</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• Attitude</li> <li>• CP - Infection control</li> <li>• Knowledge</li> <li>• Perceived control/self-efficacy</li> </ul>
Jo, 2015 (89), South Korea	NRCT, 2 groups	Hospital, intensive care units	<ul style="list-style-type: none"> <li>• Nurses: 42</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Attitude</li> <li>• CP - Counseling/provision of advice</li> </ul>

### Additional file 3. Description of included studies.

Johnson, 2019 (90), Australia	cRCT, 2 groups	Hospital, medicine, surgical, aged care, haematology-oncology, palliative care units	<ul style="list-style-type: none"> <li>• Clusters: 8</li> <li>• Nurses: 68 IG (CG NR)</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Medication administration</li> </ul>
Johnston, 2007 (91), Canada	cRCT, 2 groups	Hospital, pediatric care units	<ul style="list-style-type: none"> <li>• Clusters: 6</li> <li>• Nurses: 112</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Audit and feedback (A&amp;F)</li> <li>• Individual Clinician Education (EMat)</li> <li>• Local opinion leaders</li> </ul>	<ul style="list-style-type: none"> <li>• Audit and feedback (monitoring the performance of the delivery of healthcare)</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Documentation</li> <li>• CP - Medication administration</li> <li>• CP - Symptom management</li> <li>• Knowledge</li> </ul>
Jones, 1998 (92), UK	cRCT, 2 groups	Hospital, stroke rehabilitation units, general medical wards	<ul style="list-style-type: none"> <li>• Clusters: 6</li> <li>• Nurses: 116</li> <li>• Patients: 40</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP – Care coordination</li> <li>• Knowledge</li> </ul>
Kalinowski, 2015 (93), Germany	cRCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>• Clusters: 12</li> <li>• Nurses: NR</li> <li>• Patients: 747</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (CPG + EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP – Symptom management</li> </ul>
Kaner, 2003 (94), UK	cRCT, 3 groups	Primary care	<ul style="list-style-type: none"> <li>• Clusters: 212</li> <li>• Nurses: NR</li> <li>• Patient: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Intervention group 1</li> <li>• Individual Clinician Education (Educational Outreach Visits) + Support</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (CPG)</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Counseling/provision of advice</li> </ul>
				<ul style="list-style-type: none"> <li>• Intervention group 2</li> <li>• Individual Clinician Education (Educational Outreach Visits)</li> </ul>		
Karvinen, 2017 (95), Canada	RCT, 2 groups	Hospital, oncology care units	<ul style="list-style-type: none"> <li>• Nurses: 54</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• Attitude</li> <li>• CP - Counseling/provision of advice</li> <li>• Knowledge</li> <li>• Perceived control/self-efficacy</li> </ul>
Kavak, 2019 (96), Turkey	RCT, 2 groups	Hospital, psychiatric care units	<ul style="list-style-type: none"> <li>• Nurses: 126</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• Attitude</li> <li>• CP - Physical restraints</li> <li>• Knowledge</li> </ul>
Khodadadi, 2013 (97), Iran	RCT, 2 groups	Hospital, medical, surgical units	<ul style="list-style-type: none"> <li>• Nurses: 73</li> <li>• Patients: 160</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Counseling/provision of advice</li> <li>• Perceived control/self-efficacy</li> <li>• Skills</li> </ul>
Kim, 2007 (98), South Korea	NRCT, 2 groups	Hospital, operating room	<ul style="list-style-type: none"> <li>• Nurses: 26</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Audit and feedback (clinical incident reporting)</li> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> <li>• Reminders</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Infection control</li> </ul>
Kim, 2014 (99), South Korea	RCT, 2 groups	Hospital, oncology care units	<ul style="list-style-type: none"> <li>• Nurses: 32</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (COP)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• Attitude</li> <li>• CP - Counseling/provision of advice</li> </ul>

### Additional file 3. Description of included studies.

						<ul style="list-style-type: none"> <li>• Knowledge</li> </ul>
Kim, 2022 (100), South Korea	RCT, 2 groups	Hospital, medical units	<ul style="list-style-type: none"> <li>• Nurses: 60</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> <li>• Reminders</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP – Assessment/examination</li> <li>• Knowledge</li> <li>• Perceived control/self-efficacy</li> <li>• Skills</li> </ul>
Kinsman, 2021 (101), Australia	NRCT, 2 groups	Hospital, medical units	<ul style="list-style-type: none"> <li>• Nurses: 126</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat), web-based</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat), face-to-face</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Assessment/examination</li> <li>• CP – Documentation</li> <li>• CP - Equipment Management</li> </ul>
Koh, 2009 (102), Singapore	cRCT, 2 groups	Hospital, medical, surgical, and geriatric units	<ul style="list-style-type: none"> <li>• Clusters: 2</li> <li>• Nurses: 641</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Audit and feedback (A&amp;F)</li> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (CPG + EMat)</li> <li>• Local opinion leaders</li> <li>• Reminders</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Assessment/examination</li> <li>• Knowledge</li> <li>• Patient Health</li> </ul>
Köpke, 2012 (103), Germany	cRCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>• Clusters: 36</li> <li>• Nurses: NR</li> <li>• Patients: 3771</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (CPG + EMat + EO)</li> <li>• Tailored interventions (TI)</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• CP – Physical restraint</li> <li>• Patient Health</li> </ul>
Kroth, 2006 (104), USA	RCT, 2 groups	Hospital, medical care, surgical care units	<ul style="list-style-type: none"> <li>• Nurses: 144</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Reminders</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Assessment/examination</li> </ul>
Kyriacos, 2015 (105), South Africa	Pragmatic, cRCT, 2 groups	Hospital, general, vascular, and orthopedic surgery units	<ul style="list-style-type: none"> <li>• Clusters: 6</li> <li>• Nurses: 122</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> <li>• Managerial supervision</li> <li>• Reminders</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Documentation</li> <li>• Knowledge</li> </ul>
Kyriacos, 2019 (106), South Africa	cRCT, 2 groups	Hospital, medical care, surgical care units	<ul style="list-style-type: none"> <li>• Clusters: 2</li> <li>• Nurses: 47</li> <li>• Patients: 363</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Reminders</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Assessment/examination</li> <li>• Patient Health</li> </ul>
Lacko, 1999 (107), USA	NRCT, 2 groups	Hospital	<ul style="list-style-type: none"> <li>• Nurses: IG 25 (CG: NR)</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat)</li> <li>• Local opinion leaders</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP – Assessment/examination</li> </ul>
Lau, 2017 (108), USA	cRCT, 2 groups	Hospital, medical care, surgical care units	<ul style="list-style-type: none"> <li>• Clusters: 21</li> <li>• Nurses: 933</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat), interactive learner-centric dynamic scenario-based education</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat), static</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Medication administration</li> </ul>
Lee, 2015 (109), South Korea	NRCCT, 2 groups	Hospital, gastroenterology care unit	<ul style="list-style-type: none"> <li>• Clusters: 2</li> <li>• Nurses: NR</li> <li>• Patients: 233</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Equipment management</li> <li>• Patient Health</li> </ul>
Lim, 2020 (110), Malaysia	cRCT, 4 groups	Primary care	<ul style="list-style-type: none"> <li>• Clusters: NR</li> <li>• Nurses: 45</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Intervention group 1</li> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Control group 1</li> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• Attitude</li> <li>• CP - Assessment/examination</li> </ul>

### Additional file 3. Description of included studies.

				Intervention group 2	Control group 2	
				<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Counseling/provision of advice</li> <li>Knowledge</li> <li>Skills</li> </ul>
Lin, 2008 (111), Taiwan	NRCT, 2 groups	Hospital, surgical care units	<ul style="list-style-type: none"> <li>Nurses: 81</li> <li>Patients: 40</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> <li>Reminders</li> <li>Tailored interventions (TI)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Symptom management</li> <li>Knowledge</li> </ul>
Liu, 2010 (112), Taiwan	cRCT, 2 groups	Community health centres	<ul style="list-style-type: none"> <li>Clusters: 10</li> <li>Nurses: 163</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat + EO)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Care coordination</li> <li>Knowledge</li> <li>Perceived control/self-efficacy</li> </ul>
Liu, 2020 (113), China	RCT, 2 groups	Hospital, surgical care units	<ul style="list-style-type: none"> <li>Nurses: NR</li> <li>Patients: 210</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Equipment management</li> </ul>
Locke, 2011 (114), USA	NRCCT, 2 groups	Hospital, surgical care units	<ul style="list-style-type: none"> <li>Clusters: 2</li> <li>Nurses: 58</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Testing/screening</li> </ul>
Lundgren, 1999 (115), Sweden	cRCT, 2 groups	Hospital, surgical care, internal medicine units	<ul style="list-style-type: none"> <li>Nurses: 36</li> <li>Patients: 99</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Documentation</li> <li>CP - Equipment management</li> <li>Patient Health</li> </ul>
Magill, 2018 (116), UK	Pragmatic cRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>Clusters: 23</li> <li>Nurses: 23</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> <li>Managerial supervision</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Counseling/provision of advice</li> </ul>
Magnan, 2008 (117), USA	NRCT, 2 groups	Hospital, acute care units	<ul style="list-style-type: none"> <li>Nurses: 1,401</li> <li>Patients: 102</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> </ul>
Mäki-Turja-Rostedt, 2020 (118), Finland	cRCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>Clusters: NR</li> <li>Nurses: 141</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat + EO)</li> <li>Reminders</li> <li>Tailored interventions (local consensus process)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Counseling/provision of advice</li> <li>CP - Documentation</li> </ul>
Mancheril, 2021 (119), USA	NRCT, 2 groups	Hospital, acute care units	<ul style="list-style-type: none"> <li>Nurses: 205</li> <li>Patients: 478</li> </ul>	<ul style="list-style-type: none"> <li>Audit and Feedback (A&amp;F)</li> <li>Reminders</li> <li>Individual Clinical Education (EMat + CPG)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>Patient Health</li> </ul>
Manias, 2011 (120), Australia	cRCT, 2 groups	Hospitals, subacute care, geriatric care units	<ul style="list-style-type: none"> <li>Clusters: 2</li> <li>Nurses: 44</li> <li>Patients: 96</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Symptom management</li> <li>Patient Health</li> </ul>
Marcantonio, 2010 (121), USA	cRCT, 2 groups	Skilled nursing facility	<ul style="list-style-type: none"> <li>Clusters: 8</li> <li>Nurses: NR</li> <li>Patients: 457</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat + EO)</li> <li>Local opinion leaders</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Care coordination</li> <li>CP - Symptom management</li> <li>Patient Health</li> </ul>

