EVIDENCE TABLE

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Question: JIT compared to no JIT for Simulation in healthcare professionals (trainees or practitioners)
Setting: We did not filter by setting, studies could involve JIT conducted through simulation among any healthcare provider (professional or trainee) in any setting (operating room, emergency department, medicine ward etc.)
Bibliography: . just-in-time training for simulation in healthcare professionals (trainees or practitioners). Cochrane Database of Systematic Reviews [Year], Issue [Issue].

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	JIT	no JIT	Relative (95% CI)	Absolute (95% CI)		
Total time (T1 and T2) (assessed with: seconds)												
7	randomised trials	serious[a]	serious[b]	not serious	very serious[c]	none	207	148	-	SMD **0.38 SD lower** (0.96 lower to 0.2 higher)	⨁◯◯◯ Very low	
Product (T3) (assessed with: infection rate)												
1	observational studies	serious[d]	not serious	serious[e]	not serious	none	Before and after implementation of a central venous catheter (CVC) dress rehearsal program the overall cetnral line associated blood stream infection (CLABSI) rate decreased from 5.3/1000 CVC line days (January 2007 to October 2008) to 2.9/1000 line days (November 2008 to July 2010) (P < 0.001)				⨁◯◯◯ Very low	
Product (T2) (assessed with: Procedure success)												
2	observational studies	very serious[f]	not serious	not serious	very serious[g]	none	Kessler 2015 (infant LP): Crude RR 1.08 (95% CI 0.69-1.71) Absolute effect 28 more per 1,000 (from 109 fewer to 249 more) Nishisaki 2010 (intubation): Crude RR 0.80 (95% CI 0.52-1.24) Absolute effect 125 fewer per 1,000 (from 300 fewer to 150 more)				⨁◯◯◯ Very low	
Expert rated global performance (T2 Process)												
5	randomised trials	serious[h]	not serious	not serious	very serious[c]	none	131	106	-	SMD **0.97 higher** (0.17 higher to 1.77 higher)	⨁◯◯◯ Very low	
Process (T1) (assessed with: various)												
4	randomised trials	very serious[i]	not serious	serious[j]	not serious	none	236	237	-	**0** (0 to 0)	⨁◯◯◯ Very low	
Knowledge												
2	observational studies	serious[d]	not serious	very serious[k]	not serious	none	After training participants of a JIT training session for intraosseous (IO) needle placement and defibrillator use had statistically significant increases in correct responses on 5 out of 5 procedure/equipment knowledge-related questions as compared to before training. (Itoh 2019) After training, participants of a JIT training session on nasopharyngeal swab collection had statistically significant increases in correct responses on 2 knowledge related questions. (Carlson 2021)				⨁◯◯◯ Very low	

CI: confidence interval; **SMD:** standardised mean difference

Explanations

a. Although studies showed consistent findings except for Branzetti 2017 , studies contributing more weight were moderate to high risk of bias overall
b. Studies had divergent results
c. The confidence interval crosses two decision making thresholds of small and moderate effect size
d. Non comparative before and after design
e. Only addressed 1 procedure (CVC dressing changes) which are not representative of all just-in-time simulation training tasks
f. Reported unadjusted proportions
g. Very wide confidence intervals, compatible with important benefit, no difference as well as important harm
h. Although studies showed consistent findings, studies contributing more weight were moderate risk of bias overall
i. Studies had moderate and high risk of bias
j. Many heterogeneous outcomes and studies
k. Only addressed knowledge for 2 types of procedures which are not representative of all just-in-time simulation training

EVIDENCE TO DECISION TABLE

QUESTION

Should JIT vs. no JIT be used for Simulation in healthcare professionals (trainees or practitioners)?	
POPULATION:	Simulation in healthcare professionals (trainees or practitioners)
INTERVENTION:	JIT
COMPARISON:	no JIT
MAIN OUTCOMES:	Total time (T1 and T2 Process outcomes); Expert rated global performance (T2 Process); Procedure success (T2 Product); Self-efficacy (T2 outcome) ; Self-efficacy (T2 outcome) ; T3 product observational (infection);
SETTING:	We did not filter by setting, studies could involve JIT conducted through simulation among any healthcare provider (professional or trainee) in any setting (operating room, emergency department, medicine ward etc.)
PERSPECTIVE:	
BACKGROUND:	Although just-in-time training (JIT) is increasingly used in simulation-based health professions education, its impact on learning, performance, and patient outcomes remains uncertain. The aim of this work is to produce recommendations for the use of JIT simulation training based on the available evidence.
CONFLICT OF INTERESTS:	The authors and panel members are all simulation educators.

