

Multimedia Appendix 4: Results of the included studies									
Study ID (Author Year), Study Design, Country	Intervention Type	Population (N)	Field of Study	Knowledge	Clinical practice improvement	Healthcare Professionals' Attitude	Patient-related outcomes	Economic outcome(s)	Conclusion
Bochicchio 2006, RCT, USA	I: Mobile digital education C: Traditional education (Usual practice)	12 primary care physicians	Antibiotic decision management guide	Post-intervention mean score on 50 items MCQ, SMD=1.3 [0.00, 2.6]	N/A	N/A	N/A	N/A	Knowledge: Mobile digital education > Traditional education
Butler 2012, RCT, UK	I: Online blended education (Online digital education plus traditional education) C: Traditional education (Usual practice)	68 practices, 263 primary care physicians and 480,000 patients (approximate number)	Multifaceted educational program to reduce antibiotic dispensing in primary care	N/A	Reported a reduction in the rate of total oral antibiotic dispensing for the study year in online blended education (4.2%, 95% CI 0.6% to 7.7%, P=0.02)	N/A	No difference in post-intervention hospital admission rate (MD=-1.9%, 95% CI: -13.2 to 8.2, P=0.72) and re-consultation rate at seven day post-intervention median scores (MD=-0.65 (95% CI -1.69 to 0.55, P=0.446) between the intervention (i.e. online blended digital education) and the traditional education groups (i.e. usual practice).	Mean cost of the programme (intervention) was £2923 per practice (SD £1187). There was a 5.5% (-0.4% to 11.4%) reduction in the cost of dispensed antibiotics in the intervention group compared with the control group which was equivalent to a reduction of about £830 a year for an average intervention practice.	Clinical practice improvement: Online blended education > Traditional education Patient-related outcomes: Online blended education = Traditional education Economic outcome(s): Online blended education > Traditional education

Chen 2014, cRCT, China	I: Mobile digital education C: Traditional education (Traditional CME program)	100 practices and 479 primary care physicians	Management of upper respiratory infection	Post-intervention mean score on 10 items MCQ, SMD=1.09 [0.96, 1.23]	Antibiotic prescribing rate for intervention group in comparison to the control (RR=1.02, 95% CI: 0.94 to 1.1, P=0.63).	One-third of the participants in the intervention group reported that they frequently adopted the recommendations in their clinical decision-making and 95% wanted to continue receiving the text messages.	N/A	Total cost in the intervention group = <2 Yuan (US \$0.32) per health worker (i.e. cost on text messages) Total cost in traditional education group = 560 Yuan (US \$89.96) per health worker (for printed materials, accommodation and transportation costs)	Knowledge: Mobile digital education > Traditional education Clinical practice improvement: Mobile digital education = Traditional education Healthcare Professionals' Attitude: (no comparative data) Economic outcome(s): Mobile digital education > Traditional education
Dekker 2018, cRCT, the Netherlands	I: Online digital education C: Traditional education (Usual practice)	35 practices, 75 primary care physicians and 1009 patients	Antibiotic prescription in acute respiratory infection	N/A	Antibiotic prescribing rate was lower in the online digital education compared to traditional education: RR=0.65 (95% CI 0.46-0.91)	N/A	Re-consultation rate for children within the same disease episode was lower in the intervention group receiving online digital education compared to traditional education (RR=0.66, 95% CI 0.38 to 1.16).	N/A	Clinical practice improvement: Online digital education > traditional education (usual practice) Patient-related outcomes: Online digital education = traditional education (usual practice)
Legare 2012, cRCT, Canada Couet 2014,	I: Online blended education (Online digital education plus	9 practices, 149 primary care physicians and 359 patients	Antibiotic prescription in acute respiratory infection	N/A	N/A	N/A	Patients deciding to use antibiotics for acute respiratory infections compared to traditional education	N/A	Patient-related outcomes: Online blended education = Traditional education