### Additional file 3. Description of included studies.

				<ul style="list-style-type: none"> <li>• Patient-mediated interventions</li> </ul>		
Maruyama, 2022 (122), Japan	RCT, groups	Perinatal Hospitals and midwifery clinics	<ul style="list-style-type: none"> <li>• Nurses: 88</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP – Counseling/Provision of advice</li> <li>• Knowledge</li> </ul>
Mazzuca, 1987 (123), USA	cRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>• Clusters: 7</li> <li>• Nurses: 29</li> <li>• Patients: 150</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (CPG + EMat + EO)</li> <li>• Reminders</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP - Assessment/examination</li> <li>• CP - Care coordination</li> <li>• CP - Counseling/provision of advice</li> </ul>
McDonald, 2005 (124), USA	RCT, 3 groups	Homecare	<ul style="list-style-type: none"> <li>• Nurses: 336</li> <li>• Patients: 673</li> </ul>	Intervention group 1 <ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat + EO)</li> <li>• Reminders</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP – Assessment/examination</li> <li>• CP – Documentation</li> </ul>
				Intervention group 2 <ul style="list-style-type: none"> <li>• Reminders</li> </ul>		
Memon, 2022 (125), Pakistan	NRCT, 2 groups	Hospital, gynecology and obstetrics unit	<ul style="list-style-type: none"> <li>• Nurses: 90</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (CPG + EMat)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP – Assessment/examination</li> <li>• Knowledge</li> </ul>
Meyer, 2001 (126), South Africa	cRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>• Clusters: 24</li> <li>• Nurses: NR</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP - Prescription</li> </ul>
Meyer, 2003 (127), Germany	cRCT, 2 groups	Nursing home	<ul style="list-style-type: none"> <li>• Clusters: 49</li> <li>• Nurses: NR</li> <li>• Patients: 942</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat + EO)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP - Equipment Management</li> <li>• Patient Health</li> </ul>
Michaels, 2007 (128), USA	NRCCT, 2 groups	Hospital, medicine, surgical, critical care, geriatrics, and pediatrics units	<ul style="list-style-type: none"> <li>• Clusters: 19</li> <li>• Nurses: NR</li> <li>• Patients: 911</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (CPG + EMat)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP - Symptom management</li> </ul>
Middleton, 2011 (129), Australia	cRCT, 2 groups	Hospital, acute stroke units	<ul style="list-style-type: none"> <li>• Clusters: 20</li> <li>• Nurses: NR</li> <li>• Patients: 735</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EO)</li> <li>• Group Clinician Education (EMeet + IPE)</li> <li>• Local opinion leaders</li> <li>• Reminders</li> <li>• Tailored interventions (TI)</li> </ul>	Individual Clinician Education (CPG)	<ul style="list-style-type: none"> <li>• CP - Assessment/examination</li> <li>• Patient Health</li> </ul>
Morita, 2009 (130), Japan	RCT, 3 groups	Hospital, general practice and palliative care units	<ul style="list-style-type: none"> <li>• Nurses: 41</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> <li>• Tailored interventions (TI)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• Attitude</li> <li>• CP - Counseling/provision of advice</li> <li>• Perceived control/self-efficacy</li> </ul>
Morita, 2014 (131), Japan	RCT, 2 groups	Hospital, palliative care, medical care units	<ul style="list-style-type: none"> <li>• Nurses: 76</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• Attitude</li> <li>• CP - Counseling/provision of advice</li> <li>• Knowledge</li> <li>• Intention</li> <li>• Perceived control/self-efficacy</li> </ul>

### Additional file 3. Description of included studies.

Mousavi, 2022 (132), Iran	NRCT, 2 groups	Hospital, emergency, medical care, surgical care units	<ul style="list-style-type: none"> <li>Nurses: 68</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat + EO)</li> <li>Reminders</li> </ul>	Individual Clinician Education (EO)	<ul style="list-style-type: none"> <li>CP - Equipment Management</li> <li>Knowledge</li> </ul>
Muller-Staub, 2008 (133), Switzerland	cRCT, 2 groups	Hospital, medical care, surgical care units	<ul style="list-style-type: none"> <li>Clusters: NR</li> <li>Nurses: NR</li> <li>Patients: 225</li> </ul>	Group Clinician Education (EMeet), including guided clinical reasoning	Group Clinician Education (EMeet)	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Documentation</li> </ul>
Murtaugh, 2005 (134), USA	RCT, 3 groups	Homecare	<ul style="list-style-type: none"> <li>Nurses: 388</li> <li>Patients: NR</li> </ul>	Intervention group 1 <ul style="list-style-type: none"> <li>Individual Clinician Education (CPG + EMat)</li> <li>Reminders</li> </ul>	Usual care	CP - Assessment/examination
				Intervention group 2 <ul style="list-style-type: none"> <li>Individual Clinician Education (CPG + EMat + EO)</li> <li>Reminders</li> </ul>		
Nakatani, 2012 (135), Japan	cRCT, 2 groups	Community health centres	<ul style="list-style-type: none"> <li>Clusters: 100</li> <li>Nurses: NR</li> <li>Patients: NR</li> </ul>	Individual Clinician Education (CPG + EMat)	Usual care	CP - Counseling/provision of advice
Nemati, 2022 (136), Iran	cRCT, 2 groups	Hospital, medical care units	<ul style="list-style-type: none"> <li>Clusters: 2</li> <li>Nurses: 67</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> <li>Reminders</li> </ul>	Usual care	CP – Care coordination
Noome, 2017 (137), Netherlands	cRCT, 2 groups	Hospital, intensive care units	<ul style="list-style-type: none"> <li>Clusters: 12</li> <li>Nurses: 265</li> <li>Patients: 33 (family member of patients)</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (CPG)</li> <li>Group Clinician Education (EMeet)</li> <li>Local opinion leaders</li> </ul>	Individual Clinician Education (CPG)	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Care coordination</li> <li>CP - Counseling/provision of advice</li> <li>CP - Documentation</li> <li>Knowledge</li> </ul>
Noordman, 2014 (138), Netherlands	NRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>Nurses: 17</li> <li>Patients: 325</li> </ul>	Audit and feedback (A&F)	Usual care	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>Skills</li> </ul>
Nowalk, 2005 (139), USA	NRCT, 2 groups	Community health centres	<ul style="list-style-type: none"> <li>Nurses: NR</li> <li>Patients: 1587</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet + IPE)</li> <li>Individual Clinician Education (EO)</li> <li>Patient-mediated interventions</li> <li>Reminders</li> <li>Tailored interventions (TI)</li> </ul>	Usual care	CP - Immunization
O'Neil, 2016 (140), USA	NRCCT, 2 groups	Hospital, medical care units	<ul style="list-style-type: none"> <li>Clusters: 8</li> <li>Nurses: NR</li> <li>Patients: 5,170</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Infection control</li> <li>Patient Health</li> </ul>
O'Neill, 1999 (141), Canada	RCT, 2 groups	Hospital, medical care units	<ul style="list-style-type: none"> <li>Nurses: 70</li> <li>Patients: 110</li> </ul>	Group Clinician Education (EMeet)	Usual care	CP - Testing/screening
Ogden, 1997 (142), UK	RCT, 3 groups	Primary care	<ul style="list-style-type: none"> <li>Nurses: 240</li> </ul>	Intervention group 1 <ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	Usual care	Attitude

### Additional file 3. Description of included studies.

			<ul style="list-style-type: none"> <li>Patients: 179</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> </ul>		<ul style="list-style-type: none"> <li>CP - Care coordination</li> <li>CP - Counseling/provision of advice</li> <li>Knowledge</li> <li>Perceived control/self-efficacy</li> </ul>
				<ul style="list-style-type: none"> <li>Intervention group 2</li> <li>Individual Clinician Education (EMat)</li> </ul>		
Omidi, 2020 (143), Iran	RCT, 2 groups	Hospital, oncology care units	<ul style="list-style-type: none"> <li>Nurses: 70</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Care coordination</li> <li>CP - Counseling/provision of advice</li> <li>CP - Symptom management</li> <li>Knowledge</li> </ul>
Oniki, 2003 (144), USA	NRCT, 3 groups	Hospital, intensive care units	<ul style="list-style-type: none"> <li>Nurses: NR</li> <li>Patients: 180</li> </ul>	<ul style="list-style-type: none"> <li>Intervention group 1</li> <li>Reminders</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Documentation</li> </ul>
				<ul style="list-style-type: none"> <li>Intervention group 2</li> <li>Reminders</li> </ul>		
Pagaiya, 2005 (145), Thailand	cRCT, 2 groups	Community health centres	<ul style="list-style-type: none"> <li>Clusters: 18</li> <li>Nurses: 18</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (CPG + EMat + EO)</li> <li>Audit and feedback (A&amp;F)</li> <li>Group Clinician Education (EMeet)</li> <li>Tailored interventions (local consensus processes)</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (CPG)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Prescription</li> <li>CP - Testing/screening</li> </ul>
Park, 2021 (146), South Korea	NRCT, 2 groups	Hospital, long-term care unit	<ul style="list-style-type: none"> <li>Nurses: 60</li> <li>Patients: 60</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat)</li> <li>Tailored Intervention (TI)</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> <li>Reminders</li> <li>Audit and Feedback (CQI)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Care coordination</li> <li>Knowledge</li> <li>Patient Health</li> </ul>
Parker, 2013 (147), USA	cRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>Clusters: 37</li> <li>Nurses: 175</li> <li>Patients: 699</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> <li>Reminders</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Counseling/provision of advice</li> <li>Perceived control/self-efficacy</li> </ul>
Passos, 2022 (148), Brazil	cRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>Clusters: 28</li> <li>Nurses: 110</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Infection control</li> <li>Knowledge</li> </ul>
Pauwels, 2018 (149), Indonesia	NRCCT, 2 groups	Community health centres	<ul style="list-style-type: none"> <li>Clusters: 2</li> <li>Nurses: NR</li> <li>Patients: 231</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> </ul>
Pitkälä, 2014 (150), Finland	cRCT, 2 groups	Assisted living facilities	<ul style="list-style-type: none"> <li>Clusters: 20</li> <li>Nurses: NR</li> <li>Patients: 227</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet + IPE)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Medication administration</li> <li>Patient Health</li> </ul>

### Additional file 3. Description of included studies.

Quintard, 2010 (151), France	NRCT, 2 groups	Hospitals	<ul style="list-style-type: none"> <li>Nurses: 74</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Tailored interventions (TI)</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Infection control</li> </ul>
Rankin, 2013 (152), Canada	RCT, 2 groups	Hospital, emergency care unit	<ul style="list-style-type: none"> <li>Nurses: 132</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> </ul>
Rantz, 2001 (153), USA	cRCT, 3 groups	Nursing homes	<ul style="list-style-type: none"> <li>Clusters: 113</li> <li>Nurses: NR</li> <li>Patients: 7,385</li> </ul>	Intervention group 1 <ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Medication administration</li> <li>CP - Physical restraints</li> <li>Patient Health</li> </ul>
				Intervention group 2 <ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat + EO)</li> <li>Tailored interventions (TI)</li> </ul>		
Reynolds, 2021 (154), USA	Stepped-wedge, cRCT, 2 groups	Hospital, intensive care units	<ul style="list-style-type: none"> <li>Clusters: 14</li> <li>Nurses: NR</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Individual Clinician Education (EMat + EO)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP – Documentation</li> <li>Knowledge</li> <li>Patient Health</li> </ul>
Rhew, 1999 (155), USA	NRCT, 3 groups	Hospital, outpatient clinics	<ul style="list-style-type: none"> <li>Nurses: NR</li> <li>Patients: 3,502</li> </ul>	Intervention group 1 <ul style="list-style-type: none"> <li>Individual Clinician Education (CPG)</li> <li>Patient-mediated interventions</li> <li>Reminders</li> <li>Audit and feedback (A&amp;F)</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (CPG)</li> <li>Patient-mediated interventions</li> <li>Reminders</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Immunization</li> </ul>
				Intervention group 2 <ul style="list-style-type: none"> <li>Individual Clinician Education (CPG)</li> <li>Patient-mediated interventions</li> <li>Reminders</li> </ul>		
Roelands, 2004 (156), Belgium	NRCCT, 2 groups	Homecare	<ul style="list-style-type: none"> <li>Clusters: 23</li> <li>Nurses: 64</li> <li>Patients: 140</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (CPG + EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Counseling/provision of advice</li> <li>Perceived control/self-efficacy</li> <li>Social norms</li> </ul>
Rothschild, 2005 (157), USA	NRCT (time series), 2 groups	Hospital, intensive care units	<ul style="list-style-type: none"> <li>Nurses: NR</li> <li>Patients: 735</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (clinical incident reporting)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Medication administration</li> </ul>
Rutherford-Hemming, 2016 (158), USA	NRCT, 2 groups	Hospital, obstetric care units	<ul style="list-style-type: none"> <li>Nurses: 64</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet), simulation with debriefing</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet), online learning modules</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>Knowledge</li> </ul>
Sadeghi, 2018 (159), Iran	NRCT, 2 groups	Hospital, emergency care units	<ul style="list-style-type: none"> <li>Nurses: 100</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Infection control</li> </ul>



