INPLASY

Comparative Effectiveness of Face-to-Face, Online, and Blended Learning in Evidence-Based Medicine Education: A Systematic Review and Bayesian Network Meta-Analysis of Randomised Controlled Trials

INPLASY202630077
doi: 10.37766/inplasy2026.3.0077
Received: 21 March 2026
Published: 21 March 2026

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ADMINISTRATIVE INFORMATION

Support - N/A.

Review Stage at time of this submission - Data extraction.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202630077

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 21 March 2026 and was last updated on 21 March 2026.

INTRODUCTION

Review question / Objective To compare the effectiveness of face-to-face instruction, online learning, and blended learning relative to no intervention on EBM competency outcomes — including knowledge, skills, attitudes, and behaviour — among health professions students and clinicians, using Bayesian network meta-analysis of randomised controlled trials.

Condition being studied Evidence-based medicine (EBM) competency in health professions education, encompassing knowledge, skills, attitudes, and behaviour related to the EBM process.

METHODS

Participant or population Undergraduate students enrolled in health professions programmes (including medicine, nursing, pharmacy, and allied health) and postgraduate healthcare professionals receiving formal EBM education.

Intervention EBM educational interventions delivered via face-to-face instruction, online learning, or blended learning, encompassing a comprehensive EBM curriculum spanning the full EBM proces.

Comparator No intervention (control group receiving no EBM education or usual care without structured EBM teaching), as well as active comparisons among face-to-face instruction, online learning, and blended learning.

Study designs to be included Randomised controlled trials (RCTs), including parallel-group, cluster-randomised, and crossover designs.

Eligibility criteria Inclusion criteria: (1) randomised controlled trials (parallel-group, cluster-randomised, or crossover designs); (2) participants were undergraduate health professions students or postgraduate healthcare professionals; (3)

intervention was a comprehensive EBM curriculum delivered via face-to-face instruction, online learning, or blended learning; (4) at least one quantitative outcome reportable as a continuous measure (knowledge, skills, attitudes, behaviour, or confidence/self-efficacy) was assessed; (5) sufficient data available for effect size extraction.
Exclusion criteria: (1) non-randomised studies or before-after designs without a concurrent control group; (2) interventions targeting only a discrete EBM sub-skill (e.g., literature searching, critical appraisal, or clinical decision analysis in isolation); (3) EBM used as an implementation strategy rather than taught as a skill set; (4) conference abstracts without extractable quantitative data; (5) studies from which outcome data could not be extracted.

Information sources PubMed/MEDLINE, Embase, Cochrane Central Register of Controlled Trials (CENTRAL), CINAHL, and China National Knowledge Infrastructure (CNKI), searched from inception to March 2026. ClinicalTrials.gov was additionally searched for registered but unpublished trials. Reference lists of all included studies and relevant previously published systematic reviews were hand-searched to identify additional eligible studies.

Main outcome(s) Primary outcome: EBM knowledge assessed immediately after the intervention. Secondary outcomes: EBM skills, attitudes towards EBM, EBM-related behaviours, and knowledge and skills retention assessed at approximately 3–5 months post-intervention.

Quality assessment / Risk of bias analysis The methodological quality of included studies was assessed using the Cochrane Risk of Bias tool version 2 (RoB 2), with separate versions applied for parallel-group, cluster-randomised, and crossover RCTs. Two reviewers independently assessed each study across five domains: randomisation process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. Each domain was rated as low risk, some concerns, or high risk, and an overall risk of bias judgement was assigned accordingly. Discrepancies were resolved by discussion and consensus.

Strategy of data synthesis Bayesian network meta-analysis (NMA) was conducted using the multinma package in R. Arm-level data were pooled as standardised mean differences (SMDs) using a random-effects model, with No Intervention as the network reference treatment. Weakly informative priors were specified: normal(0, 1) for treatment effects and half-normal(0, 0.5) for between-study heterogeneity (τ). MCMC sampling used 4 chains of 4,000 iterations (2,000 warm-up) with adapt_delta = 0.99; convergence was confirmed by $\hat{R} < 1.01$. Relative effects are reported as posterior median SMDs with 95% credible intervals (CrI) and 95% predictive intervals (PrI). Treatment hierarchy was summarised using the surface under the cumulative ranking curve (SUCRA). Network consistency was evaluated by comparing the consistency model against an unrelated mean effects (UME) model. Sensitivity analyses included use of non-informative priors and exclusion of influential outlier studies.

Subgroup analysis Subgroup analyses will be conducted by participant type (undergraduate health professions students versus postgraduate healthcare professionals) to explore potential sources of heterogeneity. Sensitivity analyses will additionally be conducted by: (1) excluding Dizon 2014, the sole study providing a direct blended learning versus no intervention comparison with an extreme effect estimate; and (2) using non-informative priors [normal(0, 10) for treatment effects; half-normal(0, 2.5) for τ] to assess the influence of prior specification.

Sensitivity analysis (1) Excluding Dizon 2014, the sole study providing a direct blended learning versus no intervention comparison with an extreme effect estimate (SMD $\approx$ 3.2), to assess its influence on pooled estimates and network consistency; (2) replacing weakly informative priors with non-informative priors [normal(0, 10) for treatment effects; half-normal(0, 2.5) for τ] to evaluate the influence of prior specification on posterior estimates.

Country(ies) involved Taiwan.

Keywords evidence-based medicine; evidence-based practice; network meta-analysis; Bayesian; teaching modality; face-to-face; online learning; blended learning; health professions education; randomised controlled trial.

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