ASSESSMENT

Problem

Is the problem a priority?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ● Yes ○ Varies ○ Don't know		Responding to changing healthcare practice environments requires new models for training; however the most effective and efficient methods for providing simulation training remain unknown. Just-in-time simulation training, defined as training that is conducted in temporal or spatial proximity to performance, is one possible solution. Providing simulation training directly before an actual clinical procedure is resource intensive, but may be worthwhile if it improves performance and patient outcomes.

Desirable Effects

How substantial are the desirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Trivial ○ Small ● Moderate ○ Large ○ Varies ○ Don't know	*See Appendix 1*	All of the effects identified by our review consistently favoured Just-in-time simulation training. The effect sizes ranged from small to large and the panel decided that overall moderate effect was most appropriate. Because across all outcomes, the observed absolute effects favoured JIT, the panel did assign relative values and preferences to outcomes.

Undesirable Effects

How substantial are the undesirable anticipated effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ○ Small ○ Trivial ○ Varies ● Don't know	There is no research evidence systematically examining the undesirable effects of just-in-time training was identified.	Panel members noted that some of the undesirable effects of this intervention may be the time and resource intensiveness related to implementing just-in-time training before performance. One study (Mucksavage et al. 2012) examined cost-savings related to warm-up prior to a surgical procedures but it did not involve a formal cost effectiveness analysis and may not have captured all important variables.

Certainty of evidence

What is the overall certainty of the evidence of effects?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Very low ○ Low ○ Moderate ○ High ○ No included studies	The certainty of evidence for all included outcomes was very low.	Specifically with regards to time-related outcomes, T1 (studies conducted in the educational laboratory) and T2 (studies conducted in patient care settings) were combined because the panel felt that time was a similar variable in both of those settings; however the panel was clear that there seems to be appropriate amounts of data (6 RCTs) documenting effects in the educational laboratory setting, but we need more studies in the clinical setting (there were 2 RCTs identified with divergent results). The panel felt that studies in the clinical setting do need to be firmly grounded in data from the educational laboratory settings

Values

Is there important uncertainty about or variability in how much people value the main outcomes?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Important uncertainty or variability ○ Possibly important uncertainty or variability ○ Probably no important uncertainty or variability ● No important uncertainty or variability		

Balance of effects

Does the balance between desirable and undesirable effects favor the intervention or the comparison?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favors the comparison ○ Probably favors the comparison ○ Does not favor either the intervention or the comparison ● Probably favors the intervention ○ Favors the intervention ○ Varies ○ Don't know		The panel considered the desirable effects of just-in-time training identified in the systematic review but also appreciated the lack of information about any undesirable effects. The panel felt that even if there was evidence of important cost or resource use related to just in time training, most relevant decision-makers would still favour it's use given anticipated improvement in patient outcomes (despite costs and resources) The panel could not identify any other undesirable effects of just-in-time training (other than resources and costs) and also noted that just-in-time interventions have been studied enough (28 studies in our systematic review) that significant undesirable effects should have become apparent.

Resources required

How large are the resource requirements (costs)?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large costs ○ Moderate costs ○ Negligible costs and savings ○ Moderate savings ○ Large savings ○ Varies ● Don't know		The resource use of just-in-time training is not well studied. One study (Mucksavage et al. 2012) identified an approximate $2000 cost-savings related to the implementation of just-in-time training for urological surgical procedures. But this study was felt to not address all the appropriate inputs/outputs to qualify as an economic analysis.

