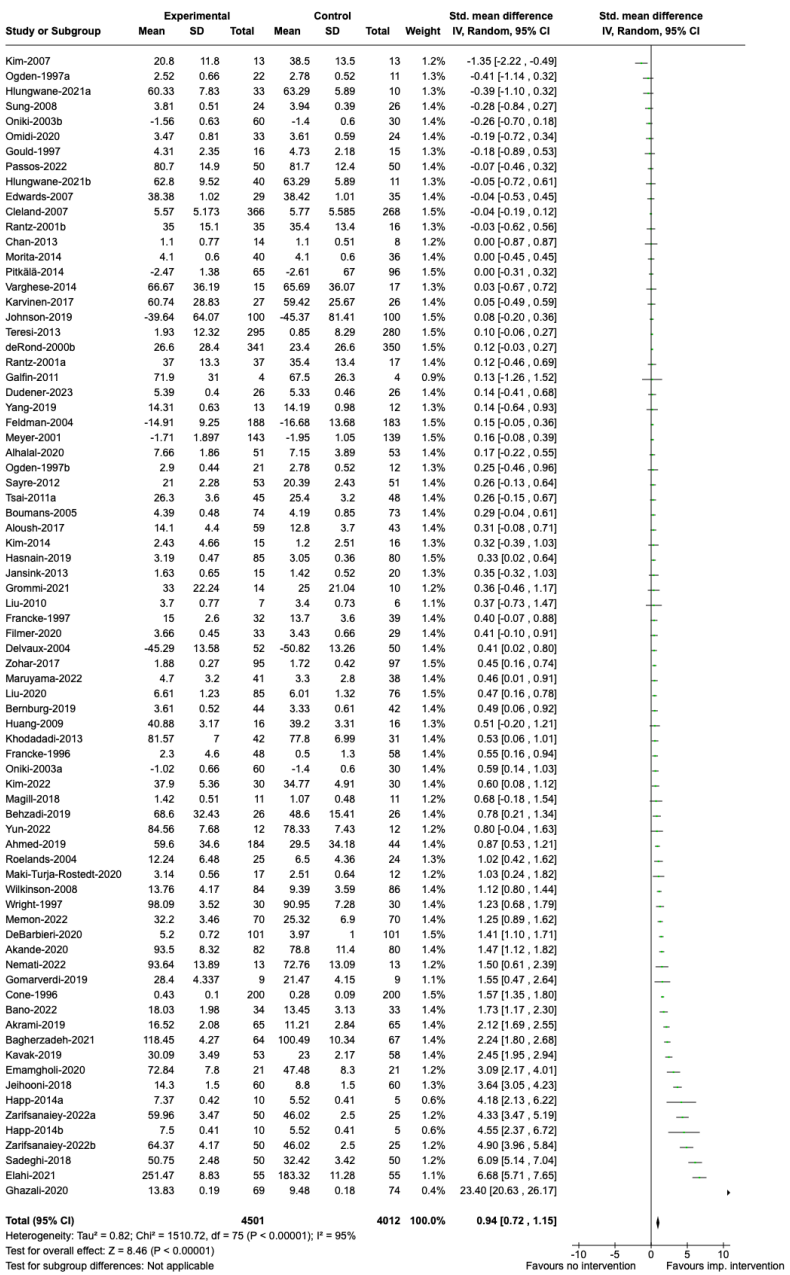
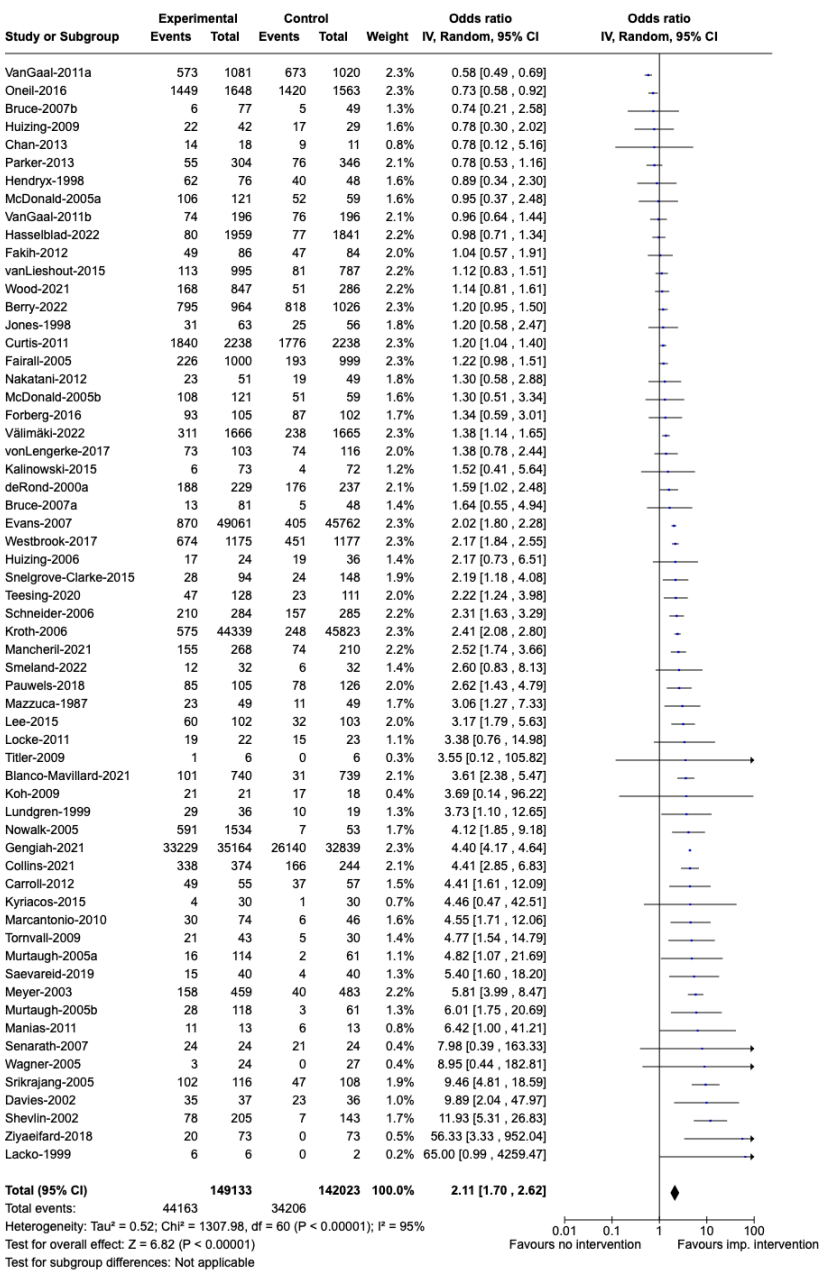
Additional file 6. Forest plots all comparisons and outcomes.

COMPARISON 1: ANY IMPLEMENTATION STRATEGY VS NO ACTIVE INTERVENTION

Clinical practice (continuous)

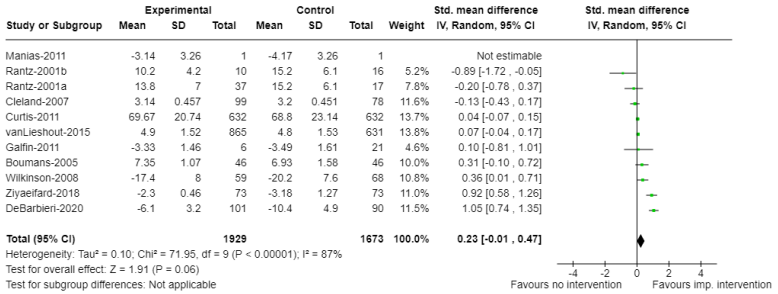


Clinical practice (dichotomous)

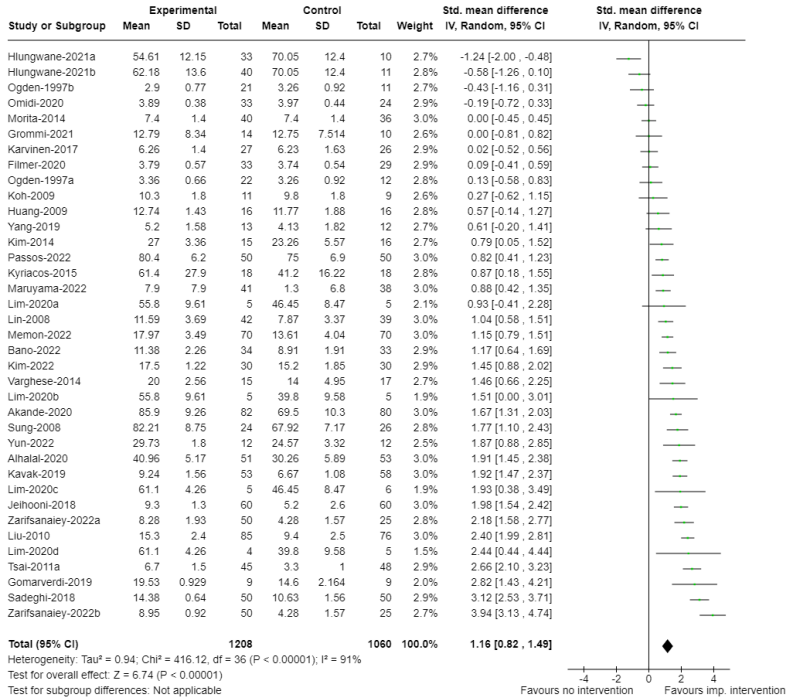


Additional file 6. Forest plots all comparisons and outcomes.