### Additional file 3. Description of included studies.

				<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> </ul>		<ul style="list-style-type: none"> <li>Knowledge</li> <li>Perceived control/self-efficacy</li> </ul>
Sævareid, 2019 (160), Norway	cRCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>Clusters: 8</li> <li>Nurses: NR</li> <li>Patients: 151</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Counseling/provision of advice</li> <li>CP - Documentation</li> </ul>
Sarna, 2012 (161), USA	RCT, 2 groups	Hospital, medical care, surgical care units	<ul style="list-style-type: none"> <li>Nurses: 1558</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> <li>Group Clinician Education (EMeet)</li> </ul>	Individual Clinician Education (EMat)	<ul style="list-style-type: none"> <li>CP - Care coordination</li> <li>CP - Counseling/provision of advice</li> </ul>
Sayre, 2012 (162), USA	NRCT, 2 groups	Hospital, acute care units	<ul style="list-style-type: none"> <li>Nurses: 145</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (COP + EMeet)</li> <li>Individual Clinician Education (EMat)</li> <li>Local opinion leaders</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Care coordination</li> </ul>
Schneider, 2006 (163), Netherlands	NRCT, 2 groups	Hospital, medical care, surgical care units	<ul style="list-style-type: none"> <li>Nurses: 30</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Medication administration</li> </ul>
Schondelmeyer, 2021 (164), USA	NRCT, 2 groups	Hospital, medical care unit	<ul style="list-style-type: none"> <li>Nurses: 847 (clinicians and nurses)</li> <li>Patients: 1051</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EO)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> </ul>
Seeley, 2008 (165), Sri Lanka	NRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>Nurses: 34</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	Individual Clinician Education (EMat)	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>Knowledge</li> <li>Skills</li> </ul>
Segal, 2015 (166), UK	RCT, 2 groups	Hospital, internal medicine units	<ul style="list-style-type: none"> <li>Nurses: 12</li> <li>Patients: 53</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG)</li> </ul>	Group Clinician Education (EMeet)	<ul style="list-style-type: none"> <li>CP - Testing/screening</li> <li>Perceived control/self-efficacy</li> </ul>
Senarath, 2017 (167), Israel	RCT, 2 groups	Hospital	<ul style="list-style-type: none"> <li>Nurses: 47</li> <li>Patients: 892</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> <li>CP - Care coordination</li> <li>CP - Infection control</li> <li>Patient Health</li> </ul>
Seo, 2020 (168), South Korea	NRCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>Nurses: 60</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> <li>Tailored interventions (TI)</li> </ul>	Group Clinician Education (EMeet)	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Care coordination</li> <li>Knowledge</li> </ul>
Seto, 1989 (169), Hong Kong	NRCT, 3 groups	Hospital, surgical care, medical care, intensive care, obstetric care units	<ul style="list-style-type: none"> <li>Nurses: 235</li> <li>Patients: NR</li> </ul>	<p>Intervention group 1</p> <ul style="list-style-type: none"> <li>Local opinion leaders</li> </ul> <p>Intervention group 2</p> <ul style="list-style-type: none"> <li>Local opinion leaders</li> <li>Individual Clinician Education (EMat)</li> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Local opinion leaders</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Infection control</li> </ul>
Seto, 1991 (170), Hong Kong	cRCT, 3 groups		<ul style="list-style-type: none"> <li>Clusters: NR</li> </ul>	<p>Intervention group 1</p> <ul style="list-style-type: none"> <li>Local opinion leaders</li> </ul>	Local opinion leaders	<ul style="list-style-type: none"> <li>CP - Infection control</li> </ul>

### Additional file 3. Description of included studies.

		Hospital, medical care, surgical care units	<ul style="list-style-type: none"> <li>Nurses: 220</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>		
				Intervention group 2		
				<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>		
Shevlin, 2002 (171), USA	RCT, 2 groups	Hospital	<ul style="list-style-type: none"> <li>Nurses: NR</li> <li>Patients: 534</li> </ul>	<ul style="list-style-type: none"> <li>Reminders</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Immunization</li> </ul>
Smeland, 2022 (172), Norway	cRCT, 2 groups	Hospital, medical care, post anesthesia	<ul style="list-style-type: none"> <li>Clusters: 6</li> <li>Nurses: 258</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG + EMat + EO)</li> <li>Reminders</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Assessment/examination</li> </ul>
Snelgrove-Clarke, 2015 (173), Canada	RCT, 2 groups	Hospital, obstetric units	<ul style="list-style-type: none"> <li>Nurses: 62</li> <li>Patients: 270</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Assessment/examination</li> </ul>
Srikrajang, 2005 (174), Thailand	RCT, 2 groups	Hospital, emergency care, labor care units	<ul style="list-style-type: none"> <li>Nurses: 24</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> <li>Reminders</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Medication administration</li> <li>CP - Testing/screening</li> </ul>
Sung, 2008 (175), South Korea	NRCT, 2 groups	Hospital, internal medicine, surgical care units	<ul style="list-style-type: none"> <li>Nurses: 50</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Knowledge</li> <li>CP - Medication administration</li> <li>Perceived control/self-efficacy</li> </ul>
Teasing, 2020 (176), Netherlands	cRCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>Clusters: 116</li> <li>Nurses: 782</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> <li>Patient-mediated interventions</li> <li>Reminders</li> <li>Tailored interventions (TI)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Infection control</li> </ul>
Teresi, 2013 (177), USA	cRCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>Clusters: 47</li> <li>Nurses: NR</li> <li>Patients: 1,405</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Incident reporting</li> </ul>
Titler, 2009 (178), USA	cRCT, 2 groups	Hospital, medical care, surgical care, orthopedic care units	<ul style="list-style-type: none"> <li>Clusters: 12</li> <li>Nurses: 198</li> <li>Patients: 1,401</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (CPG)</li> <li>Local opinion leaders</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Medication administration</li> </ul>
Tornvall, 2009 (179), Sweden	cRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>Clusters: 17</li> <li>Nurses: 138</li> <li>Patients: 176</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Documentation</li> </ul>
Tsai, 2011a (180), Taiwan	cRCT, 2 groups	Hospital, emergency care, psychiatric, gastrointestinal, medical-surgical units	<ul style="list-style-type: none"> <li>Nurses: 458</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Counseling/provision of advice</li> <li>Knowledge</li> <li>Perceived control/self-efficacy</li> </ul>
Tsai, 2011b (181), Taiwan	RCT, 2 groups	Hospital	<ul style="list-style-type: none"> <li>Nurses: 195</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>CP - Care coordination</li> <li>CP - Counseling/provision of advice</li> </ul>

### Additional file 3. Description of included studies.

						<ul style="list-style-type: none"> <li>• Knowledge</li> </ul>	
Välimäki, 2022 (182), Finland	cRCT, 2 groups	Hospital, psychiatric units	<ul style="list-style-type: none"> <li>• Clusters: 28</li> <li>• Nurses: 648</li> <li>• Patients: 8,349</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat + EO)</li> <li>• Tailored interventions (TI)</li> <li>• Reminders</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP – Physical restraints</li> </ul>	
van de Steeg, 2014 (183), Netherlands	Stepped-wedge, cRCT, 2 groups	Hospital	<ul style="list-style-type: none"> <li>• Clusters: 36</li> <li>• Nurses: 1,123</li> <li>• Patients: 3,273</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP - Assessment/examination</li> <li>• Patient Health</li> </ul>	
van Gaal, 2011 (184), Netherlands	van Gaal, 2011a	cRCT, 2 groups	Hospital, internal medicine, surgical care, rehabilitation units	<ul style="list-style-type: none"> <li>• Clusters: 10</li> <li>• Nurses: NR</li> <li>• Patients: 404</li> </ul>	<ul style="list-style-type: none"> <li>• Audit and feedback (A&amp;F)</li> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> <li>• Patient-mediated interventions</li> <li>• Tailored interventions (TI)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP - Care coordination</li> <li>• CP - Infection control</li> <li>• CP - Other</li> </ul>
	van Gaal, 2011b	cRCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>• Clusters: 10</li> <li>• Nurses: NR</li> <li>• Patients: 2,482</li> </ul>	<ul style="list-style-type: none"> <li>• Audit and feedback (A&amp;F)</li> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> <li>• Patient-mediated interventions</li> <li>• Tailored interventions (TI)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP - Care coordination</li> <li>• CP - Infection control</li> <li>• CP - Other</li> </ul>
van Lieshout, 2015 (185), Netherlands	cRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>• Clusters: 34</li> <li>• Nurses: 34</li> <li>• Patients: 2,229</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (CPG + EMat + EO)</li> <li>• Tailored interventions (TI)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP - Counseling/provision of advice</li> <li>• Patient Health</li> </ul>	
Varghese, 2014 (186), India	NRCT, 2 groups	Hospital, medical care units	<ul style="list-style-type: none"> <li>• Nurses: 32</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP - Assessment/examination</li> <li>• CP - Documentation</li> <li>• Knowledge</li> </ul>	
Vicdan, 2019 (187), Turkey	RCT, 2 groups	Hospital, operating room and outpatient clinic	<ul style="list-style-type: none"> <li>• Nurses: 219</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	Group Clinician Education (EMeet)	<ul style="list-style-type: none"> <li>• Attitude</li> <li>• CP - Medication administration</li> <li>• Knowledge</li> </ul>	
von Lengerke, 2017 (188), Germany	cRCT, 2 groups	Hospital, intensive care, hematopoietic stem cell transplantation units	<ul style="list-style-type: none"> <li>• Clusters: 12</li> <li>• Nurses: 572</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Tailored interventions (TI)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP - Infection control</li> </ul>	
Wagner, 2005 (189), Canada	cRCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>• Clusters: 6</li> <li>• Nurses: NR</li> <li>• Patients: 910</li> </ul>	<ul style="list-style-type: none"> <li>• Audit and feedback (clinical incident reporting)</li> </ul>	Usual care	<ul style="list-style-type: none"> <li>• CP - Documentation</li> <li>• Patient Health</li> </ul>	
Wald, 2014 (190), USA	cRCT, 2 groups	Hospital	<ul style="list-style-type: none"> <li>• Clusters: 24</li> <li>• Nurses: NR</li> <li>• Patients: 13,499</li> </ul>	<ul style="list-style-type: none"> <li>• Audit and feedback (A&amp;F)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Audit and feedback (A&amp;F)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Equipment management</li> <li>• Patient Health</li> </ul>	