Certainty of evidence of required resources

What is the certainty of the evidence of resource requirements (costs)?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ Low ○ Moderate ○ High ● No included studies		

Cost effectiveness

Does the cost-effectiveness of the intervention favor the intervention or the comparison?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favors the comparison ○ Probably favors the comparison ○ Does not favor either the intervention or the comparison ○ Probably favors the intervention ○ Favors the intervention ● Varies ○ No included studies		One study (Mucksavage et al. 2012) identified an approximate $2000 cost-savings related to the implementation of just-in-time training for urological surgical procedures. But this study was felt to not address all the appropriate inputs/outputs to qualify as an economic analysis.

Equity

What would be the impact on health equity?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Reduced ● Probably reduced ○ Probably no impact ○ Probably increased ○ Increased ○ Varies ○ Don't know		Implementation of just-in-time training is likely to initially target university hospitals and tertiary care centers potentially giving rise to disparities in patient outcomes between these centres and other healthcare providing facilities. While the disparities in patient outcomes may provide empiric evidence of the effectiveness of the implementation of these guidelines in the real-world settings, it is hoped that subsequent implementation interventions would be adopted to minimize such disparities.

Acceptability

Is the intervention acceptable to key stakeholders?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know		There is no evidence examining the acceptability of just-in-time training by various stakeholders. Many of the studies focused on medical trainees (frequently novices) in whom just in time training may be more acceptable. Studies are needed to better understand how acceptable Just-in-time training may be in various contexts - practicing healthcare professionals vs trainees and in what specific circumstances (e.g. after a certain absence from practice) it might be most relevant and acceptable

Feasibility

Is the intervention feasible to implement?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know		Feasibility varies based on context. In some situations (Kessler et al 2015 study on LPs), it may be feasible to take a time out and conduct a just-in-time training session; whereas in other situations (e.g. critically ill patients requiring intubation) it would not be feasible to take time out to engage in just-in-time training. No other important barriers limiting feasibility of implementing the intervention were identified by the panel.

SUMMARY OF JUDGEMENTS

	JUDGEMENT						
PROBLEM	No	Probably no	Probably yes	**Yes**		Varies	Don't know
DESIRABLE EFFECTS	Trivial	Small	**Moderate**	Large		Varies	Don't know
UNDESIRABLE EFFECTS	Large	Moderate	Small	Trivial		Varies	**Don't know**
CERTAINTY OF EVIDENCE	**Very low**	Low	Moderate	High			No included studies
VALUES	Important uncertainty or variability	Possibly important uncertainty or variability	Probably no important uncertainty or variability	**No important uncertainty or variability**			
BALANCE OF EFFECTS	Favors the comparison	Probably favors the comparison	Does not favor either the	**Probably favors the intervention**	Favors the intervention	Varies	Don't know

	JUDGEMENT						
			intervention or the comparison				
RESOURCES REQUIRED	Large costs	Moderate costs	Negligible costs and savings	Moderate savings	Large savings	Varies	**Don't know**
CERTAINTY OF EVIDENCE OF REQUIRED RESOURCES	Very low	Low	Moderate	High			**No included studies**
COST EFFECTIVENESS	Favors the comparison	Probably favors the comparison	Does not favor either the intervention or the comparison	Probably favors the intervention	Favors the intervention	**Varies**	No included studies
EQUITY	Reduced	**Probably reduced**	Probably no impact	Probably increased	Increased	Varies	Don't know
ACCEPTABILITY	No	Probably no	Probably yes	Yes		**Varies**	Don't know
FEASIBILITY	No	Probably no	Probably yes	Yes		**Varies**	Don't know

TYPE OF RECOMMENDATION

Strong recommendation against the intervention	Conditional recommendation against the intervention	Conditional recommendation for either the intervention or the comparison	**Conditional recommendation for the intervention**	Strong recommendation for the intervention
○	○	○	●	○

CONCLUSIONS

Recommendation

We suggest that when feasible, 5-30 minutes of just-in-time simulation training (within 24 hours of performance) should be implemented for high-stakes medical or surgical procedures (conditional recommendation, very low certainty evidence) particularly when there has been a prolonged period of no training (>1-2 weeks)

Justification

- This review included both randomized and non-randomized studies. Most non-randomized studies were pre-post studies, which carry a large risk of bias so a strong recommendation could not be made.
- Despite methodological weaknesses, most of the evidence was in favour of JIT simulation training which is the basis for the conditional recommendation.
- There is significant heterogeneity in the way JIT simulation training was implemented, including training type, length, content, and setting.
- Most studies focused on laparoscopic surgical skills and most included trainees.
- Most crossover studies allowed for a 2-week washout period

Subgroup considerations

- Most of our results were not amenable to meta-analysis and were instead synthesized in a narrative format. For this reason, we were unable to undertake a priori subgroup analysis comparing cognitive versus psychomotor skills, contextual factors influencing JIT training, and specific features of JIT training.