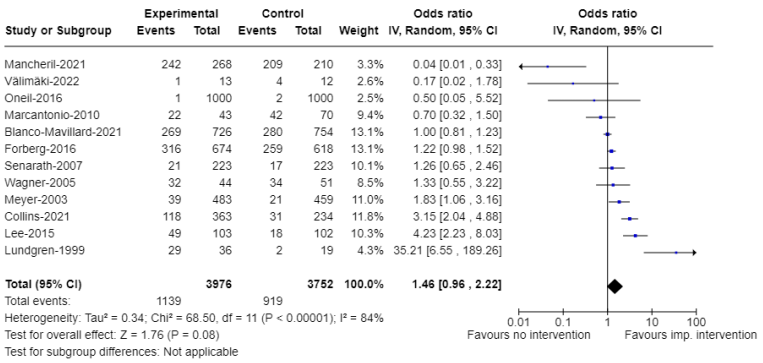
Patient outcomes (continuous)



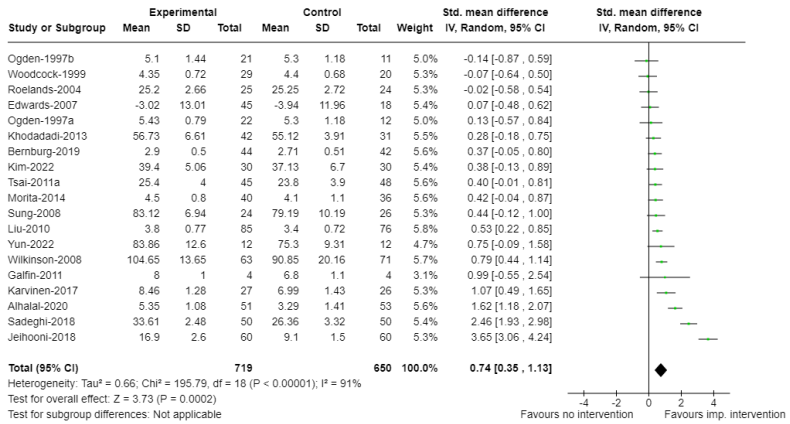
Knowledge (continuous)



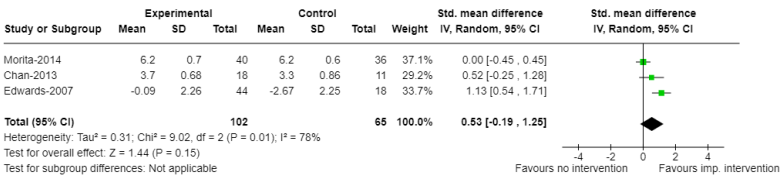
Patient outcomes (dichotomous)



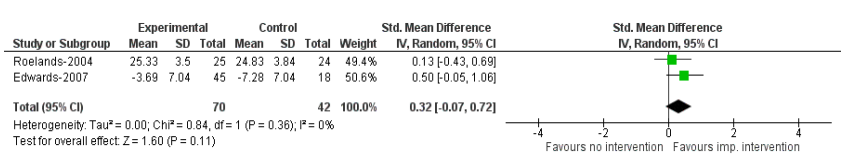
Perceived control (continuous)



Intention (continuous)



Social norms (continuous)

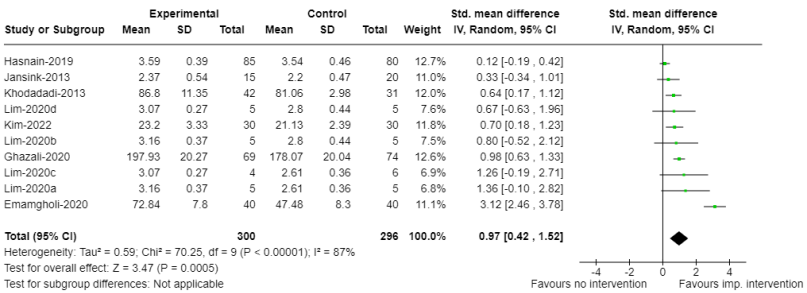


Additional file 6. Forest plots all comparisons and outcomes.

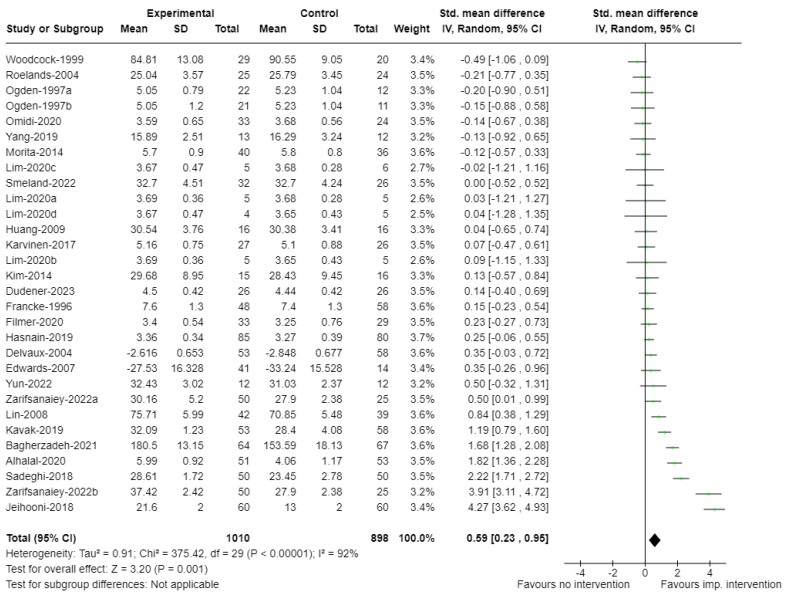
Attitude (dichotomous)

N/A

Skills (continuous)



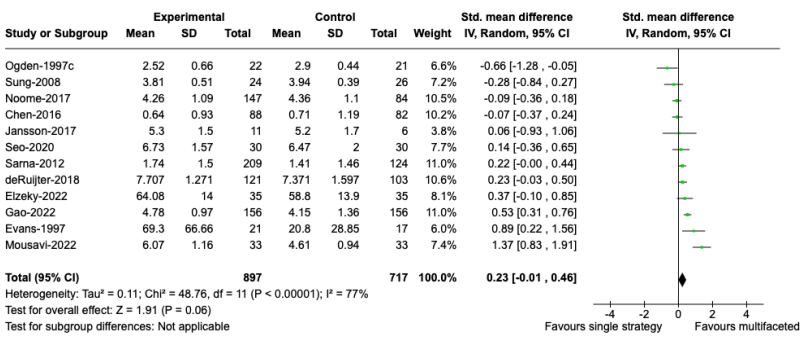
Attitude (continuous)



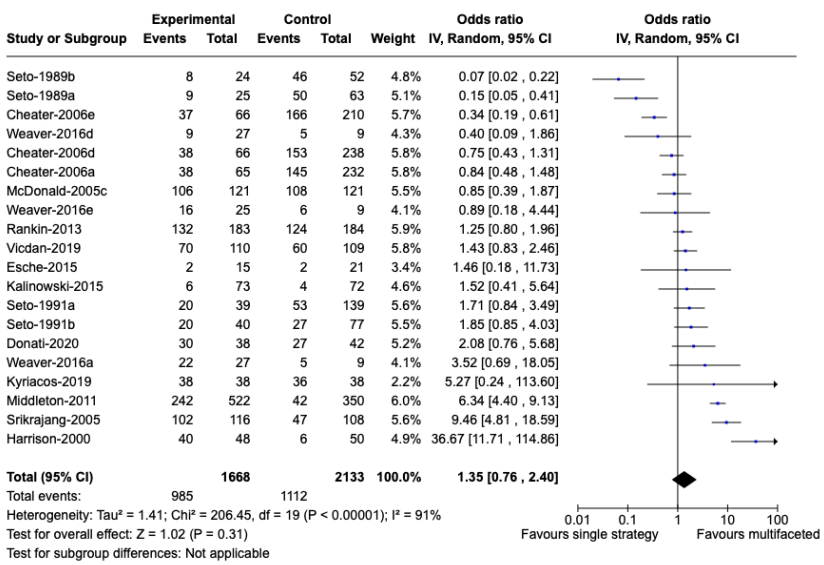
Additional file 6. Forest plots all comparisons and outcomes.

COMPARISON 2: MULTIFACETED STRATEGY VERSUS SINGLE COMPONENT STRATEGY

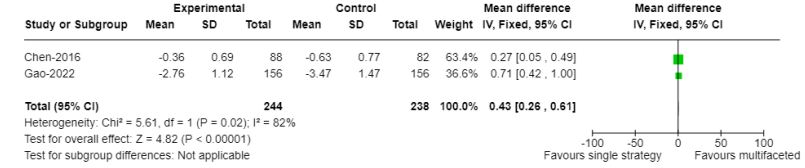
Clinical practice (continuous)



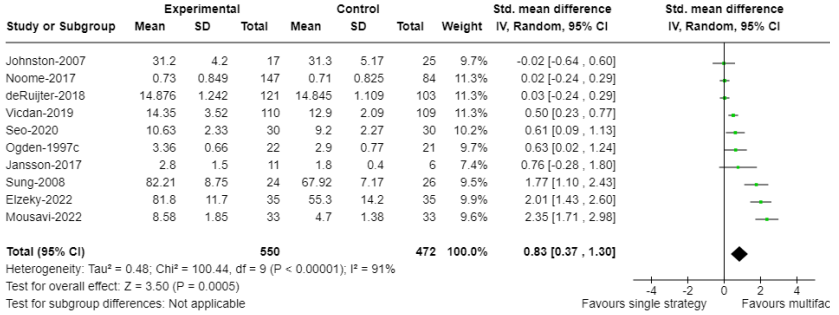
Clinical practice (dichotomous)



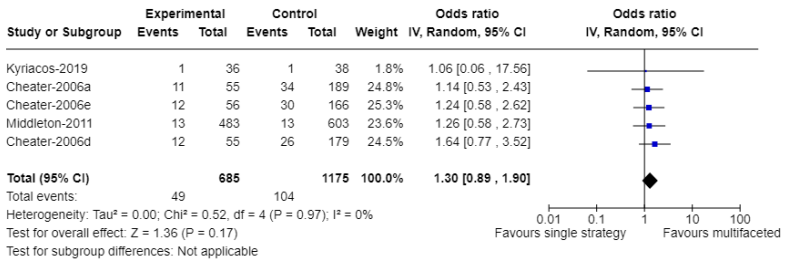
Patient outcomes (continuous)



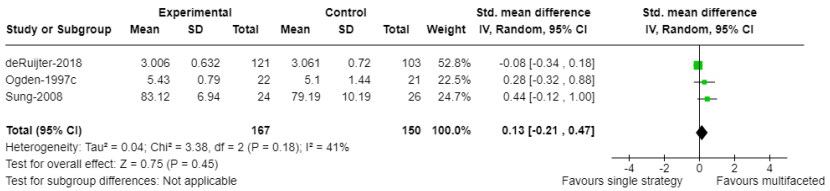
Knowledge (continuous)



Patient outcomes (dichotomous)



Perceived control (continuous)



Intention (continuous) N/A

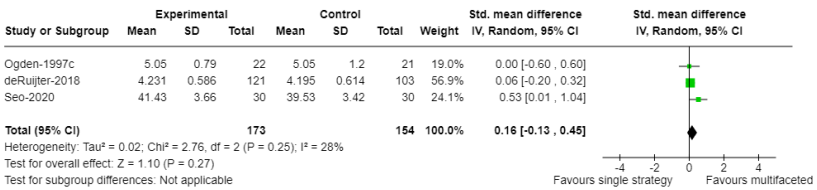
Attitude (dichotomous) N/A

Social norms (continuous) N/A

Skills (continuous) N/A

Additional file 6. Forest plots all comparisons and outcomes.