cRCT, Canada	traditional education) C: Traditional education (Usual practice)						(RR=0.48, 95% CI 0.34 to 0.68). Decisional regret: SMD=0.25 (95% CI -1.07, 1.57) Intention to engage in shared decision-making: SMD= 0.16 (95% CI -1.16, 1.47) Quality of life*: SMD=0.04 (95% CI -1.27, 1.36) Adherence to the decision: SMD=-0.82 (95% CI -2.23, 0.59) Repeated consultations: SMD=0.80 (95% CI -0.60, 2.20)		
Meeker 2016, cRCT, USA	I: Online digital education C: Traditional education (Usual practice)	47 practices and 248 primary care physicians	Antibiotic prescription among primary care practices	N/A	Reduction in antibiotic prescribing rates in the intervention group compared to traditional education (Difference in mean change score: -5.2% [95%CI, -6.9%to -1.6%]; P<0.001).	N/A	N/A	N/A	Clinical practice improvement: Online digital education > traditional education
McNulty 2018, cRCT, UK	I: Online blended education	150 practices and 166	Antibiotic dispensing in	N/A	Antibiotics Dispensing rate ratio	N/A	N/A	N/A	Clinical practice improvement:

	(Online digital education plus traditional education) C: Traditional education (Usual practice)	primary care physicians	primary care		0.973, 95% CI 0.945 to 1.001, P=0.06)				Online blended education = traditional education (reduction in antibiotic dispensing)
Little 2013, cRCT, six European countries (England, Wales, Belgium, the Netherlands, Spain and Poland) Yardley 2013, cRCT, six European countries Oppong 2018, cRCT, six European countries	Ia: Online digital education (CRP training) Ib: Online digital education (enhanced-communication training) Ic: Online digital education (combined training of CRP and enhanced-communication) C: Traditional education (Usual practice)	246 practices and 4264 patients	Antibiotic prescription in acute respiratory infection	N/A	Antibiotic prescribing rate was lower with CRP training compared to traditional education: RR=0.53, 95% CI 0.36 to 0.74, P < 0.0001 With enhanced-communication training compared to traditional education: RR=0.68, 95% CI 0.5 to 0.89, P=0.003 Combined training compared to traditional education: RR=0.38, 95% CI 0.25 to 0.55, P < 0.0001	N/A	<u>Patient enablement:</u> CRP vs traditional education: SMD=-0.11 (95% CI -0.24 to 0.01) Enhanced communication vs. traditional education: SMD=0.07 (95% CI -0.05 to 0.19) Combined group vs. traditional education: SMD=-0.01 (95% CI -0.13 to 0.11) <u>Satisfaction with consultation:</u> CRP vs. traditional education: SMD=-0.09 (95% CI -0.22 to 0.03) Enhanced communication vs. education:	10% cost reduction with online training compared to traditional education if the cost of antibiotic resistance was accounted for [€ 83.21 vs € 92.46].	Clinical practice improvement: Online digital education > traditional education Patient-related outcomes: Online digital educations ≥ traditional education (usual care) Economic outcome(s): Online based communication skills training was more cost-effective than traditional education

							<p>SMD=0.12 (95% CI -0.01 to 0.24)</p> <p>Combined group vs. traditional education: SMD=0.05 (95% CI -0.08 to 0.17)</p> <p><u>Taking antibiotics can do more harm than good:</u></p> <p>CRP vs. traditional education: SMD=0.13 (95% CI 0.01 to 0.26)</p> <p>Enhanced communication vs. traditional education: SMD=0.11 (95% CI -0.01 to 0.24)</p> <p>Combined group vs. traditional education: SMD=0.14 (95% CI 0.02 to 0.26)</p>		
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*Pooled estimate on physical and mental scales.
Abbreviations: I=Intervention, C=Control group, CRP= C Reactive Protein, N/A=Not Available, RCT=Randomized Control Trial, cRCT=cluster RCT, SMD=Standardized Mean Difference, CI=Confidence Interval, RR=Risk Ratio, CME=Continuing Medical Education, MCQ=Multiple Choice Question, UK=United Kingdom, USA=United States of America