### Additional file 3. Description of included studies.

Walsh, 2016 (191), UK	cRCT, 4 groups	Hospital	<ul style="list-style-type: none"> <li>• Clusters: 8</li> <li>• Nurses: NR</li> <li>• Patients: 9,187</li> </ul>	Intervention group 1 <ul style="list-style-type: none"> <li>• Audit and feedback (audit and feedback) + Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Medication administration</li> <li>• Knowledge</li> <li>• Patient Health</li> </ul>
				Intervention group 2 <ul style="list-style-type: none"> <li>• Audit and feedback (audit and feedback) + Individual Clinician Education (EMat) + Routine patient-reported outcome measures</li> </ul>		
				Intervention group 3 <ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat) + Routine patient-reported outcome measures</li> </ul>		
Wang, 2020 (192), China	RCT, 2 groups	Nursing homes	<ul style="list-style-type: none"> <li>• Nurses: 34</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet), more intensive and simulation</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Counseling/provision of advice</li> <li>• CP - Other</li> </ul>
Wang, 2022 (193), China	RCT, 2 groups	Hospitals	<ul style="list-style-type: none"> <li>• Nurses: 206 (not baseline since it was not stratified)</li> <li>• Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat + EGames), Game-based phone application</li> <li>• Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat), didactic lecture and skill demonstration</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Infection control</li> <li>• Skills</li> </ul>
Weaver, 2016 (194), South Africa	cRCT, 4 groups	Primary care	<ul style="list-style-type: none"> <li>• Clusters: 40</li> <li>• Nurses: NR</li> <li>• Patients: NR</li> </ul>	Intervention group 1 <ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (CPG + EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (CPG)</li> </ul>	<ul style="list-style-type: none"> <li>• CP – Testing/Screening</li> <li>• Knowledge</li> </ul>
				Intervention group 2 <ul style="list-style-type: none"> <li>• Individual Clinician Education (CPG + EMat), computer-based training</li> </ul>		
				Intervention group 3 <ul style="list-style-type: none"> <li>• Individual Clinician Education (CPG + EMat), paper-based training</li> </ul>		
Westbrook, 2017 (195), Australia	cRCT, 2 groups	Hospital, medical care, surgical care units	<ul style="list-style-type: none"> <li>• Clusters: 8</li> <li>• Nurses: 227</li> <li>• Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Clinician Education (EMat)</li> <li>• Patient-mediated interventions</li> <li>• Reminders</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Care coordination</li> </ul>
Wilkinson, 2008 (196), UK	RCT, 2 groups	Hospital, oncologic and palliative care	<ul style="list-style-type: none"> <li>• Nurses: 170</li> <li>• Patients: 215</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP - Counseling/provision of advice</li> <li>• Patient Health</li> <li>• Perceived control/self-efficacy</li> </ul>
Wood, 2021 (197), Australia	cRCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>• Clusters: 130</li> <li>• Nurses: 139</li> <li>• Patients: 43,871</li> </ul>	<ul style="list-style-type: none"> <li>• Group Clinician Education (EMeet)</li> <li>• Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>• Usual care</li> </ul>	<ul style="list-style-type: none"> <li>• CP – Testing/Screening</li> </ul>

### Additional file 3. Description of included studies.

Woodcock, 1999 (198), UK	RCT, 2 groups	Primary care	<ul style="list-style-type: none"> <li>Nurses: 49</li> <li>Patients: 360</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>Perceived control/self-efficacy</li> <li>CP - Counseling/provision of advice</li> </ul>
Wright, 1997 (199), USA	RCT, 2 groups	Hospital	<ul style="list-style-type: none"> <li>Nurses: 60</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP – Infection control</li> </ul>
Yang, 2019 (200), Taiwan	cRCT, 2 groups	Hospital, intensive care units	<ul style="list-style-type: none"> <li>Clusters: 2</li> <li>Nurses: 66</li> <li>Patients: NR</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> <li>Reminders</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP - Assessment/examination</li> <li>Knowledge</li> </ul>
Yun, 2022 (201), South Korea	cRCT, 2 groups	Hospital, pediatric intensive care unit	<ul style="list-style-type: none"> <li>Clusters: 2</li> <li>Nurses: 55</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> <li>Reminders</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP – Assessment/examination</li> <li>Knowledge</li> <li>Perceived control/ Self-efficacy</li> </ul>
Zarifsanaiey, 2022 (202), Iran	RCT, 3 groups	Comprehensive urban health service centres	<ul style="list-style-type: none"> <li>Clusters: 21</li> <li>Nurses: 150</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Intervention group 1, Online Workshop</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>Attitude</li> <li>CP – Testing/Screening</li> <li>Knowledge</li> </ul>
				<ul style="list-style-type: none"> <li>Intervention group 2, e-Flipped Workshop</li> <li>Group Clinician Education (EMeet)</li> <li>Individual Clinician Education (EMat)</li> </ul>		
Ziyaeifard, 2018 (203), Iran	NRCT, 2 groups	Hospital	<ul style="list-style-type: none"> <li>Nurses: 146</li> <li>Patients: 146</li> </ul>	<ul style="list-style-type: none"> <li>Individual Clinician Education (CPG + EMat)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Medication administration</li> <li>Patient Health</li> </ul>
Zohar, 2017 (204), Israel	cRCT, 2 groups	Hospital, inpatient unit	<ul style="list-style-type: none"> <li>Nurses: 445</li> <li>Patients: NA</li> </ul>	<ul style="list-style-type: none"> <li>Audit and feedback (A&amp;F)</li> </ul>	<ul style="list-style-type: none"> <li>Usual care</li> </ul>	<ul style="list-style-type: none"> <li>CP - Counseling/provision of advice</li> </ul>

Abbreviations: A&F: Audit and Feedback; COP: Community of Practice; CP: Clinical Practice; CPG: Clinical Practice Guidelines; cRCT: Cluster randomized controlled trial; ED: Emergency Department; EMat: Educational Material; EMeet: Educational Meeting; EO: Educational Outreach; ICU: Intensive Care Unit; IPE: InterProfessional Education; NRCT: Non-randomised controlled trial; NRCCT: Non-randomised cluster-controlled trial; PICU: Pediatric Intensive Care Unit; RCT: Randomized controlled trial; TI: Tailored interventions; UK: United Kingdom; USA: United States of America

### References of included studies

1. Abraham J, Bake M, Berger-Hoger B, Kopke S, Kupfer R, Meyer G, et al. Process evaluation of a multicomponent intervention to prevent physical restraints in nursing homes (IMPRINT): A mixed methods study. *Journal of advanced nursing*. 2021;77(3):1465-77.
2. Ahmed S, Srivastava S, Warren N, Mayra K, Misra M, Mahapatra T, et al. The impact of a nurse mentoring program on the quality of labour and delivery care at primary health care facilities in Bihar, India. *BMJ global health*. 2019;4(6):e001767.
3. Akande PA. The effect of an educational intervention to improve tuberculosis infection control among nurses in Ibadan, south-west Nigeria: a quasi-experimental study. *BMC nursing*. 2020;19:81.
4. Akrami S, Sargazi GH, Safabakhsh L, Mofrad ZP. Assessing the effect of training the safe transfer checklist on the quality of Intrahospital patient transfer: an Interventional study. *Medical-Surgical Nursing Journal*. 2019;8(4).
5. Alhalal E. The effects of an intimate partner violence educational intervention on nurses: A quasi-experimental study. *Nurse education in practice*. 2020;47:102854.
6. Aloush SM. Does educating nurses with ventilator-associated pneumonia prevention guidelines improve their compliance? *American Journal of Infection Control*. 2017;45(9):969-73.

### Additional file 3. Description of included studies.

7. Antonini M, Bellier-Teichmann T, O'Reilly L, Cara C, Brousseau S, Weidmann J, et al. Effects of an educational intervention to strengthen humanistic practice on haemodialysis nurses' caring attitudes and behaviours and quality of working life: a cluster randomised controlled trial. *BMC nursing*. 2021;20(1):255.
8. Arzani A, Valizadeh S, Poorkaremi S, Taheri Ezbarami Z, Ghojzadeh M. Evaluating the impact of a multimedia training versus lecture training on attitudes and practices in paediatric nurses in children pain management: A randomized controlled trial. *Nursing open*. 2020;7(4):1032-8.
9. Bagherzadeh M, Jafari H, Charati JY, Shafipour V. The effect of an empowerment program on the moral sensitivity and caring behaviors of emergency nurses in Iran. *Nurse education in practice*. 2021;57:103243.
10. Bano T, Sarwar H, Perveen K, Khan S. Impact of standard guidelines on nurses knowledge and practices regarding the prevention of neonatal sepsis at public hospital, Pakistan. *Pakistan Journal of Medical & Health Sciences*. 2022;16(03):303-.
11. Behzadi F, Khanjari S, Haghani H. Impact of an education program on the performance of nurses in providing oral care for mechanically ventilated children. *Australian critical care : official journal of the Confederation of Australian Critical Care Nurses*. 2019;32(4):307-13.
12. Bernburg M, Groneberg DA, Mache S. Mental Health Promotion Intervention for Nurses Working in German Psychiatric Hospital Departments: A Pilot Study. *Issues in mental health nursing*. 2019;40(8):706-11.
13. Berry SD, Goldfeld KS, McConeghy K, Gifford D, Davidson HE, Han L, et al. Evaluating the Findings of the IMPACT-C Randomized Clinical Trial to Improve COVID-19 Vaccine Coverage in Skilled Nursing Facilities. *JAMA internal medicine*. 2022;182(3):324-31.
14. Bittner MJ, Rich EC, Turner PD, Arnold WH, Jr. Limited impact of sustained simple feedback based on soap and paper towel consumption on the frequency of hand washing in an adult intensive care unit. *Infection control and hospital epidemiology*. 2002;23(3):120-6.
15. Blanco-Mavillard I, de Pedro-Gomez JE, Rodriguez-Calero MA, Bennasar-Veny M, Parra-Garcia G, Fernandez-Fernandez I, et al. Multimodal intervention for preventing peripheral intravenous catheter failure in adults (PREBACP): a multicentre, cluster-randomised, controlled trial. *The Lancet Haematology*. 2021;8(9):e637-e47.
16. Boumans N, Berkhout A, Landeweerd A. Effects of resident-oriented care on quality of care, wellbeing and satisfaction with care. *Scandinavian journal of caring sciences*. 2005;19(3):240-50.
17. Brady MC, Stott DJ, Weir CJ, Chalmers C, Sweeney P, Barr J, et al. A pragmatic, multi-centered, stepped wedge, cluster randomized controlled trial pilot of the clinical and cost effectiveness of a complex Stroke Oral healthCare intervention pLan Evaluation II (SOCLE II) compared with usual oral healthcare in stroke wards. *International journal of stroke : official journal of the International Stroke Society*. 2020;15(3):318-23.
18. Brennan K, Sanchez D, Hedges S, Lynch J, Hou YC, Al Sayfe M, et al. A nurse-led intervention to reduce the incidence and duration of delirium among adults admitted to intensive care: A stepped-wedge cluster randomised trial. *Australian critical care : official journal of the Confederation of Australian Critical Care Nurses*. 2023;36(4):441-8.
19. Bruce ML, Brown EL, Raue PJ, Mlodzianowski AE, Meyers BS, Leon AC, et al. A randomized trial of depression assessment intervention in home health care. *Journal of the American Geriatrics Society*. 2007;55(11):1793-800.
20. Bucknall TK, Considine J, Harvey G, Graham ID, Rycroft-Malone J, Mitchell I, et al. Prioritising Responses Of Nurses To deteriorating patient Observations (PRONTO): a pragmatic cluster randomised controlled trial evaluating the effectiveness of a facilitation intervention on recognition and response to clinical deterioration. *BMJ quality & safety*. 2022;31(11):818-30.
21. Carrico RM, Coty MB, Goss LK, Lajoie AS. Changing health care worker behavior in relation to respiratory disease transmission with a novel training approach that uses biosimulation. *American journal of infection control*. 2007;35(1):14-9.
22. Carroll DL, Dykes PC, Hurley AC. An electronic fall prevention toolkit: Effect on documentation quality. *Nursing Research*. 2012;61(4):309-13.
23. Chambers A, Chen C, Brown KA, Daneman N, Langford B, Leung V, et al. Virtual learning collaboratives to improve urine culturing and antibiotic prescribing in long-term care: controlled before-and-after study. *BMJ quality & safety*. 2022;31(2):94-104.
24. Chan S, Pielak K, McIntyre C, Deeter B, Taddio A. Implementation of a new clinical practice guideline regarding pain management during childhood vaccine injections. *Paediatrics & Child Health*. 2013;18(7):367-72.
25. Chang YY, Yu HH, Loh el W, Chang LY. The Efficacy of an In-Service Education Program Designed to Enhance the Effectiveness of Physical Restraints. *The journal of nursing research : JNR*. 2016;24(1):79-86.
26. Charrier L, Allochis MC, Cavallo MR, Gregori D, Cavallo F, Zotti CM. Integrated audit as a means to implement unit protocols: a randomized and controlled study. *Journal of Evaluation in Clinical Practice*. 2008;14(5):847-53.
27. Cheater FM, Baker R, Reddish S, Spiers N, Wailoo A, Gillies C, et al. Cluster randomized controlled trial of the effectiveness of audit and feedback and educational outreach on improving nursing practice and patient outcomes. *Medical care*. 2006;44(6):542-51.
28. Chen YH, Lin LC. Ability of the Pain Recognition and Treatment (PRT) Protocol to Reduce Expressions of Pain among Institutionalized Residents with Dementia: A Cluster Randomized Controlled Trial. *Pain management nursing : official journal of the American Society of Pain Management Nurses*. 2016;17(1):14-24.
29. Chenoweth L, Williams A, Fry M, Endean E, Liu Z. Outcomes of Person-centered Care for Persons with Dementia in the Acute Care Setting: A Pilot Study. *Clinical gerontologist*. 2022;45(4):983-97.
30. Cleland JA, Hall S, Price D, Lee AJ. An exploratory, pragmatic, cluster randomised trial of practice nurse training in the use of asthma action plans. *Primary care respiratory journal : journal of the General Practice Airways Group*. 2007;16(5):311-8.
31. Collins D, Inglin L, Laatikainen T, Shoismatuloeva M, Sultonova D, Jonova B, et al. Evaluation and pilot implementation of essential interventions for the management of hypertension and prevention of cardiovascular diseases in primary health care in the Republic of Tajikistan. *BMC health services research*. 2021;21(1):472.
32. Cone KJ, Anderson MA, Johnson JA. The effect of in-service education on emergency nurses' documentation of physical assessment. *Journal of emergency nursing*. 1996;22(5):398-402.
33. Cortez S, Dietrich MS, Wells N. Measuring Clinical Decision Support Influence on Evidence-Based Nursing Practice. *Oncology Nursing Forum*. 2016;43(4):E170-E7.
34. Curtis JR, Nielsen EL, Treece PD, Downey L, Dotolo D, Shannon SE, et al. Effect of a quality-improvement intervention on end-of-life care in the intensive care unit: a randomized trial. *American journal of respiratory and critical care medicine*. 2011;183(3):348-55.
35. Daly M, Kermore S, Reilly D. Evaluation of clinical practice improvement programs for nurses for the management of alcohol withdrawal in hospitals. *Contemporary Nurse*. 2009;31(2):98-107.