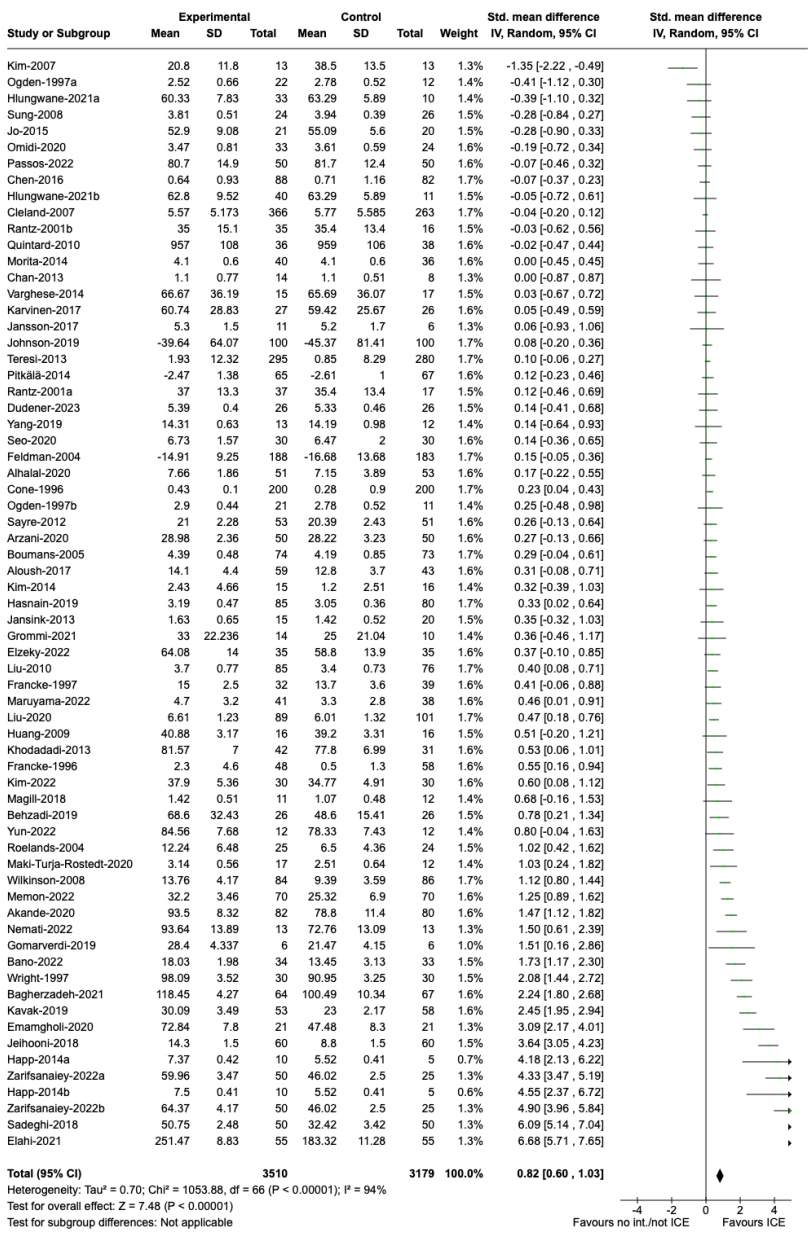
Attitude (continuous)



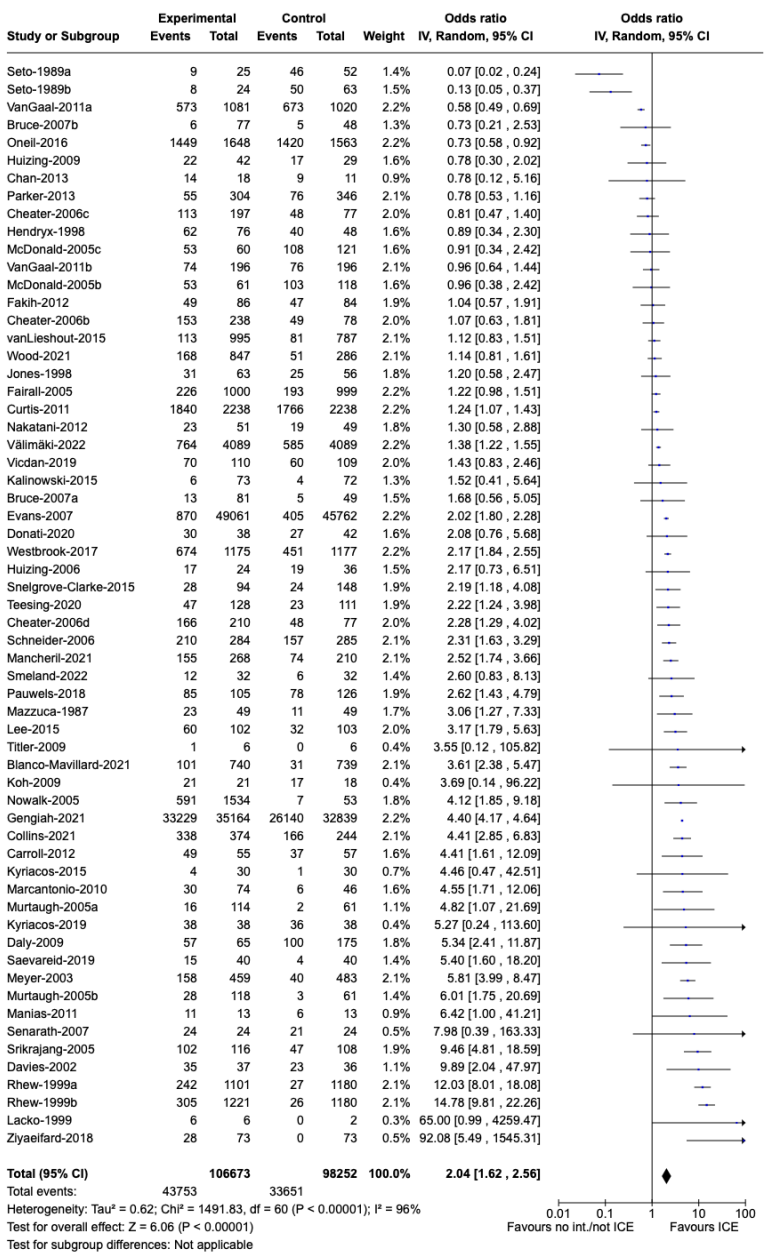
Additional file 6. Forest plots all comparisons and outcomes.

COMPARISON 3: STRATEGIES INCLUDING INDIVIDUAL CLINICIAN EDUCATION (ICE) AS COMPARED TO NO INTERVENTION OR STRATEGIES THAT DID NOT INVOLVE ICE

Clinical practice (continuous)



Clinical practice (dichotomous)

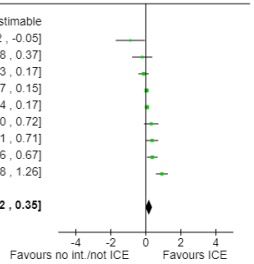


Additional file 6. Forest plots all comparisons and outcomes.

Patient outcomes (continuous)

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. mean difference IV, Random, 95% CI
Manias-2011	-3.14	3.26	1	-4.17	3.26	1		Not estimable
Rantz-2001b	10.2	4.2	10	15.2	6.1	16	3.9%	-0.89 [-1.72 , -0.05]
Rantz-2001a	13.8	7	37	15.2	6.1	17	6.6%	-0.20 [-0.78 , 0.37]
Cleland-2007	3.14	0.457	99	3.2	0.451	78	12.2%	-0.13 [-0.43 , 0.17]
Curtis-2011	69.67	20.74	632	68.8	23.14	632	16.7%	0.04 [-0.07 , 0.15]
vanLieshout-2015	4.9	1.52	865	4.8	1.53	631	16.8%	0.07 [-0.04 , 0.17]
Boumans-2005	7.35	1.07	46	6.93	1.58	46	9.5%	0.31 [-0.10 , 0.72]
Wilkinson-2008	-17.4	8	59	-20.2	7.6	68	10.9%	0.36 [0.01 , 0.71]
Chen-2016	-0.36	0.69	88	-0.63	0.77	82	12.1%	0.37 [0.06 , 0.67]
Ziyaeifard-2018	-2.3	0.46	73	-3.18	1.27	73	11.1%	0.92 [0.58 , 1.26]
Total (95% CI)			**1910**			**1644**	**100.0%**	**0.17 [-0.02 , 0.35]**

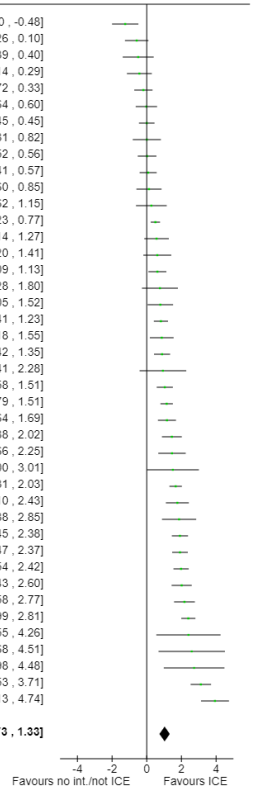
Heterogeneity: Tau² = 0.05; Chi² = 38.41, df = 8 (P < 0.00001); I² = 79%
Test for overall effect: Z = 1.77 (P = 0.08)
Test for subgroup differences: Not applicable



Knowledge (continuous)