Implementation considerations

- Programs should involve simulation experts and other healthcare educationists to specify their procedure and program specific requirements with respect to some of these specific details of JIT training.

Monitoring and evaluation

Given theoretical concerns regarding the equity of JIT training implementation in high resource versus low resource environments, the impacts of our recommendations should be monitored and evaluated.

Research priorities

1. The existing evidence is heavily weighted towards physicians in training. More studies examining non-physicians and physicians in practice are needed.
2. There is need for studies looking at patient-oriented outcomes e.h. patient morbidity, mortality, cost and resource use
3. There are many randomized controlled trial in this space but the field may benefit from interrupted time series analysis (where programs implement JIT and see changes in trends in complications and mortality before and after implementing the change.
4. Research comprehensively examining some of the undesirable effects of just-in-time training (costs, resources, and time) is required to better understand the overall balance of desirable and undesirable effects of JIT as it appears that the evidence is currently weighted to demonstrate the benefits.

APPENDICES

Appendix 1

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no JIT	Risk with JIT				
Total time (T1 and T2 Process outcomes)	The mean total time (T1 and T2 Process outcomes) was **0**	SMD **0.37 lower** (0.81 lower to 0.06 higher)	-	658 (8 RCTs)	⨁◯◯◯ Very low[a,b,c]	
Expert rated global performance (T2 Process)	The mean expert rated global performance (T2 Process) was **0**	SMD **0.97 higher** (0.17 higher to 1.77 higher)	-	237 (5 RCTs)	⨁◯◯◯ Very low[c,d]	
Procedure success (T2 Product)	Study 1 (infant LP): Crude RR 1.08 (95% CI 0.69-1.71) Absolute effect 28 more per 1,000 (from 109 fewer to 249 more) Study 2 (intubation): Crude RR 0.80 (95% CI 0.52-1.24) Absolute effect 125 fewer per 1,000 (from 300 fewer to 150 more)		-	500 (2 observational studies)	⨁◯◯◯ Very low[e,f]	

Self-efficacy (T2 outcome) Scale from: 1 to 5	The mean self-efficacy (T2 outcome) was **0**	MD **1.12 higher** (0.65 higher to 1.59 higher)	-	90 (1 RCT)	⨁◯◯◯ Very low[g,h]	
Self-efficacy (T2 outcome) assessed with: Scale from: 1 to 5	There was a statistical difference in provider self-confidence in CVC dressing changes (JIT 4.6 (0.6); no JIT, 4.1 (0.8); *P* < .0001) (n=524)		-	4.68 (1 observational study)	⨁◯◯◯ Very low[i]	
T3 product observational (infection)	Before and after implementation of a CVC dress rehearsal program the overall CLABSI rate decreased from 5.3/1000 CVC line days (January 2007 to October 2008) to 2.9/1000 line days (November 2008 to July 2010) (P < 0.001)		-	(1 observational study)	⨁◯◯◯ Very low[i,j]	

a. Although studies showed consistent findings except for Branzetti 2017 , studies contributing more weight were moderate to high risk of bias overall
b. Studies had divergent results
c. The confidence interval crosses two decision making thresholds of small and moderate effect size
d. Although studies showed consistent findings, studies contributing more weight were moderate risk of bias overall
e. Reported unadjusted proportions
f. Very wide confidence intervals, compatible with important benefit, no difference as well as important harm
g. Using the ROB2 tool the ROB had some concerns
h. Result was not statistically significant
i. Non comparative before and after design
j. Outcome (CVC infection rate) may not only be related to dressing change

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