### Additional file 3. Description of included studies.

36. Davies B, Hodnett E, Hannah M, O'Brien-Pallas L, Pringle D, Wells G. Fetal health surveillance: a community-wide approach versus a tailored intervention for the implementation of clinical practice guidelines. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne*. 2002;167(5):469-74.
37. Day T, Wainwright SP, Wilson-Barnett J. An evaluation of a teaching intervention to improve the practice of endotracheal suctioning in intensive care units. *Journal of clinical nursing*. 2001;10(5):682-96.
38. De Barbieri I, Sisti D, Di Falco A, Galeazzo M, Amatori S, Rocchi MBL, et al. Relationship-based care model in paediatrics: A randomized controlled trial to implement the parents' perception of the quality of nursing care. *Journal of Advanced Nursing*. 2020;76(12):3597-608.
39. De Rond MEJ, De Wit R, Van Dam FSAM, Muller MJ. A Pain Monitoring Program for nurses: Effect on the administration of analgesics. *Pain*. 2000;89(1):25-38.
40. Delvaux N, Razavi D, Marchal S, Bredart A, Farvacques C, Slachmuylder JL. Effects of a 105 hours psychological training program on attitudes, communication skills and occupational stress in oncology: a randomised study. *British journal of cancer*. 2004;90(1):106-14.
41. de Ruijter D, Candel M, Smit ES, de Vries H, Hoving C. The Effectiveness of a Computer-Tailored E-Learning Program for Practice Nurses to Improve Their Adherence to Smoking Cessation Counseling Guidelines: Randomized Controlled Trial. *Journal of Medical Internet Research*. 2018;20(5):14.
42. Donati D, Miccoli GA, Cianfrocca C, Di Stasio E, De Marinis MG, Tartaglino D. Effectiveness of implementing link nurses and audits and feedback to improve nurses' compliance with standard precautions: A cluster randomized controlled trial. *American journal of infection control*. 2020;48(10):1204-10.
43. Dudener E, Hallac S. The effect of the training of presence in care (TPinCare) on the care-oriented patient-nurse interaction and the caring behaviors of nurses working with oncology patients: A randomized controlled trial. *Nurse education in practice*. 2023;68:103566.
44. Edwards H, Walsh A, Courtney M, Monaghan S, Wilson J, Young J. Promoting evidence-based childhood fever management through a peer education programme based on the theory of planned behaviour. *Journal of clinical nursing*. 2007;16(10):1966-79.
45. Elahi M, Mansouri P, Khademian Z. The Effect of Education Based on Human Care Theory on Caring Behaviors and Job Involvement of Nurses in Intensive Care Units. *Iranian journal of nursing and midwifery research*. 2021;26(5):425-9.
46. Elzaky MEH, Shahine NFM. Effects of an educational program using a virtual social network on nurses' knowledge and performance of blood pressure measurement: a randomized controlled trial. *BMC nursing*. 2022;21(1):365.
47. Emamgholi S, Khanjari S, Haghani H. Impact of an Educational Program on Nurses' Performance in Providing Peripherally Inserted Central Catheter Care for Neonates. *Journal of infusion nursing : the official publication of the Infusion Nurses Society*. 2020;43(5):275-82.
48. Esche CA, Warren JI, Woods AB, Jesada EC, Iliuta R. Traditional classroom education versus computer-based learning: how nurses learn about pressure ulcers. *Journal for nurses in professional development*. 2015;31(1):21-7.
49. Evans D, Mellins R, Lobach K, Ramos-Bonoan C, Pinkett-Heller M, Wiesemann S, et al. Improving care for minority children with asthma: professional education in public health clinics. *Pediatrics*. 1997;99(2):157-64.
50. Evans SM, Smith BJ, Esterman A, Runciman WB, Maddern G, Stead K, et al. Evaluation of an intervention aimed at improving voluntary incident reporting in hospitals. *Quality & safety in health care*. 2007;16(3):169-75.
51. Fabre V, Pleiss A, Klein E, Demko Z, Salinas A, Jones G, et al. A pilot study to evaluate the impact of a nurse-driven urine culture diagnostic stewardship intervention on urine cultures in the acute care setting. *The Joint Commission Journal on Quality and Patient Safety*. 2020;46(11):650-5.
52. Fairall LR, Zwarenstein M, Bateman ED, Bachmann M, Lombard C, Majara BP, et al. Effect of educational outreach to nurses on tuberculosis case detection and primary care of respiratory illness: pragmatic cluster randomised controlled trial. *BMJ (Clinical research ed)*. 2005;331(7519):750-4.
53. Fakhri MG, Jones K, Rey JE, Berriel-Cass D, Kalinicheva T, Szpunar S, et al. Sustained improvements in peripheral venous catheter care in non-intensive care units: a quasi-experimental controlled study of education and feedback. *Infection control and hospital epidemiology*. 2012;33(5):449-55.
54. Feldman PH, Peng TR, Murtaugh CM, Kelleher C, Donelson SM, McCann ME, et al. A randomized intervention to improve heart failure outcomes in community-based home health care. *Home health care services quarterly*. 2004;23(1):1-23.
55. Filmer T, Herbig B. A training intervention for home care nurses in cross-cultural communication: An evaluation study of changes in attitudes, knowledge and behaviour. *Journal of Advanced Nursing*. 2020;76(1):147-62.
56. Forberg U, Unbeck M, Wallin L, Johansson E, Petzold M, Ygge BM, et al. Effects of computer reminders on complications of peripheral venous catheters and nurses' adherence to a guideline in paediatric care--a cluster randomised study. *Implementation science : IS*. 2016;11:10.
57. Francke AL, Luiken JB, Garssen B, Abu-Saad HH, Grypdonck M. Effects of a pain programme on nurses' psychosocial, physical and relaxation interventions. *Patient education and counseling*. 1996;28(2):221-30.
58. Francke AL, Luiken JB, de Schepper AM, Abu-Saad HH, Grypdonck M. Effects of a continuing education program on nurses' pain assessment practices. *Journal of pain and symptom management*. 1997;13(2):90-7.
59. Friese CR, Yang J, Mendelsohn-Victor K, McCullagh MC. Randomized Controlled Trial of an Intervention to Improve Nurses' Hazardous Drug Handling. *Oncology Nursing Forum*. 2019;46(2):248-56.
60. Funk M, Fennie KP, Stephens KE, May JL, Winkler CG, Drew BJ. Association of Implementation of Practice Standards for Electrocardiographic Monitoring With Nurses' Knowledge, Quality of Care, and Patient Outcomes: Findings From the Practical Use of the Latest Standards of Electrocardiography (PULSE) Trial. *Circulation Cardiovascular quality and outcomes*. 2017;10(2).
61. Galfin JM, Watkins ER, Harlow T. Evaluation of a training programme to teach a guided self-help psychological intervention to hospice staff. *International journal of palliative nursing*. 2011;17(3):119-24.
62. Gao Q, Xu Q, Zhou X, Yao Z, Yao Y. A Case-Control Study of the Effects of Implementing the Registered Nurses' Association of Ontario Guidelines for the Assessment and Management of Postoperative Pain and the Use of Relaxation Therapy in 312 Patients with Bone and Soft-Tissue Malignancy. *Medical science monitor : international medical journal of experimental and clinical research*. 2022;28:e937496.