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. mean difference IV, Random, 95% CI
Hlungwane-2021a	54.61	12.15	33	70.05	12.4	10	2.4%	-1.24 [-2.00 , -0.48]
Hlungwane-2021b	62.18	13.6	40	70.05	12.4	11	2.5%	-0.58 [-1.26 , 0.10]
Carrico-2007	0.72	0.18	10	0.81	0.17	10	2.2%	-0.49 [-1.39 , 0.40]
Ogden-1997b	2.9	0.77	21	3.26	0.92	12	2.4%	-0.43 [-1.14 , 0.29]
Omidi-2020	3.89	0.38	33	3.97	0.44	24	2.6%	-0.19 [-0.72 , 0.33]
Johnston-2007	31.2	4.2	17	31.3	5.17	25	2.5%	-0.02 [-0.64 , 0.60]
Morita-2014	7.4	1.4	40	7.4	1.4	36	2.6%	0.00 [-0.45 , 0.45]
Grommi-2021	12.786	8.341	14	12.75	7.514	10	2.3%	0.00 [-0.81 , 0.82]
Karvinen-2017	6.26	1.4	27	6.23	1.63	26	2.6%	0.02 [-0.52 , 0.56]
Rutherford-Hemming-2016	67.7	15.9	35	66.4	16	29	2.6%	0.08 [-0.41 , 0.57]
Ogden-1997a	3.36	0.66	22	3.26	0.92	11	2.4%	0.13 [-0.60 , 0.85]
Koh-2009	10.3	1.8	11	9.8	1.8	9	2.3%	0.27 [-0.62 , 1.15]
Vicdan-2019	14.35	3.52	110	12.9	2.09	109	2.7%	0.50 [0.23 , 0.77]
Huang-2009	12.74	1.43	16	11.77	1.88	16	2.4%	0.57 [-0.14 , 1.27]
Yang-2019	5.2	1.58	13	4.13	1.82	12	2.3%	0.61 [-0.20 , 1.41]
Seo-2020	10.63	2.33	30	9.2	2.27	30	2.6%	0.61 [0.09 , 1.13]
Jansson-2017	2.8	1.5	11	1.8	0.4	6	2.1%	0.76 [-0.28 , 1.80]
Kim-2014	27	3.36	15	23.26	5.57	16	2.4%	0.79 [0.05 , 1.52]
Passos-2022	80.4	6.2	50	75	6.9	50	2.7%	0.82 [0.41 , 1.23]
Kyriacos-2015	61.4	27.9	18	41.2	16.22	18	2.4%	0.87 [0.18 , 1.55]
Maruyama-2022	7.9	7.9	41	1.3	6.8	38	2.6%	0.88 [0.42 , 1.35]
Lim-2020a	55.8	9.61	5	46.45	8.47	5	1.8%	0.93 [-0.41 , 2.28]
Lin-2008	11.59	3.69	42	7.87	3.37	39	2.6%	1.04 [0.58 , 1.51]
Memon-2022	17.97	3.49	70	13.61	4.04	70	2.7%	1.15 [0.79 , 1.51]
Bano-2022	11.38	2.26	34	8.91	1.91	33	2.6%	1.17 [0.64 , 1.69]
Kim-2022	17.5	1.22	30	15.2	1.85	30	2.5%	1.45 [0.88 , 2.02]
Varghese-2014	20	2.56	15	14	4.95	17	2.3%	1.46 [0.66 , 2.25]
Lim-2020b	55.8	9.61	5	39.8	9.58	5	1.6%	1.51 [0.00 , 3.01]
Akande-2020	85.9	9.26	82	69.5	10.3	80	2.7%	1.67 [1.31 , 2.03]
Sung-2008	82.21	8.75	24	67.92	7.17	26	2.5%	1.77 [1.10 , 2.43]
Yun-2022	29.73	1.8	12	24.57	3.32	12	2.2%	1.87 [0.88 , 2.85]
Alhalal-2020	40.96	5.17	51	30.26	5.89	53	2.6%	1.91 [1.45 , 2.38]
Kavak-2019	9.24	1.56	53	6.67	1.08	58	2.6%	1.92 [1.47 , 2.37]
Jeihooni-2018	9.3	1.3	60	5.2	2.6	60	2.6%	1.98 [1.54 , 2.42]
Elzeky-2022	81.8	11.7	35	55.3	14.2	35	2.5%	2.01 [1.43 , 2.60]
Zarifsanaiey-2022a	8.28	1.93	50	4.28	1.57	25	2.5%	2.18 [1.58 , 2.77]
Liu-2010	15.3	2.4	85	9.4	2.5	76	2.7%	2.40 [1.99 , 2.81]
Lim-2020c	61.1	4.26	4	39.8	9.56	6	1.4%	2.41 [0.55 , 4.26]
Lim-2020d	61.1	4.26	5	39.8	9.58	5	1.3%	2.60 [0.68 , 4.51]
Gomarverdi-2019	19.53	0.929	6	14.6	2.164	6	1.4%	2.73 [0.98 , 4.48]
Sadeghi-2018	14.38	0.64	50	10.63	1.56	50	2.5%	3.12 [2.53 , 3.71]
Zarifsanaiey-2022b	8.95	0.92	50	4.28	1.57	25	2.3%	3.94 [3.13 , 4.74]
Total (95% CI)			**1375**			**1224**	**100.0%**	**1.03 [0.73 , 1.33]**

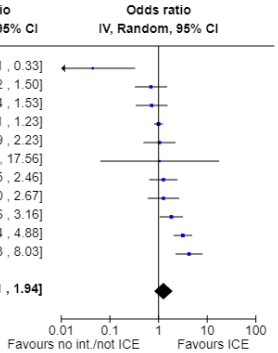
Heterogeneity: Tau² = 0.83; Chi² = 445.66, df = 41 (P < 0.00001); I² = 91%
Test for overall effect: Z = 6.74 (P < 0.00001)
Test for subgroup differences: Not applicable



Patient outcomes (dichotomous)

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds ratio IV, Random, 95% CI
Mancheril-2021	242	268	209	210	3.5%	0.04 [0.01 , 0.33]
Marcantonio-2010	22	43	42	70	9.5%	0.70 [0.32 , 1.50]
Cheater-2006b	26	179	12	63	9.6%	0.72 [0.34 , 1.53]
Blanco-Mavillard-2021	269	726	280	754	13.0%	1.00 [0.81 , 1.23]
Cheater-2006c	30	166	11	63	9.5%	1.04 [0.49 , 2.23]
Kyriacos-2019	1	36	1	38	2.0%	1.06 [0.06 , 17.56]
Senarath-2007	21	223	17	223	10.2%	1.26 [0.65 , 2.46]
Cheater-2006d	35	166	11	63	9.6%	1.26 [0.60 , 2.67]
Meyer-2003	39	483	21	459	11.0%	1.83 [1.06 , 3.16]
Collins-2021	118	363	31	234	11.8%	3.15 [2.04 , 4.88]
Lee-2015	49	103	18	102	10.4%	4.23 [2.23 , 8.03]
Total (95% CI)		**2756**		**2279**	**100.0%**	**1.26 [0.81 , 1.94]**
Total events:	852		653			

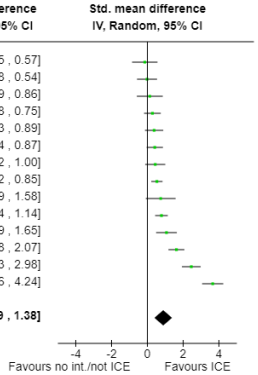
Heterogeneity: Tau² = 0.37; Chi² = 52.55, df = 10 (P < 0.00001); I² = 81%
Test for overall effect: Z = 1.03 (P = 0.30)
Test for subgroup differences: Not applicable



Perceived control (continuous)

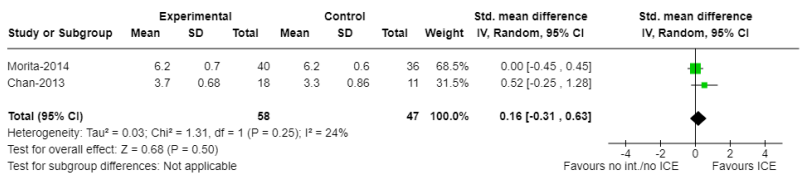
Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. mean difference IV, Random, 95% CI
Ogden-1997b	5.1	1.44	21	5.3	1.18	12	6.8%	-0.14 [-0.85 , 0.57]
Roelands-2004	25.2	2.66	25	25.25	2.72	24	7.1%	-0.02 [-0.58 , 0.54]
Ogden-1997a	5.43	0.79	22	5.3	1.18	11	6.7%	0.14 [-0.59 , 0.86]
Khodadadi-2013	56.73	6.61	42	55.12	3.91	31	7.3%	0.28 [-0.18 , 0.75]
Kim-2022	39.4	5.06	30	37.13	6.7	30	7.2%	0.38 [-0.13 , 0.89]
Morita-2014	4.5	0.8	40	4.1	1.1	36	7.4%	0.42 [-0.04 , 0.87]
Sung-2008	83.12	6.94	24	79.19	10.19	26	7.1%	0.44 [-0.12 , 1.00]
Liu-2010	3.8	0.77	85	3.4	0.72	76	7.6%	0.53 [0.22 , 0.85]
Yun-2022	83.86	12.6	12	75.3	9.31	12	6.4%	0.75 [-0.09 , 1.58]
Wilkinson-2008	104.65	13.65	63	90.85	20.16	71	7.6%	0.79 [0.44 , 1.14]
Karvinen-2017	8.46	1.28	27	6.99	1.43	26	7.1%	1.07 [0.49 , 1.65]
Alhalal-2020	5.35	1.08	51	3.29	1.41	53	7.4%	1.62 [1.18 , 2.07]
Sadeghi-2018	33.61	2.48	50	26.36	3.32	50	7.2%	2.46 [1.93 , 2.98]
Jeihooni-2018	16.9	2.6	60	9.1	1.5	60	7.1%	3.65 [3.06 , 4.24]
Total (95% CI)			**552**			**518**	**100.0%**	**0.89 [0.39 , 1.38]**

Heterogeneity: Tau² = 0.80; Chi² = 173.74, df = 13 (P < 0.00001); I² = 93%
Test for overall effect: Z = 3.53 (P = 0.0004)
Test for subgroup differences: Not applicable

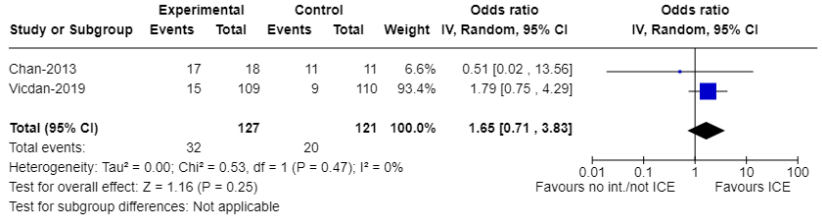


Additional file 6. Forest plots all comparisons and outcomes.

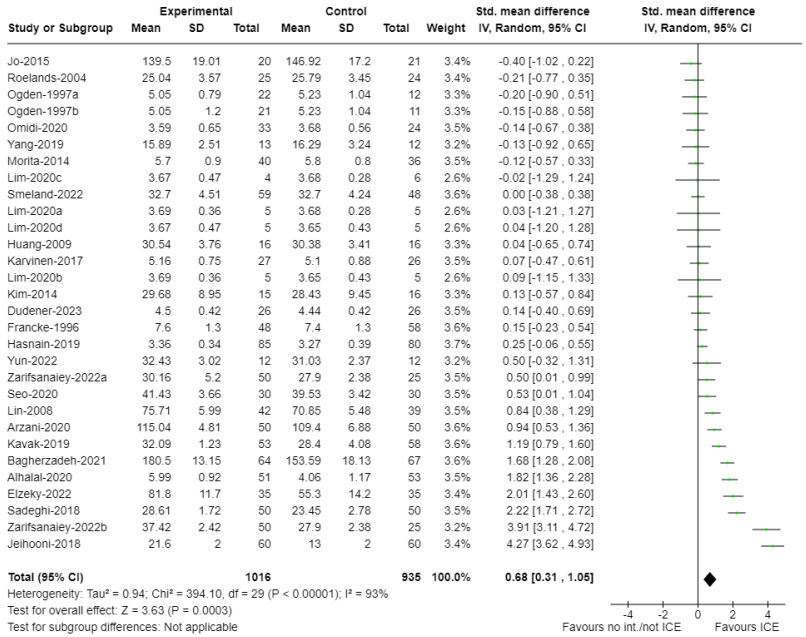
Intention (continuous)



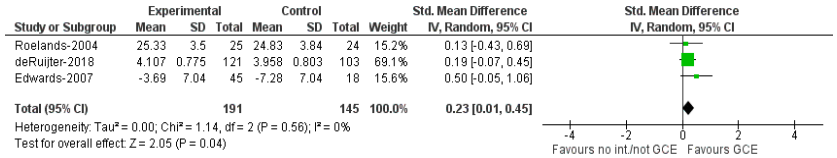
Attitude (dichotomous)



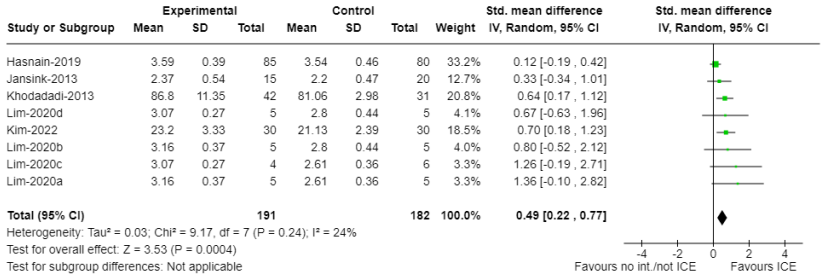
Attitude (continuous)



Social norms (continuous)



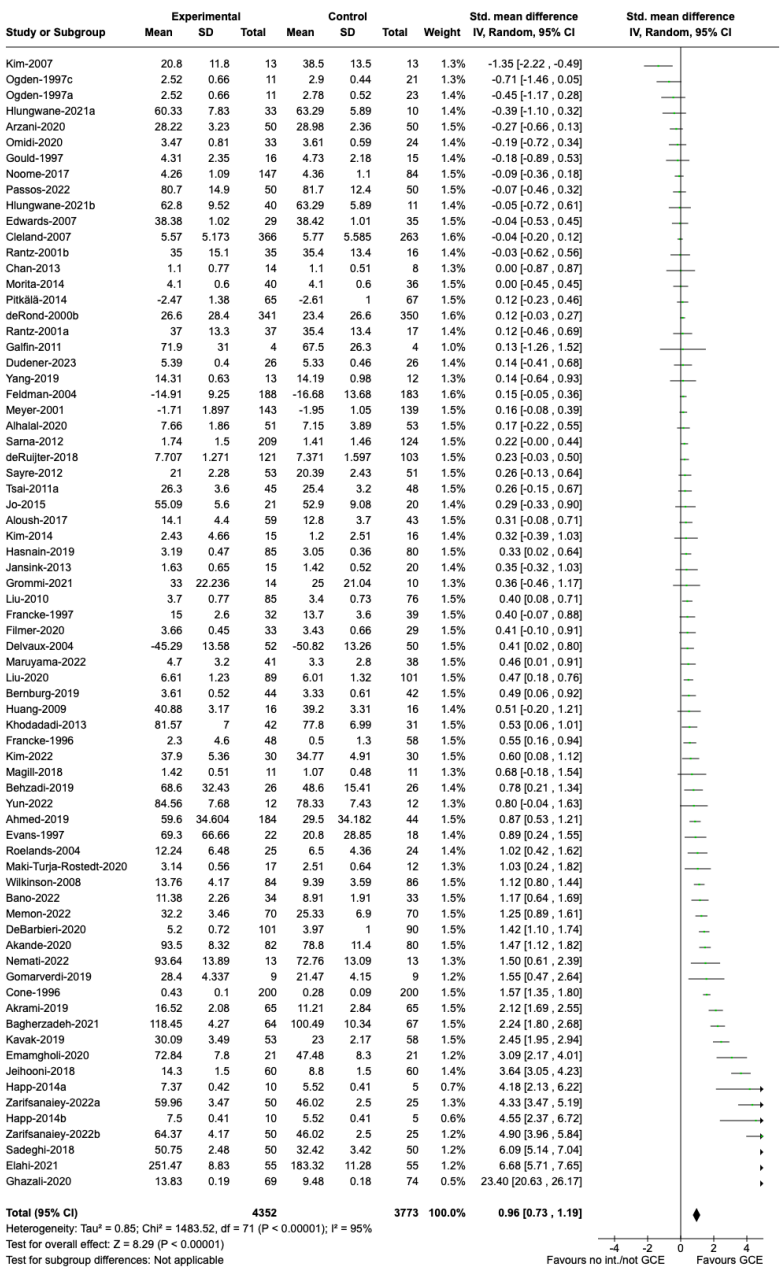
Skills (continuous)



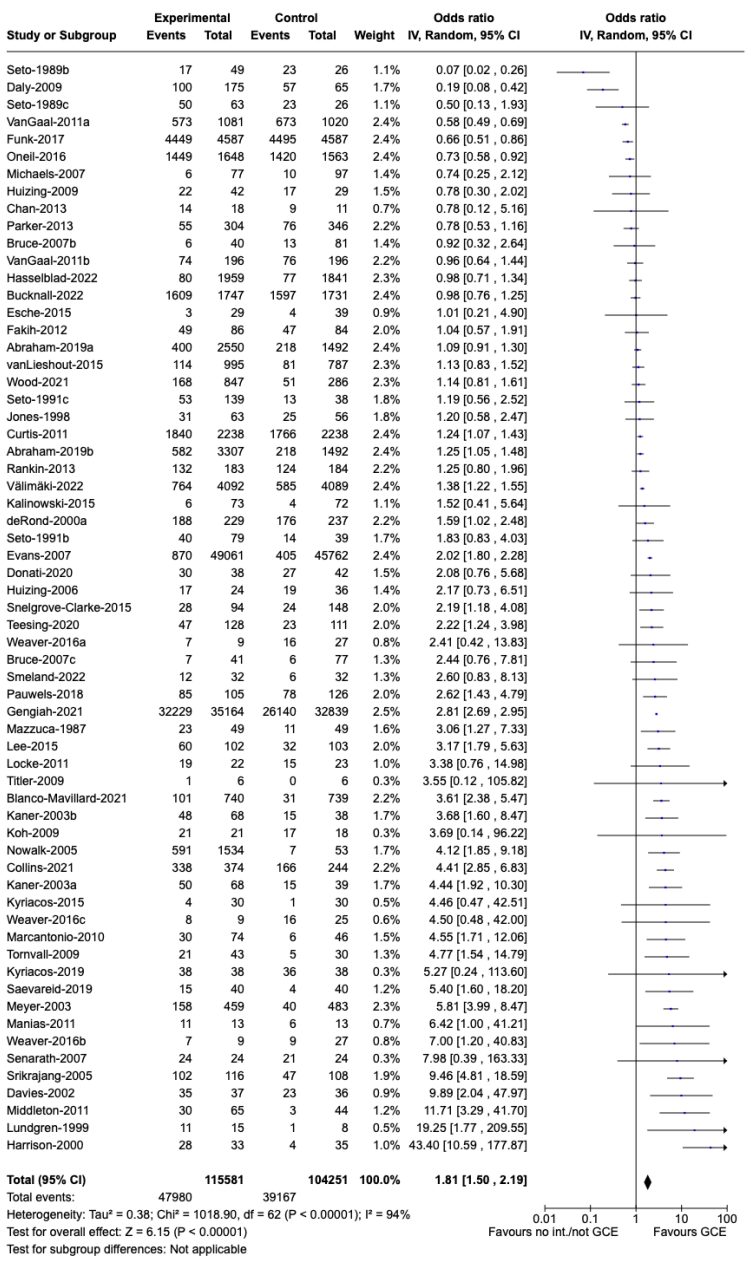
Additional file 6. Forest plots all comparisons and outcomes.

COMPARISON 4: STRATEGIES INCLUDING GROUP CLINICIAN EDUCATION (GCE) AS COMPARED TO NO INTERVENTION OR STRATEGIES THAT DID NOT INVOLVE GCE

Clinical practice (continuous)



Clinical practice (dichotomous)

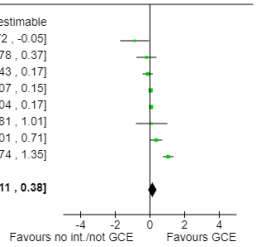


Additional file 6. Forest plots all comparisons and outcomes.

Patient outcomes (continuous)

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. mean difference IV, Random, 95% CI
Manias-2011	-3.14	3.26	1	-4.17	3.26	1		Not estimable
Rantz-2001b	10.2	4.2	10	15.2	6.1	16	5.9%	-0.89 [-1.72 , -0.05]
Rantz-2001a	13.8	7	37	15.2	6.1	17	9.2%	-0.20 [-0.78 , 0.37]
Cleland-2007	3.14	0.457	99	3.2	0.451	78	14.8%	-0.13 [-0.43 , 0.17]
Curtis-2011	69.67	20.74	632	68.8	23.14	632	18.3%	0.04 [-0.07 , 0.15]
vanLieshout-2015	4.9	1.52	865	4.8	1.53	631	18.4%	0.07 [-0.04 , 0.17]
Galfin-2011	-3.33	1.46	6	-3.49	1.61	21	5.2%	0.10 [-0.81 , 1.01]
Wilkinson-2008	-17.4	8	59	-20.2	7.6	68	13.6%	0.36 [0.01 , 0.71]
DeBarbieri-2020	-6.1	3.2	101	-10.4	4.9	90	14.7%	1.05 [0.74 , 1.35]
Total (95% CI)			**1810**			**1554**	**100.0%**	**0.14 [-0.11 , 0.38]**

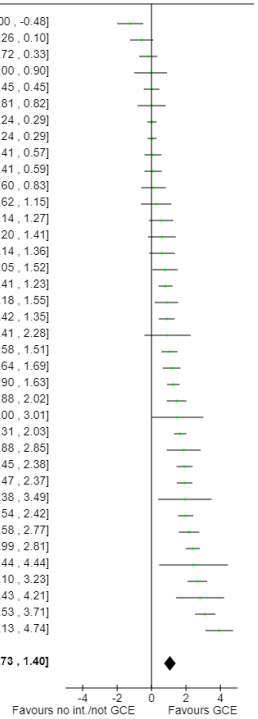
Heterogeneity: Tau² = 0.08; Chi² = 49.91, df = 7 (P < 0.00001); I² = 86%
Test for overall effect: Z = 1.10 (P = 0.27)
Test for subgroup differences: Not applicable



Knowledge (continuous)