### Additional file 3. Description of included studies.

63. Gengiah S, Barker PM, Yende-Zuma N, Mbatha M, Naidoo S, Taylor M, et al. A cluster-randomized controlled trial to improve the quality of integrated HIV-tuberculosis services in primary health care clinics in South Africa. *Journal of the International AIDS Society*. 2021;24(9):e25803.
64. Ghazali SA, Abdullah KL, Moy FM, Ahmad R, Hussin EOD. The impact of adult trauma triage training on decision-making skills and accuracy of triage decision at emergency departments in Malaysia: A randomized control trial. *International emergency nursing*. 2020;51:100889.
65. Gomarverdi S, Khatibani M, Bikmoradi A, Soltanian AR. Effects of a multi-component educational intervention on nurses' knowledge and adherence to standard precautions in intensive care units. *Journal of infection prevention*. 2019;20(2):83-90.
66. Gould D, Chamberlain A. The use of a ward-based educational teaching package to enhance nurses' compliance with infection control procedures. *Journal of clinical nursing*. 1997;6(1):55-67.
67. Grommi S, Voutilainen A, Vaajoki A, Kankkunen P. Educating registered nurses for pain knowledge and documentation management: A randomized controlled trial. *International Journal of Caring Sciences*. 2021;14:919-29.
68. Hammersley VS, Elton RA, Walker S, Hansen CH, Sheikh A. Adolescent seasonal allergic rhinitis and the impact of health-care professional training: Cluster randomised controlled trial of a complex intervention in primary care. *NPJ primary care respiratory medicine*. 2014;24:14012.
69. Happ MB, Garrett KL, Tate JA, DiVirgilio D, Houze MP, Demirci JR, et al. Effect of a multi-level intervention on nurse-patient communication in the intensive care unit: Results of the SPEACS trial. *Heart & lung : the journal of critical care*. 2014;43(2):89-98.
70. Happ MB, Sereika SM, Houze MP, Seaman JB, Tate JA, Nilsen ML, et al. Quality of care and resource use among mechanically ventilated patients before and after an intervention to assist nurse-nonvocal patient communication. *Heart & lung : the journal of critical care*. 2015;44(5):408-15.e2.
71. Harrison A, Karim SA, Floyd K, Lombard C, Lurie M, Ntuli N, et al. Syndrome packets and health worker training improve sexually transmitted disease case management in rural South Africa: randomized controlled trial. *AIDS (London, England)*. 2000;14(17):2769-79.
72. Hasnain MG, Levi CR, Ryan A, Hubbard IJ, Hall A, Oldmeadow C, et al. Can a multicomponent multidisciplinary implementation package change physicians' and nurses' perceptions and practices regarding thrombolysis for acute ischemic stroke? An exploratory analysis of a cluster-randomized trial. *Implementation science : IS*. 2019;14(1):98.
73. Hasselblad M, Morrison J, Kleinpell R, Buie R, Ariosto D, Hardiman E, et al. Promoting patient and nurse safety: testing a behavioural health intervention in a learning healthcare system: results of the Demeanor pragmatic, cluster, cross-over trial. *BMJ open quality*. 2022;11(1).
74. Hendryx MS, Fieselmann JF, Bock MJ, Wakefield DS, Helms CM, Bentler SE. Outreach education to improve quality of rural ICU care. Results of a randomized trial. *American journal of respiratory and critical care medicine*. 1998;158(2):418-23.
75. Hessig RE, Arcand LL, Frost MH. The effects of an educational intervention on oncology nurses' attitude, perceived knowledge, and self-reported application of complementary therapies. *Oncology Nursing Forum*. 2004;31(1):71-8.
76. Hlungwane EZ, Ten Ham-Baloyi W, Jordan P, Oamen BR. Nurses' Knowledge on Sepsis Related to Mechanical Ventilation: An Intervention Study. *The journal of nursing research : JNR*. 2021;29(4):e158.
77. Hodl M, Halfens RJG, Lohrmann C. Effectiveness of conservative urinary incontinence management among female nursing home residents-A cluster RCT. *Archives of gerontology and geriatrics*. 2019;81:245-51.
78. Hong SW, Ching TY, Fwng JPM, Seto WL. The employment of ward opinion leaders for continuing education in the hospital. *Medical Teacher*. 1990;12(2):209-17.
79. Huang HT, Chuang YH, Chiang KF. Nurses' physical restraint knowledge, attitudes, and practices: the effectiveness of an in-service education program. *The journal of nursing research : JNR*. 2009;17(4):241-8.
80. Huis A, Schoonhoven L, Grol R, Donders R, Hulscher M, van Achterberg T. Impact of a team and leaders-directed strategy to improve nurses' adherence to hand hygiene guidelines: a cluster randomised trial. *International journal of nursing studies*. 2013;50(4):464-74.
81. Huizing AR, Hamers JP, Gulpers MJ, Berger MP. Short-term effects of an educational intervention on physical restraint use: a cluster randomized trial. *BMC geriatrics*. 2006;6:17.
82. Huizing AR, Hamers JP, Gulpers MJ, Berger MP. Preventing the use of physical restraints on residents newly admitted to psycho-geriatric nursing home wards: a cluster-randomized trial. *International journal of nursing studies*. 2009;46(4):459-69.
83. Hutchinson AM, Brotto V, Chapman A, Sales AE, Mohebbi M, Bucknall TK. Use of an audit with feedback implementation strategy to promote medication error reporting by nurses. *Journal of clinical nursing*. 2020;29(21-22):4180-93.
84. Jansink R, Braspenning J, Laurant M, Keizer E, Elwyn G, Weijden T, et al. Minimal improvement of nurses' motivational interviewing skills in routine diabetes care one year after training: a cluster randomized trial. *BMC Family Practice*. 2013;14:44.
85. Jansson MM, Ala-Kokko TI, Ohtonen PP, Meriläinen MH, Syrjälä HP, Kyngäs HA. Human patient simulation education in the nursing management of patients requiring mechanical ventilation: a randomized, controlled trial. *American Journal of Infection Control*. 2014;42(3):271-6.
86. Jansson MM, Syrjala HP, Ohtonen PP, Meriläinen MH, Kyngäs HA, Ala-Kokko TI. Randomized, controlled trial of the effectiveness of simulation education: A 24-month follow-up study in a clinical setting. *American journal of infection control*. 2016;44(4):387-93.
87. Jansson MM, Syrjala HP, Ohtonen PP, Meriläinen MH, Kyngäs HA, Ala-Kokko TI. Effects of simulation education on oral care practices-a randomized controlled trial. *Nursing in Critical Care*. 2017;22(3):161-8.
88. Jaihooni AK, Kashfi SH, Bahmandost M, Afzali Harsini P. Promoting Preventive Behaviors of Nosocomial Infections in Nurses: The Effect of an Educational program based on Health Belief Model. *Investigación y educación en enfermería*. 2018;36(1):e09.
89. Jo KH, An GJ. Effects of an educational programme on shared decision-making among Korean nurses. *International journal of nursing practice*. 2015;21(6):839-46.
90. Johnson M, Langdon R, Levett-Jones T, Weidemann G, Manias E, Everett B. A cluster randomised controlled feasibility study of nurse-initiated behavioural strategies to manage interruptions during medication administration. *International journal of quality in health care : journal of the International Society for Quality in Health Care*. 2019;31(8):G67-G73.
91. Johnston CC, Gagnon A, Rennick J, Rosmus C, Patenaude H, Ellis J, et al. One-on-one coaching to improve pain assessment and management practices of pediatric nurses. *Journal of pediatric nursing*. 2007;22(6):467-78.



### Additional file 3. Description of included studies.

92. Jones A, Carr EK, Newham DJ, Wilson-Barnett J. Positioning of stroke patients: evaluation of a teaching intervention with nurses. *Stroke*. 1998;29(8):1612-7.
93. Kalinowski S, Budnick A, Kuhnert R, Konner F, Kissel-Kroll A, Kreutz R, et al. Nonpharmacologic Pain Management Interventions in German Nursing Homes: A Cluster Randomized Trial. *Pain management nursing : official journal of the American Society of Pain Management Nurses*. 2015;16(4):464-74.
94. Kaner E, Lock C, Heather N, McNamee P, Bond S. Promoting brief alcohol intervention by nurses in primary care: a cluster randomised controlled trial. *Patient education and counseling*. 2003;51(3):277-84.
95. Karvinen KH, Balneaves LG, Courneya KS, Perry B, Truant T, Vallance J. Evaluation of Online Learning Modules for Improving Physical Activity Counseling Skills, Practices, and Knowledge of Oncology Nurses. *Oncology Nursing Forum*. 2017;44(6):729-38.
96. Kavak F, Yilmaz E, Okanlı A, Aslanoglu E. The effect of psychoeducation given to psychiatry nurses on level of knowledge, attitudes, and practices regarding physical restraint: A randomized controlled study. *Perspectives in Psychiatric Care*. 2019;55(4):743-51.
97. Khodadadi E, Ebrahimi H, Moghaddasian S, Babapour J. The effect of communication skills training on quality of care, self-efficacy, job satisfaction and communication skills rate of nurses in hospitals of tabriz, iran. *Journal of caring sciences*. 2013;2(1):27-37.
98. Kim MS, Kim JS, Jung IS, Kim YH, Kim HJ. The effectiveness of the error reporting promoting program on the nursing error incidence rate in Korean operating rooms. *Taehan Kanho Hakhoe chi*. 2007;37(2):185-91.
99. Kim JH, Shin JS. Effects of an online problem-based learning program on sexual health care competencies among oncology nurses: a pilot study. *Journal of continuing education in nursing*. 2014;45(9):393-401.
100. Kim HJ, Hwang SY. Effect of Website-based Learning on Improved Monitoring of Adverse Drug Reactions by Clinical Nurses. *Asian nursing research*. 2022;16(1):45-51.
101. Kinsman L, Cooper S, Champion R, Kim JA, Boyle J, Cameron A, et al. The impact of web-based and face-to-face simulation education programs on nurses' response to patient deterioration: A multi-site interrupted time series study. *Nurse education today*. 2021;102:104939.
102. Koh SL, Hafizah N, Lee JY, Loo YL, Muthu R. Impact of a fall prevention programme in acute hospital settings in Singapore. *Singapore medical journal*. 2009;50(4):425-32.
103. Kopke S, Muhlhauser I, Gerlach A, Haut A, Haastert B, Mohler R, et al. Effect of a guideline-based multicomponent intervention on use of physical restraints in nursing homes: a randomized controlled trial. *JAMA*. 2012;307(20):2177-84.
104. Kroth PJ, Dexter PR, Overhage JM, Knipe C, Hui SL, Belsito A, et al. A computerized decision support system improves the accuracy of temperature capture from nursing personnel at the bedside. *AMIA Annual Symposium proceedings AMIA Symposium*. 2006:444-8.
105. Kyriacos U, Jelsma J, James M, Jordan S. Early warning scoring systems versus standard observations charts for wards in South Africa: a cluster randomized controlled trial. *Trials*. 2015;16:103.
106. Kyriacos U, Burger D, Jordan S. Testing effectiveness of the revised Cape Town modified early warning and SBAR systems: a pilot pragmatic parallel group randomised controlled trial. *Trials*. 2019;20(1):809.
107. Lacko L, Bryan Y, Dellasega C, Salerno F. Changing clinical practice through research: the case of delirium. *Clinical Nursing Research*. 1999;8(3):235-50.
108. Lau BD, Shaffer DL, Hobson DB, Yenokyan G, Wang J, Sugar EA, et al. Effectiveness of two distinct web-based education tools for bedside nurses on medication administration practice for venous thromboembolism prevention: A randomized clinical trial. *PLoS ONE*. 2017;12(8):e0181664.
109. Lee YJ, Kim ES, Park KS, Cho KB, Jang BK, Chung WJ, et al. Education for Ward Nurses Influences the Quality of Inpatient's Bowel Preparation for Colonoscopy. *Medicine*. 2015;94(34):e1423.
110. Lim SC, Mustapha FI, Aagaard-Hansen J, Calopietro M, Aris T, Bjerre-Christensen U. Impact of continuing medical education for primary healthcare providers in Malaysia on diabetes knowledge, attitudes, skills and clinical practices. *Medical education online*. 2020;25(1):1710330.
111. Lin PC, Chiang HW, Chiang TT, Chen CS. Pain management: evaluating the effectiveness of an educational programme for surgical nursing staff. *Journal of clinical nursing*. 2008;17(15):2032-41.
112. Liu WI, Edwards H, Courtney M. Case management educational intervention with public health nurses: cluster randomized controlled trial. *Journal of advanced nursing*. 2010;66(10):2234-44.
113. Liu A, Yan S, Wang H, Lin Y, Wu J, Fu L, et al. Ward nurses-focused educational intervention improves the quality of bowel preparation in inpatients undergoing colonoscopy: A CONSORT-compliant randomized controlled trial. *Medicine (Baltimore)*. 2020;99(36):e20976.
114. Locke C, McEuen J, Felder RS, Lesselroth B, Barrett TW, Stevens B, et al. Evaluating an insulin infusion protocol in an acute care setting. *Clinical nurse specialist CNS*. 2011;25(5):237-43.
115. Lundgren A, Wahren LK. Effect of education on evidence-based care and handling of peripheral intravenous lines. *Journal of clinical nursing*. 1999;8(5):577-85.
116. Magill N, Graves H, de Zoysa N, Winkley K, Amiel S, Shuttlewood E, et al. Assessing treatment fidelity and contamination in a cluster randomised controlled trial of motivational interviewing and cognitive behavioural therapy skills in type 2 diabetes. *BMC Family Practice*. 2018;19(1):60.
117. Magnan MA, Maklebust J. The effect of Web-based Braden Scale training on the reliability and precision of Braden Scale pressure ulcer risk assessments. *Journal of wound, ostomy, and continence nursing : official publication of The Wound, Ostomy and Continence Nurses Society*. 2008;35(2):199-208; discussion 9.
118. Maki-Turja-Rostedt S, Leino-Kilpi H, Korhonen T, Vahlberg T, Haavisto E. Consistent practice for pressure ulcer prevention in long-term older people care: A quasi-experimental intervention study. *Scandinavian journal of caring sciences*. 2021;35(3):962-78.
119. Mancheril B, Kram B, Schultheis J, Kram S, Trammel M, Liu B, et al. Impact of a Real-Time, Pharmacist-Led, Intensive Care Unit-Based Feedback Intervention on Analgesia and Sedation Quality Among Mechanically Ventilated Patients. *Journal of nursing care quality*. 2021;36(3):242-8.
120. Manias E, Gibson SJ, Finch S. Testing an Educational Nursing Intervention for Pain Assessment and Management in Older People. *Pain medicine (Malden, Mass)*. 2011;12(8):1199-215.
121. Marcantonio ER, Bergmann MA, Kiely DK, Orav EJ, Jones RN. Randomized trial of a delirium abatement program for postacute skilled nursing facilities. *Journal of the American Geriatrics Society*. 2010;58(6):1019-26.
122. Maruyama N, Kataoka Y, Horiuchi S. Effects of e-learning on the support of midwives and nurses to perinatal women suffering from intimate partner violence: A randomized controlled trial. *Japan journal of nursing science : JJNS*. 2022;19(2):e12464.
123. Mazzuca SA, Barger GJ, Brandt KD. Arthritis care in older-adult centers. A controlled study of an education program for public health nurses. *Arthritis and rheumatism*. 1987;30(3):275-80.