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. mean difference IV, Random, 95% CI
Hlungwane-2021a	54.61	12.15	33	70.05	12.4	10	2.6%	-1.24 [-2.00 , -0.48]
Hlungwane-2021b	62.18	13.6	40	70.05	12.4	11	2.7%	-0.58 [-1.26 , 0.10]
Omidi-2020	3.89	0.38	33	3.97	0.44	24	2.8%	-0.19 [-0.72 , 0.33]
Funk-2017	70.2	15.5	9	71	14.3	8	2.4%	-0.05 [-1.00 , 0.90]
Morita-2014	7.4	1.4	40	7.4	1.4	36	2.9%	0.00 [-0.45 , 0.45]
Grommi-2021	12.786	8.341	14	12.75	7.514	10	2.6%	0.00 [-0.81 , 0.82]
Noome-2017	0.73	0.849	147	0.71	0.825	84	3.0%	0.02 [-0.24 , 0.29]
deRuijter-2018	14.876	1.242	121	14.845	1.109	103	3.0%	0.03 [-0.24 , 0.29]
Rutherford-Hemming-2016	67.7	15.9	35	66.4	16	29	2.8%	0.08 [-0.41 , 0.57]
Filmer-2020	3.79	0.57	33	3.74	0.54	29	2.8%	0.09 [-0.41 , 0.59]
Ogden-1997a	3.36	0.66	11	3.26	0.92	23	2.7%	0.12 [-0.60 , 0.83]
Koh-2009	10.3	1.8	11	9.8	1.8	9	2.5%	0.27 [-0.62 , 1.15]
Huang-2009	12.74	1.43	16	11.77	1.88	16	2.7%	0.57 [-0.14 , 1.27]
Yang-2019	5.2	1.58	13	4.13	1.85	12	2.6%	0.60 [-0.20 , 1.41]
Ogden-1997c	3.36	0.66	11	2.9	0.77	21	2.6%	0.61 [-0.14 , 1.36]
Kim-2014	27	3.36	15	23.26	5.57	16	2.6%	0.79 [0.05 , 1.52]
Passos-2022	80.4	6.2	50	75	6.9	50	2.9%	0.82 [0.41 , 1.23]
Kyriacos-2015	61.4	27.9	18	41.2	16.22	18	2.7%	0.87 [0.18 , 1.55]
Maruyama-2022	7.9	7.9	41	1.3	6.8	38	2.9%	0.88 [0.42 , 1.35]
Lim-2020a	55.8	9.61	5	46.45	8.47	5	2.0%	0.93 [-0.41 , 2.28]
Lin-2008	11.59	3.69	42	7.87	3.37	39	2.9%	1.04 [0.58 , 1.51]
Bano-2022	11.38	2.26	34	8.91	1.91	33	2.8%	1.17 [0.64 , 1.69]
Memon-2022	17.97	3.49	70	13.16	4.04	70	2.9%	1.27 [0.90 , 1.63]
Kim-2022	17.5	1.22	30	15.2	1.85	30	2.8%	1.45 [0.88 , 2.02]
Lim-2020b	55.8	9.61	5	39.8	9.58	5	1.9%	1.51 [0.00 , 3.01]
Akande-2020	85.9	9.26	82	69.5	10.3	80	2.9%	1.67 [1.31 , 2.03]
Yun-2022	29.73	1.8	12	24.57	3.32	12	2.4%	1.87 [0.88 , 2.85]
Alhalal-2020	40.96	5.17	51	30.26	5.89	53	2.9%	1.91 [1.45 , 2.38]
Kavak-2019	9.24	1.56	53	6.67	1.08	58	2.9%	1.92 [1.47 , 2.37]
Lim-2020c	61.1	4.26	5	46.45	8.47	6	1.8%	1.93 [0.38 , 3.49]
Jeihooni-2018	9.3	1.3	60	5.2	2.6	60	2.9%	1.98 [1.54 , 2.42]
Zarifsanaiey-2022a	8.28	1.93	50	4.28	1.57	25	2.8%	2.18 [1.58 , 2.77]
Liu-2010	15.3	2.4	85	9.4	2.5	76	2.9%	2.40 [1.99 , 2.81]
Lim-2020d	61.1	4.26	4	39.8	9.58	5	1.5%	2.44 [0.44 , 4.44]
Tsai-2011a	6.7	1.5	45	3.3	1	48	2.8%	2.66 [2.10 , 3.23]
Gomarverdi-2019	19.53	0.929	9	14.6	2.164	9	2.0%	2.82 [1.43 , 4.21]
Sadeghi-2018	14.38	0.64	50	10.63	1.56	50	2.8%	3.12 [2.53 , 3.71]
Zarifsanaiey-2022b	8.95	0.92	50	4.28	1.57	25	2.6%	3.94 [3.13 , 4.74]
Total (95% CI)			**1433**			**1236**	**100.0%**	**1.07 [0.73 , 1.40]**

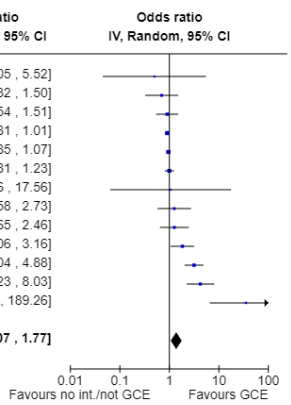
Heterogeneity: Tau² = 0.97; Chi² = 520.18, df = 37 (P < 0.00001); I² = 93%
Test for overall effect: Z = 6.22 (P < 0.00001)
Test for subgroup differences: Not applicable



Patient outcomes (dichotomous)

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds ratio IV, Random, 95% CI
Oneil-2016	1	1000	2	1000	1.0%	0.50 [0.05 , 5.52]
Marcantonio-2010	22	43	42	70	6.2%	0.70 [0.32 , 1.50]
Bucknall-2022	29	1000	32	1000	9.1%	0.90 [0.54 , 1.51]
Abraham-2019a	1505	4740	733	2157	14.1%	0.90 [0.81 , 1.01]
Abraham-2019b	1223	3712	734	2158	14.1%	0.95 [0.85 , 1.07]
Blanco-Mavillard-2021	269	726	280	754	13.1%	1.00 [0.81 , 1.23]
Kyriacos-2019	1	36	1	38	0.8%	1.06 [0.06 , 17.56]
Middleton-2011	13	483	13	603	6.1%	1.26 [0.58 , 2.73]
Senarath-2007	21	223	17	223	7.2%	1.26 [0.65 , 2.46]
Meyer-2003	39	483	21	459	8.6%	1.83 [1.06 , 3.16]
Collins-2021	118	363	31	234	10.1%	3.15 [2.04 , 4.88]
Lee-2015	49	103	18	102	7.5%	4.23 [2.23 , 8.03]
Lundgren-1999	29	36	2	19	2.0%	35.21 [6.55 , 189.26]
Total (95% CI)		**12948**		**8817**	**100.0%**	**1.37 [1.07 , 1.77]**
Total events:	3319		1926			

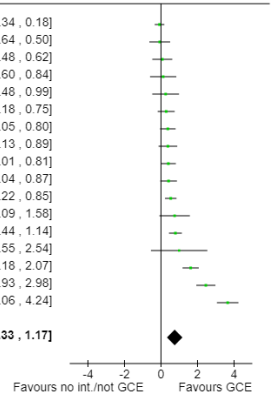
Heterogeneity: Tau² = 0.12; Chi² = 74.22, df = 12 (P < 0.00001); I² = 84%
Test for overall effect: Z = 2.46 (P = 0.01)
Test for subgroup differences: Not applicable



Perceived control (continuous)

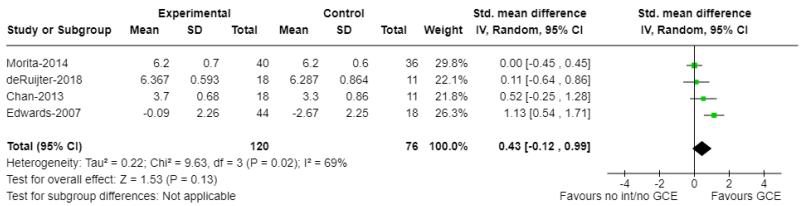
Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. mean difference IV, Random, 95% CI
deRuijter-2018	3.006	0.632	121	3.061	0.72	103	6.5%	-0.08 [-0.34 , 0.18]
Woodcock-1999	4.35	0.72	29	4.4	0.68	20	5.9%	-0.07 [-0.64 , 0.50]
Edwards-2007	-3.02	13.01	45	-3.94	11.96	18	6.0%	0.07 [-0.48 , 0.62]
Ogden-1997a	5.43	0.79	11	5.3	1.18	23	5.6%	0.12 [-0.60 , 0.84]
Ogden-1997c	5.43	0.79	11	5.1	1.44	21	5.5%	0.26 [-0.48 , 0.99]
Khodadadi-2013	56.73	6.61	42	55.12	3.91	31	6.1%	0.28 [-0.18 , 0.75]
Bernburg-2019	2.9	0.5	44	2.71	0.51	42	6.2%	0.37 [-0.05 , 0.80]
Kim-2022	39.4	5.06	30	37.13	6.7	30	6.1%	0.38 [-0.13 , 0.89]
Tsai-2011a	25.4	4	45	23.8	3.9	48	6.3%	0.40 [-0.01 , 0.81]
Morita-2014	4.5	0.8	40	4.1	1.1	36	6.2%	0.42 [-0.04 , 0.87]
Liu-2010	3.8	0.77	85	3.4	0.72	76	6.4%	0.53 [0.22 , 0.85]
Yun-2022	83.86	12.6	12	75.3	9.31	12	5.3%	0.75 [-0.09 , 1.58]
Wilkinson-2008	104.65	13.65	63	90.85	20.16	71	6.3%	0.79 [0.44 , 1.14]
Galfin-2011	8	1	4	6.8	1.1	4	3.5%	0.99 [-0.55 , 2.54]
Alhalal-2020	5.35	1.08	51	3.29	1.41	53	6.2%	1.62 [1.18 , 2.07]
Sadeghi-2018	33.61	2.48	50	26.36	3.32	50	6.0%	2.46 [1.93 , 2.98]
Jeihooni-2018	16.9	2.6	60	9.1	1.5	60	5.9%	3.65 [3.06 , 4.24]
Total (95% CI)			**743**			**698**	**100.0%**	**0.75 [0.33 , 1.17]**

Heterogeneity: Tau² = 0.70; Chi² = 215.09, df = 16 (P < 0.00001); I² = 93%
Test for overall effect: Z = 3.48 (P = 0.0005)
Test for subgroup differences: Not applicable

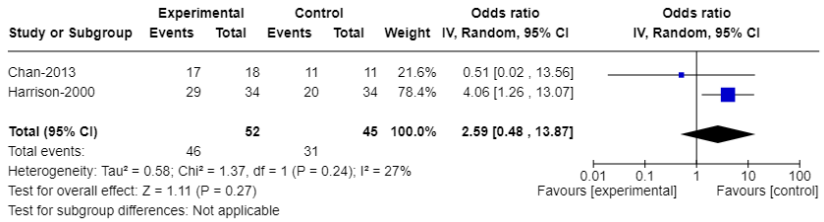


Additional file 6. Forest plots all comparisons and outcomes.

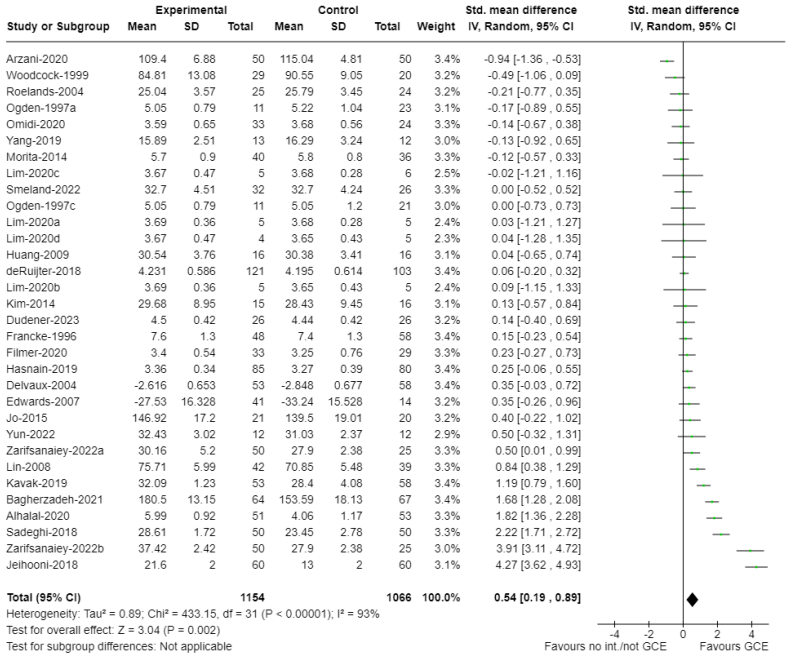
Intention (continuous)



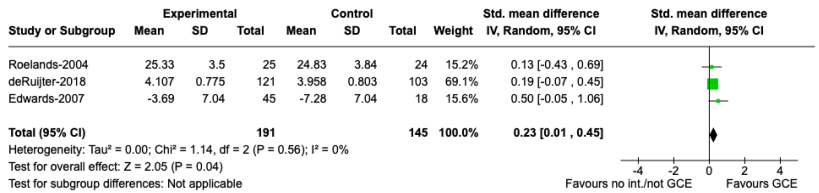
Attitude (dichotomous)



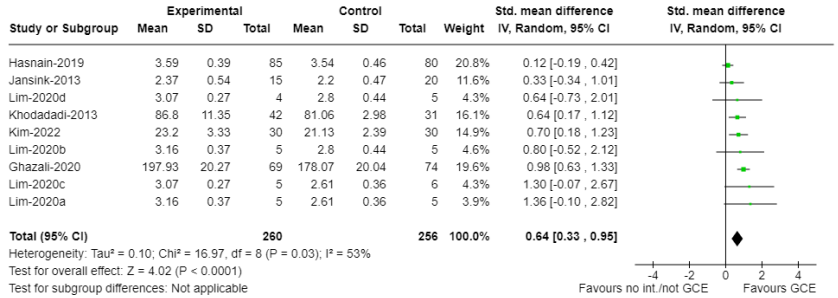
Attitude (continuous)



Social norms (continuous)



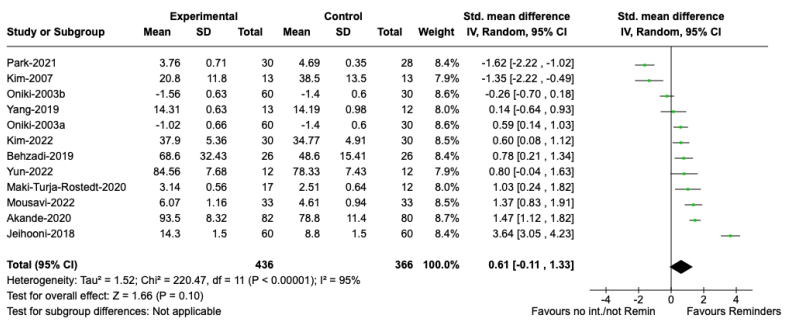
Skills (continuous)



Additional file 6. Forest plots all comparisons and outcomes.

COMPARISON 5: STRATEGIES INCLUDING REMINDERS AS COMPARED TO NO INTERVENTION OR STRATEGIES THAT DID NOT INVOLVE REMINDERS

Clinical practice (continuous)

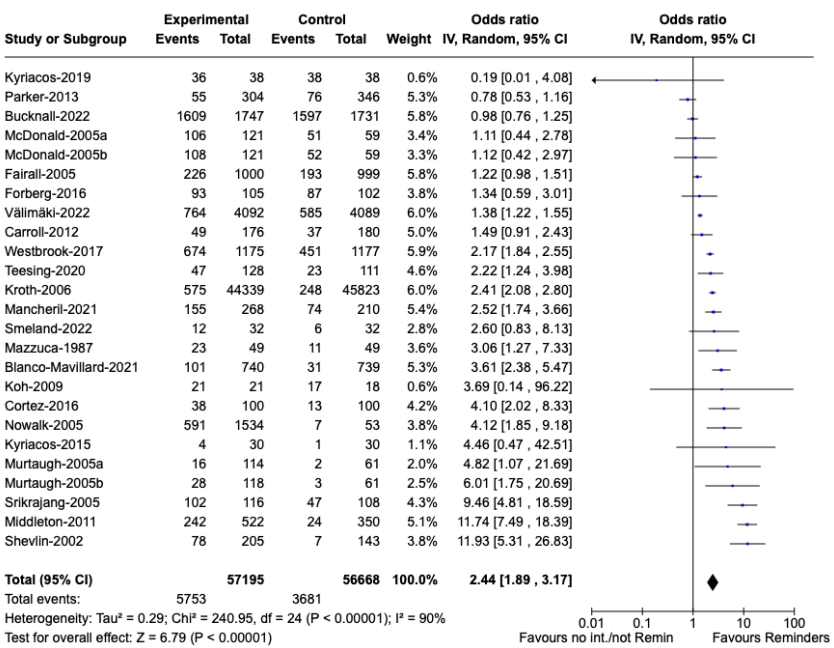


Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. mean difference IV, Random, 95% CI
Park-2021	3.76	0.71	30	4.69	0.35	28	8.4%	-1.62 [-2.22 , -1.02]
Kim-2007	20.8	11.8	13	38.5	13.5	13	7.9%	-1.35 [-2.22 , -0.49]
Oniki-2003b	-1.56	0.63	60	-1.4	0.6	30	8.6%	-0.26 [-0.70 , 0.18]
Yang-2019	14.31	0.63	13	14.19	0.98	12	8.0%	0.14 [-0.64 , 0.93]
Oniki-2003a	-1.02	0.66	60	-1.4	0.6	30	8.6%	0.59 [0.14 , 1.03]
Kim-2022	37.9	5.36	30	34.77	4.91	30	8.5%	0.60 [0.08 , 1.12]
Behzadi-2019	68.6	32.43	26	48.6	15.41	26	8.4%	0.78 [0.21 , 1.34]
Yun-2022	84.56	7.68	12	78.33	7.43	12	7.9%	0.80 [-0.04 , 1.63]
Maki-Turja-Rostedt-2020	3.14	0.56	17	2.51	0.64	12	8.0%	1.03 [0.24 , 1.82]
Mousavi-2022	6.07	1.16	33	4.61	0.94	33	8.5%	1.37 [0.83 , 1.91]
Akande-2020	93.5	8.32	82	78.8	11.4	80	8.7%	1.47 [1.12 , 1.82]
Jeihooni-2018	14.3	1.5	60	8.8	1.5	60	8.4%	3.64 [3.05 , 4.23]
Total (95% CI)			**436**			**366**	**100.0%**	**0.61 [-0.11 , 1.33]**

Heterogeneity: Tau² = 1.52; Chi² = 220.47, df = 11 (P < 0.00001); I² = 95%
Test for overall effect: Z = 1.66 (P = 0.10)
Test for subgroup differences: Not applicable

Std. mean difference IV, Random, 95% CI
-4 -2 0 2 4
Favours no int./not Remin | Favours Reminders

Clinical practice (dichotomous)



Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds ratio IV, Random, 95% CI
Kyriacos-2019	36	38	38	38	0.6%	0.19 [0.01 , 4.08]
Parker-2013	55	304	76	346	5.3%	0.78 [0.53 , 1.16]
Bucknall-2022	1609	1747	1597	1731	5.8%	0.98 [0.76 , 1.25]
McDonald-2005a	106	121	51	59	3.4%	1.11 [0.44 , 2.78]
McDonald-2005b	108	121	52	59	3.3%	1.12 [0.42 , 2.97]
Fairall-2005	226	1000	193	999	5.8%	1.22 [0.98 , 1.51]
Forberg-2016	93	105	87	102	3.8%	1.34 [0.59 , 3.01]
Välimäki-2022	764	4092	585	4089	6.0%	1.38 [1.22 , 1.55]
Carroll-2012	49	176	37	180	5.0%	1.49 [0.91 , 2.43]
Westbrook-2017	674	1175	451	1177	5.9%	2.17 [1.84 , 2.55]
Teesing-2020	47	128	23	111	4.6%	2.22 [1.24 , 3.98]
Kroth-2006	575	44339	248	45823	6.0%	2.41 [2.08 , 2.80]
Mancheril-2021	155	268	74	210	5.4%	2.52 [1.74 , 3.66]
Smeland-2022	12	32	6	32	2.8%	2.60 [0.83 , 8.13]
Mazzuca-1987	23	49	11	49	3.6%	3.06 [1.27 , 7.33]
Blanco-Mavillard-2021	101	740	31	739	5.3%	3.61 [2.38 , 5.47]
Koh-2009	21	21	17	18	0.6%	3.69 [0.14 , 96.22]
Cortez-2016	38	100	13	100	4.2%	4.10 [2.02 , 8.33]
Nowalk-2005	591	1534	7	53	3.8%	4.12 [1.85 , 9.18]
Kyriacos-2015	4	30	1	30	1.1%	4.46 [0.47 , 42.51]
Murtaugh-2005a	16	114	2	61	2.0%	4.82 [1.07 , 21.69]
Murtaugh-2005b	28	118	3	61	2.5%	6.01 [1.75 , 20.69]
Srikrajang-2005	102	116	47	108	4.3%	9.46 [4.81 , 18.59]
Middleton-2011	242	522	24	350	5.1%	11.74 [7.49 , 18.39]
Shevlin-2002	78	205	7	143	3.8%	11.93 [5.31 , 26.83]
Total (95% CI)		**57195**		**56668**	**100.0%**	**2.44 [1.89 , 3.17]**
Total events:	5753		3681			

Heterogeneity: Tau² = 0.29; Chi² = 240.95, df = 24 (P < 0.00001); I² = 90%
Test for overall effect: Z = 6.79 (P < 0.00001)
Test for subgroup differences: Not applicable

Odds ratio IV, Random, 95% CI
0.01 0.1 1 10 100
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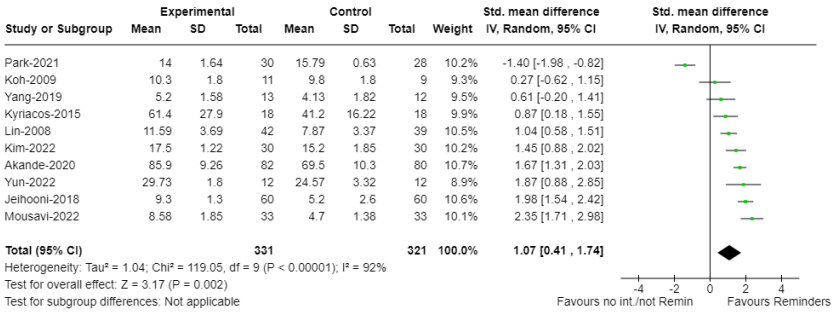
Patient outcomes (continuous)

N/A

Knowledge (continuous)