### Additional file 3. Description of included studies.

124. McDonald MV, Pezzin LE, Feldman PH, Murtaugh CM, Peng TR. Can just-in-time, evidence-based "reminders" improve pain management among home health care nurses and their patients? *Journal of pain and symptom management*. 2005;29(5):474-88.
125. Memon S, Imdad B, Aziz A, Aziz F, Memon F, Zafar SN. Assessing the Effectiveness of Training and Education on the Knowledge about active Management of 3rd Stage Labor by Nurses and Midwives. *Journal of Liaquat University of Medical & Health Sciences*. 2022;21(04):285-90.
126. Meyer JC, Summers RS, Moller H. Randomized, controlled trial of prescribing training in a South African province. *Medical education*. 2001;35(9):833-40.
127. Meyer G, Warnke A, Bender R, Muhlhauser I. Effect on hip fractures of increased use of hip protectors in nursing homes: cluster randomised controlled trial. *BMJ (Clinical research ed)*. 2003;326(7380):76.
128. Michaels TK, Hubbart E, Carroll SA, Hudson-Barr D. Evaluating an educational approach to improve pain assessment in hospitalized patients. *Journal of nursing care quality*. 2007;22(3):260-5.
129. Middleton S, McElduff P, Ward J, Grimshaw JM, Dale S, D'Este C, et al. Implementation of evidence-based treatment protocols to manage fever, hyperglycaemia, and swallowing dysfunction in acute stroke (QASC): a cluster randomised controlled trial. *Lancet (London, England)*. 2011;378(9804):1699-706.
130. Morita T, Murata H, Kishi E, Miyashita M, Yamaguchi T, Uchitomi Y. Meaninglessness in terminally ill cancer patients: a randomized controlled study. *Journal of pain and symptom management*. 2009;37(4):649-58.
131. Morita T, Tamura K, Kusajima E, Sakai S, Kawa M, Imura C, et al. Nurse education program on meaninglessness in terminally ill cancer patients: a randomized controlled study of a novel two-day workshop. *Journal of palliative medicine*. 2014;17(12):1298-305.
132. Mousavi H, Ghanbari A, Karkhah S, Alizadeh J, Kazemnejad Leyli E, Jafaraghaee F. The effect of clinical guideline education on the knowledge and practice of nurses for peripheral intravenous catheter placement based on short message service: A quasi-experimental study. *The journal of vascular access*. 2024;25(1):132-9.
133. Muller-Staub M, Needham I, Odenbreit M, Lavin MA, van Achterberg T. Implementing nursing diagnostics effectively: cluster randomized trial. *Journal of advanced nursing*. 2008;63(3):291-301.
134. Murtaugh CM, Pezzin LE, McDonald MV, Feldman PH, Peng TR. Just-in-time evidence-based e-mail "reminders" in home health care: impact on nurse practices. *Health services research*. 2005;40(3):849-64.
135. Nakatani Y, Tamaki J, Komatsu M, Iki M, Kajita E. Effect of distributing an evidence-based guideline for prevention of osteoporosis on health education programs in municipal health centers: a randomized controlled trial. *Journal of epidemiology*. 2012;22(2):103-12.
136. Nemati SM, Fathi M, Nouri B, Valiee S. Effects of an specific methodology (I Pass the Baton) on quality of handoff information among Nurses: A comparative study. *Journal of healthcare quality research*. 2022;37(5):268-74.
137. Noome M, Dijkstra BM, van Leeuwen E, Vloet LCM. Effectiveness of supporting intensive care units on implementing the guideline 'End-of-life care in the intensive care unit, nursing care': a cluster randomized controlled trial. *Journal of advanced nursing*. 2017;73(6):1339-54.
138. Noordman J, van der Weijden T, van Dulmen S. Effects of video-feedback on the communication, clinical competence and motivational interviewing skills of practice nurses: a pre-test posttest control group study. *Journal of advanced nursing*. 2014;70(10):2272-83.
139. Nowalk MP, Lin CJ, Zimmerman RK, Troy JA, Hoberman A, Kearney DH, et al. Tailored interventions to introduce influenza vaccination among 6- to 23-month-old children at inner-city health centers. *The American journal of managed care*. 2005;11(11):717-24.
140. O'Neil C, Ball K, Wood H, McMullen K, Kremer P, Jafarzadeh SR, et al. A Central Line Care Maintenance Bundle for the Prevention of Central Line-Associated Bloodstream Infection in Non-Intensive Care Unit Settings. *Infection control and hospital epidemiology*. 2016;37(6):692-8.
141. O'Neill KL, Ross-Kerr JC. Impact of an instructional program on nurses' accuracy in capillary blood glucose monitoring. *Clinical nursing research*. 1999;8(2):166-78.
142. Ogden J, Hoppe R. The relative effectiveness of two styles of educational package to change practice nurses' management of obesity. *International journal of obesity and related metabolic disorders : journal of the International Association for the Study of Obesity*. 1997;21(11):963-71.
143. Omidi K, Dehghan M, Shahrabaki PM. Effectiveness of A Traditional Training Method in Increasing Long-Term End-of-Life Care Perception and Clinical Competency among Oncology Nurses: A Pilot Clinical Trial. *Asia-Pacific journal of oncology nursing*. 2020;7(3):287-94.
144. Oniki TA, Clemmer TP, Pryor TA. The effect of computer-generated reminders on charting deficiencies in the ICU. *Journal of the American Medical Informatics Association : JAMIA*. 2003;10(2):177-87.
145. Pagaiya N, Garner P. Primary care nurses using guidelines in Thailand: a randomized controlled trial. *Tropical medicine & international health : TM & IH*. 2005;10(5):471-7.
146. Park BM. Development and Effect of a Fall Prevention Program Based on King's Theory of Goal Attainment in Long-Term Care Hospitals: An Experimental Study. *Healthcare (Basel, Switzerland)*. 2021;9(6).
147. Parker PA, Urbauer D, Fisch MJ, Fellman B, Hough H, Miller J, et al. A multisite, community oncology-based randomized trial of a brief educational intervention to increase communication regarding complementary and alternative medicine. *Cancer*. 2013;119(19):3514-22.
148. Passos I, Padoveze MC, Zem-Mascarenhas SH, Kawagoe JY, Felix A, Timmons S, et al. An innovative strategy for nursing training on standard and transmission-based precautions in primary health care: A randomized controlled trial. *American journal of infection control*. 2022;50(6):657-62.
149. Pauwels PPYT, Metsemakers JFM, Himawan AB, Kristina TN. The efficacy of education with the WHO dengue algorithm on correct diagnosing and triaging of dengue-suspected patients; Study in public health centre. *Hiroshima Journal of Medical Sciences*. 2018;67:35-40.
150. Pitkala KH, Juola AL, Kautiainen H, Soini H, Finne-Soveri UH, Bell JS, et al. Education to reduce potentially harmful medication use among residents of assisted living facilities: a randomized controlled trial. *Journal of the American Medical Directors Association*. 2014;15(12):892-8.
151. Quintard B, Lecigne A, Pascual A, Rogues AM, Parneix P. Efficacité comparée de deux stratégies de prévention des infections nosocomiales: Impact sur les représentations et les pratiques auto-déclarées. [Comparative effectiveness of two strategies against nosocomial infections: Impact on social representations and declared behaviors.]. *Le Travail Humain: A Bilingual and Multi-Disciplinary Journal in Human Factors*. 2010;73(3):239-60.
152. Rankin JA, Then KL, Atack L. Can emergency nurses' triage skills be improved by online learning? Results of an experiment. *Journal of emergency nursing*. 2013;39(1):20-6.

### Additional file 3. Description of included studies.

153. Rantz MJ, Popejoy L, Petroski GF, Madsen RW, Mehr DR, Zwygart-Stauffacher M, et al. Randomized clinical trial of a quality improvement intervention in nursing homes. *The Gerontologist*. 2001;41(4):525-38.
154. Reynolds SS, Woltz P, Keating E, Neff J, Elliott J, Hatch D, et al. Results of the Chlorhexidine Gluconate Bathing implementation intervention to improve evidence-based nursing practices for prevention of central line associated bloodstream infections Study (CHAnGing BathS): a stepped wedge cluster randomized trial. *Implementation science* : IS. 2021;16(1):45.
155. Rhew DC, Glassman PA, Goetz MB. Improving pneumococcal vaccine rates. Nurse protocols versus clinical reminders. *Journal of general internal medicine*. 1999;14(6):351-6.
156. Roelands M, Van Oost P, Stevens V, Depoorter AM, Buysse A. Clinical practice guidelines to improve shared decision-making about assistive device use in home care: a pilot intervention study. *Patient Education and Counseling*. 2004;55(2):252-64.
157. Rothschild JM, Keohane CA, Cook EF, Orav EJ, Burdick E, Thompson S, et al. A controlled trial of smart infusion pumps to improve medication safety in critically ill patients. *Critical care medicine*. 2005;33(3):533-40.
158. Rutherford-Hemming T, Kelsey NC, Grenig DL, Feliciano M, Simko L, Henrich CM. Multisite Single-Blinded Randomized Control Study of Transfer and Retention of Knowledge and Skill Between Nurses Using Simulation and Online Self-Study Module. *Simulation in healthcare* : journal of the Society for Simulation in Healthcare. 2016;11(4):264-70.
159. Sadeghi R, Hashemi M, Khanjani N. The impact of educational intervention based on the health belief model on observing standard precautions among emergency center nurses in Sirjan, Iran. *Health Education Research*. 2018;33(4):327-35.
160. Saevareid TJL, Thoresen L, Gjerberg E, Lillemoen L, Pedersen R. Improved patient participation through advance care planning in nursing homes-A cluster randomized clinical trial. *Patient education and counseling*. 2019;102(12):2183-91.
161. Sarna L, Bialous SA, Ong MK, Wells M, Kotlerman J. Increasing nursing referral to telephone quitlines for smoking cessation using a web-based program. *Nursing Research*. 2012;61(6):433-40.
162. Sayre MM, McNeese-Smith D, Leach LS, Phillips LR. An educational intervention to increase "speaking-up" behaviors in nurses and improve patient safety. *Journal of nursing care quality*. 2012;27(2):154-60.
163. Schneider PJ, Pedersen CA, Montanya KR, Curran CR, Harpe SE, Bohenek W, et al. Improving the safety of medication administration using an interactive CD-ROM program. *American journal of health-system pharmacy* : AJHP : official journal of the American Society of Health-System Pharmacists. 2006;63(1):59-64.
164. Schondelmeyer AC, Bettencourt AP, Xiao R, Beidas RS, Wolk CB, Landrigan CP, et al. Evaluation of an Educational Outreach and Audit and Feedback Program to Reduce Continuous Pulse Oximetry Use in Hospitalized Infants With Stable Bronchiolitis: A Nonrandomized Clinical Trial. *JAMA network open*. 2021;4(9):e2122826.
165. Seeley MA, Harding KG. The effects of education and training on clinical practice in wound healing. *International wound journal*. 2008;5(5):660-4.
166. Segal G, Karniel E, Mahagna A, Kaa'dan F, Levi Z, Balik C. A nurse-guided, basal-prandial insulin treatment protocol for achieving glycaemic control of hospitalized, non-critically ill diabetes patients, is non-inferior to physician-guided therapy: A pivotal, nurse-empowerment study. *International journal of nursing practice*. 2015;21(6):790-6.
167. Senarath U, Fernando DN, Rodrigo I. Effect of training for care providers on practice of essential newborn care in hospitals in Sri Lanka. *Journal of obstetric, gynecologic, and neonatal nursing* : JOGNN. 2007;36(6):531-41.
168. Seo Y, Roh YS. Effects of pressure ulcer prevention training among nurses in long-term care hospitals. *Nurse education today*. 2020;84:104225.
169. Seto WH, Ching PT, Fung JP, Fielding R. The role of communication in the alteration of patient-care practices in hospital--a prospective study. *The Journal of hospital infection*. 1989;14(1):29-37.
170. Seto WH, Ching TY, Yuen KY, Chu YB, Seto WL. The enhancement of infection control in-service education by ward opinion leaders. *American journal of infection control*. 1991;19(2):86-91.
171. Shevlin JD, Summers-Bean C, Thomas D, Whitney CG, Todd D, Ray SM. A systematic approach for increasing pneumococcal vaccination rates at an inner-city public hospital. *American journal of preventive medicine*. 2002;22(2):92-7.
172. Smeland AH, Twycross A, Lundeberg S, Smastuen MC, Rustoen T. Educational Intervention to Strengthen Pediatric Postoperative Pain Management: A Cluster Randomized Trial. *Pain management nursing* : official journal of the American Society of Pain Management Nurses. 2022;23(4):430-42.
173. Snelgrove-Clarke E, Davies B, Flowerdew G, Young D. Implementing a Fetal Health Surveillance Guideline in Clinical Practice: A Pragmatic Randomized Controlled Trial of Action Learning. *Worldviews on evidence-based nursing*. 2015;12(5):281-8.
174. Srikrajang J, Pochamarn C, Chittreecheur J, Apisarnthanarak A, Danchaiwijitr S. Effectiveness of education and problem solving work group on nursing practices to prevent needlestick and sharp injury. *Journal of the Medical Association of Thailand = Chotmaihet thangphaet*. 2005;88 Suppl 10:S115-9.
175. Sung YH, Kwon IG, Ryu E. Blended learning on medication administration for new nurses: integration of e-learning and face-to-face instruction in the classroom. *Nurse education today*. 2008;28(8):943-52.
176. Teasing GR, Erasmus V, Nieboer D, Petrigiani M, Koopmans MPG, Vos MC, et al. Increased hand hygiene compliance in nursing homes after a multimodal intervention: A cluster randomized controlled trial (HANDSOME). *Infection control and hospital epidemiology*. 2020;41(10):1169-77.
177. Teresi JA, Ramirez M, Ellis J, Silver S, Boratgis G, Kong J, et al. A staff intervention targeting resident-to-resident elder mistreatment (R-REM) in long-term care increased staff knowledge, recognition and reporting: results from a cluster randomized trial. *International journal of nursing studies*. 2013;50(5):644-56.
178. Titler MG, Herr K, Brooks JM, Xie XJ, Ardery G, Schilling ML, et al. Translating research into practice intervention improves management of acute pain in older hip fracture patients. *Health services research*. 2009;44(1):264-87.
179. Tornvall E, Wahren LK, Wilhelmsson S. Advancing nursing documentation--an intervention study using patients with leg ulcer as an example. 2009;78(9):605-17.
180. Tsai YF, Tsai MC, Lin YP, Weng CE, Chou YL, Chen CY. An alcohol training program improves Chinese nurses' knowledge, self-efficacy, and practice: a randomized controlled trial. *Alcoholism, clinical and experimental research*. 2011;35(5):976-83.
181. Tsai WP, Lin LY, Chang HC, Yu LS, Chou MC. The effects of the Gatekeeper Suicide-Awareness Program for nursing personnel. *Perspectives in psychiatric care*. 2011;47(3):117-25.
182. Valimaki M, Lantta T, Anttila M, Vahlberg T, Normand SL, Yang M. An Evidence-Based Educational Intervention for Reducing Coercive Measures in Psychiatric Hospitals: A Randomized Clinical Trial. *JAMA network open*. 2022;5(8):e2229076.

### Additional file 3. Description of included studies.

183. van de Steeg L, R IJ, Langelaan M, Wagner C. Can an e-learning course improve nursing care for older people at risk of delirium: a stepped wedge cluster randomised trial. *BMC geriatrics*. 2014;14:69.
184. van Gaal BG, Schoonhoven L, Mintjes JA, Borm GF, Koopmans RT, van Achterberg T. The SAFE or SORRY? programme. part II: effect on preventive care. *International journal of nursing studies*. 2011;48(9):1049-57.
185. van Lieshout J, Huntink E, Koetsenruijter J, Wensing M. Tailored implementation of cardiovascular risk management in general practice: a cluster randomized trial. *Implementation science* : IS. 2016;11:115.
186. Varghese NC, Macaden L, Premkumar B, Mathews P, Kumar S. Delirium in older people in hospital: an education programme. *British journal of nursing (Mark Allen Publishing)*. 2014;23(13):704-9.
187. Vicdan AK, Fatma Birgili R. Evaluation of the training given to the nurses on the injection application to the ventrogluteal site: a quasi-experimental study. *International journal of caring sciences*. 2019;12(3):1467-79.
188. von Lengerke T, Lutze B, Krauth C, Lange K, Stahmeyer JT, Chaberny IF. Promoting Hand Hygiene Compliance PSYGIENE-a Cluster-Randomized Controlled Trial of Tailored Interventions. *Deutsches Ärzteblatt international*. 2017;114(3):29-36.
189. Wagner LM, Capezuti E, Taylor JA, Sattin RW, Ouslander JG. Impact of a falls menu-driven incident-reporting system on documentation and quality improvement in nursing homes. *The Gerontologist*. 2005;45(6):835-42.
190. Wald HL, Bandle B, Richard AA, Min SJ, Capezuti E. A Trial of electronic surveillance feedback for quality improvement at Nurses Improving Care for Healthsystem Elders (NICHE) hospitals. *American journal of infection control*. 2014;42(10 Suppl):S250-6.
191. Walsh TS, Kydonaki K, Antonelli J, Stephen J, Lee RJ, Everingham K, et al. Staff education, regular sedation and analgesia quality feedback, and a sedation monitoring technology for improving sedation and analgesia quality for critically ill, mechanically ventilated patients: a cluster randomised trial. *The Lancet Respiratory medicine*. 2016;4(10):807-17.
192. Wang L, Chen H, Yang L, Qian C, Sun D, Sun Y. Systematic training program for nursing home staff based on the concept of combination of medicine and care. *Medicine*. 2020;99(24):e20559.
193. Wang J, Wei L, Li H, Zhang H, Gu R, Zhang Y, et al. Effectiveness of a Game-Based Phone Application in Educating Health Care Workers on the Proper Use of Personal Protective Equipment. *Journal of continuing education in nursing*. 2022;53(5):212-20.
194. Weaver MR, Pillay E, Jed SL, de Kadt J, Galagan S, Gilvydis J, et al. Three methods of delivering clinic-based training on syndromic management of sexually transmitted diseases in South Africa: a pilot study. *Sexually transmitted infections*. 2016;92(2):135-41.
195. Westbrook JI, Li L, Hooper TD, Raban MZ, Middleton S, Lehnbohm EC. Effectiveness of a 'Do not interrupt' bundled intervention to reduce interruptions during medication administration: a cluster randomised controlled feasibility study. *BMJ quality & safety*. 2017;26(9):734-42.
196. Wilkinson S, Perry R, Blanchard K, Linsell L. Effectiveness of a three-day communication skills course in changing nurses' communication skills with cancer/palliative care patients: a randomised controlled trial. *Palliative medicine*. 2008;22(4):365-75.
197. Wood A, Braat S, Temple-Smith M, Lorch R, Vaisey A, Guy R, et al. A chlamydia education and training program for general practice nurses: reporting the effect on chlamydia testing uptake. *Australian journal of primary health*. 2021;27(1):36-42.
198. Woodcock AJ, Kinmonth AL, Campbell MJ, Griffin SJ, Spiegel NM. Diabetes care from diagnosis: effects of training in patient-centred care on beliefs, attitudes and behaviour of primary care professionals. *Patient education and counseling*. 1999;37(1):65-79.
199. Wright BJ, Turner JG, Daffin P. Effectiveness of computer-assisted instruction in increasing the rate of universal precautions--related behaviors. *American journal of infection control*. 1997;25(5):426-9.
200. Yang FH, Lin FY, Hwu YJ. The Feasibility Study of a Revised Standard Care Procedure on the Capacity of Nasogastric Tube Placement Verification Among Critical Care Nurses. *The journal of nursing research* : JNR. 2019;27(4):e31.
201. Yun EJ, Kim TI. Development and effectiveness of an educational program on developmental positioning for neonatal intensive care unit nurses in South Korea: a quasi-experimental study. *Child health nursing research*. 2022;28(1):70-81.
202. Zarifsanaiy N, Sajjadian R, Karimian Z, Khojasteh L, Shahraki HR. Investigating the effectiveness of Case-Based Technology-Enhanced workshops (e-Flipped vs. Online) among health worker nurses during the COVID-19 pandemic. *Nursing open*. 2023;10(4):2329-37.
203. Ziyaeifard M, Azarfarin R, Zamani K, Alizadehasl A, Khalili Y, Moradian M, et al. Imperative role of education of ICU nurses regarding postoperative pain management after pediatric cardiac surgery. *Iranian Heart Journal*. 2018;19(2):13-9.
204. Zohar D, Werber YT, Marom R, Curlau B, Blondheim O. Modifying head nurse messages during daily conversations as leverage for safety climate improvement: a randomised field experiment. *BMJ quality & safety*. 2017;26(8):653-62.