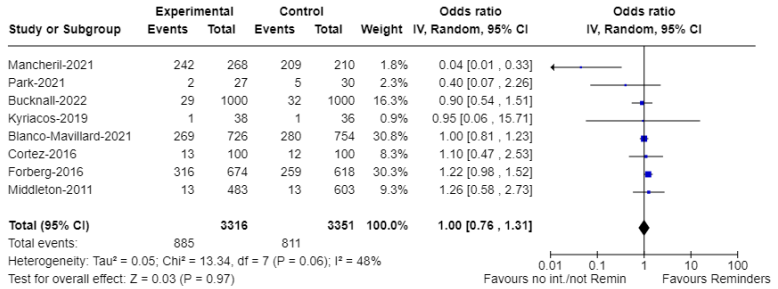
Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. mean difference IV, Random, 95% CI
Park-2021	14	1.64	30	15.79	0.63	28	10.2%	-1.40 [-1.98 , -0.82]
Koh-2009	10.3	1.8	11	9.8	1.8	9	9.3%	0.27 [-0.62 , 1.15]
Yang-2019	5.2	1.58	13	4.13	1.82	12	9.5%	0.61 [-0.20 , 1.41]
Kyriacos-2015	61.4	27.9	18	41.2	16.22	18	9.9%	0.87 [0.18 , 1.55]
Lin-2008	11.59	3.69	42	7.87	3.37	39	10.5%	1.04 [0.58 , 1.51]
Kim-2022	17.5	1.22	30	15.2	1.85	30	10.2%	1.45 [0.88 , 2.02]
Akande-2020	85.9	9.26	82	69.5	10.3	80	10.7%	1.67 [1.31 , 2.03]
Yun-2022	29.73	1.8	12	24.57	3.32	12	8.9%	1.87 [0.88 , 2.85]
Jeihooni-2018	9.3	1.3	60	5.2	2.6	60	10.6%	1.98 [1.54 , 2.42]
Mousavi-2022	8.58	1.85	33	4.7	1.38	33	10.1%	2.35 [1.71 , 2.98]
Total (95% CI)			**331**			**321**	**100.0%**	**1.07 [0.41 , 1.74]**

Heterogeneity: Tau² = 1.04; Chi² = 119.05, df = 9 (P < 0.00001); I² = 92%
Test for overall effect: Z = 3.17 (P = 0.002)
Test for subgroup differences: Not applicable

Std. mean difference IV, Random, 95% CI
-4 -2 0 2 4
Favours no int./not Remin | Favours Reminders

Additional file 6. Forest plots all comparisons and outcomes.

Patient outcomes (dichotomous)



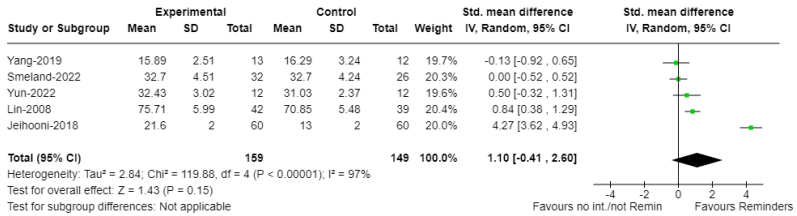
Intention (continuous)

N/A

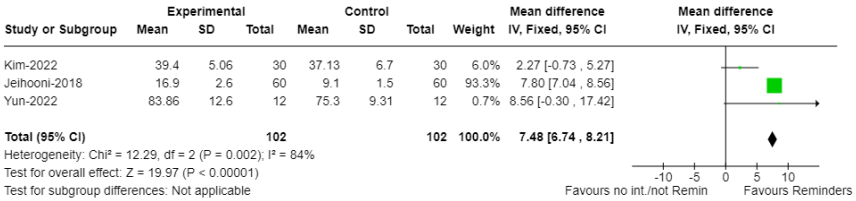
Attitude (dichotomous)

N/A

Attitude (continuous)



Perceived control (continuous)



Social norms (continuous)

N/A

Skills (continuous)

N/A

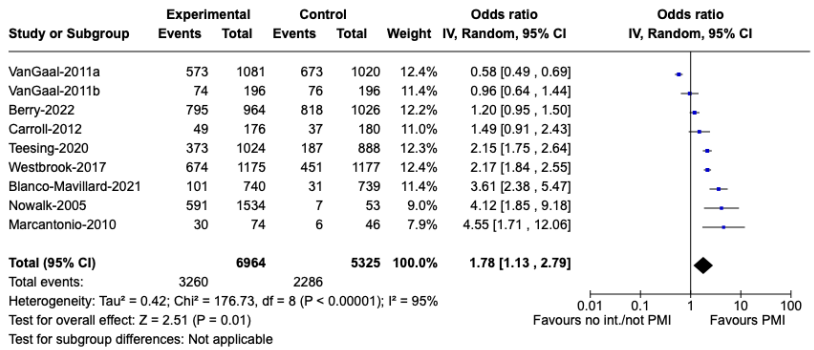
Additional file 6. Forest plots all comparisons and outcomes.

COMPARISON 6: STRATEGIES INCLUDING PATIENT-MEDIATED INTERVENTION (PMI) AS COMPARED TO NO INTERVENTION OR STRATEGIES THAT DID NOT INVOLVE PMI

Clinical practice (continuous)

N/A

Clinical practice (dichotomous)



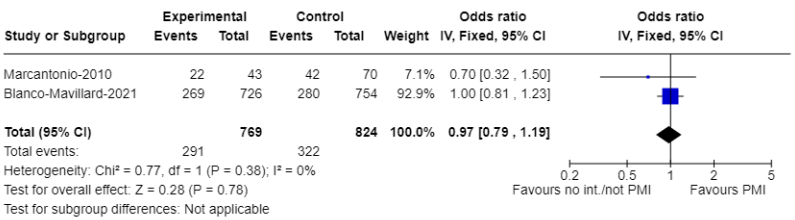
Patient outcomes (continuous)

N/A

Knowledge (continuous)

N/A

Patient outcomes (dichotomous)



Perceived control (continuous)

N/A

Intention (continuous)

N/A

Social norms (continuous)

N/A

Attitude (dichotomous)

N/A

Skills (continuous)

N/A

Attitude (continuous)

N/A

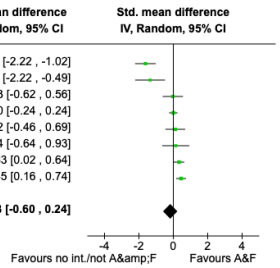
Additional file 6. Forest plots all comparisons and outcomes.

COMPARISON 7: STRATEGIES INCLUDING AUDIT AND FEEDBACK (A&F) AS COMPARED TO NO INTERVENTION OR STRATEGIES THAT DID NOT INVOLVE A&F

Clinical practice (continuous)

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. mean difference IV, Random, 95% CI
Park-2021	3.76	0.71	30	4.69	0.35	28	11.9%	-1.62 [-2.22 , -1.02]
Kim-2007	20.8	11.8	13	38.5	13.5	13	9.4%	-1.35 [-2.22 , -0.49]
Rantz-2001b	35	15.1	35	35.4	13.4	16	12.0%	-0.03 [-0.62 , 0.56]
Friese-2019	2.3	0.9	121	2.3	0.9	136	15.0%	0.00 [-0.24 , 0.24]
Rantz-2001a	37	13.3	37	35.4	13.4	17	12.2%	0.12 [-0.46 , 0.69]
Yang-2019	14.31	0.63	13	14.19	0.98	12	10.1%	0.14 [-0.64 , 0.93]
Hasnain-2019	3.19	0.47	85	3.05	0.36	80	14.6%	0.33 [0.02 , 0.64]
Zohar-2017	1.88	0.27	95	1.72	0.42	97	14.7%	0.45 [0.16 , 0.74]
Total (95% CI)			**429**			**399**	**100.0%**	**-0.18 [-0.60 , 0.24]**

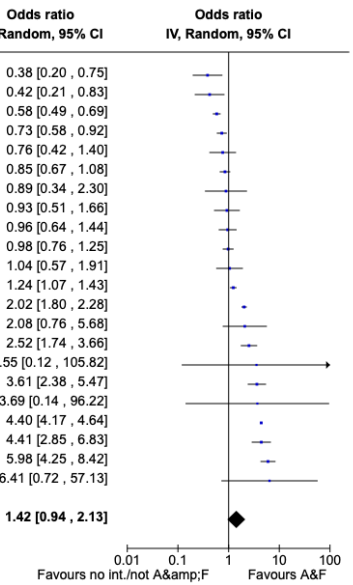
Heterogeneity: Tau² = 0.29; Chi² = 51.02, df = 7 (P < 0.00001); I² = 86%
Test for overall effect: Z = 0.85 (P = 0.40)
Test for subgroup differences: Not applicable



Clinical practice (dichotomous)

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds ratio IV, Random, 95% CI
Cheater-2006a	46	80	67	86	4.7%	0.38 [0.20 , 0.75]
Cheater-2006c	59	94	68	85	4.7%	0.42 [0.21 , 0.83]
VanGaal-2011a	573	1081	673	1020	5.4%	0.58 [0.49 , 0.69]
Oneil-2016	1449	1648	1420	1563	5.3%	0.73 [0.58 , 0.92]
Cheater-2006b	46	80	62	97	4.8%	0.76 [0.42 , 1.40]
Rhew-1999c	121	550	305	1221	5.3%	0.85 [0.67 , 1.08]
Hendryx-1998	62	76	40	48	4.2%	0.89 [0.34 , 2.30]
Cheater-2006e	59	95	62	97	4.9%	0.93 [0.51 , 1.66]
VanGaal-2011b	74	196	76	196	5.1%	0.96 [0.64 , 1.44]
Bucknall-2022	1609	1747	1597	1731	5.3%	0.98 [0.76 , 1.25]
Fakih-2012	49	86	47	84	4.8%	1.04 [0.57 , 1.91]
Curtis-2011	1840	2238	1766	2238	5.4%	1.24 [1.07 , 1.43]
Evans-2007	870	49061	405	45762	5.4%	2.02 [1.80 , 2.28]
Donati-2020	30	38	27	42	4.1%	2.08 [0.76 , 5.68]
Mancheril-2021	155	268	74	210	5.2%	2.52 [1.74 , 3.66]
Titler-2009	1	6	0	6	1.1%	3.55 [0.12 , 105.82]
Blanco-Mavillard-2021	101	740	31	739	5.1%	3.61 [2.38 , 5.47]
Koh-2009	21	21	17	18	1.2%	3.69 [0.14 , 96.22]
Gengiah-2021	33229	35164	26140	32839	5.4%	4.40 [4.17 , 4.64]
Collins-2021	338	374	166	244	5.1%	4.41 [2.85 , 6.83]
Rhew-1999a	121	551	53	1180	5.2%	5.98 [4.25 , 8.42]
Wagner-2005	5	44	1	51	2.1%	6.41 [0.72 , 57.13]
Total (95% CI)		**94238**		**89557**	**100.0%**	**1.42 [0.94 , 2.13]**
Total events:	40858		33097			

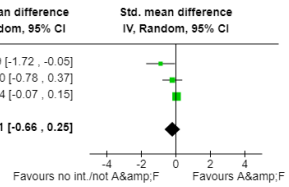
Heterogeneity: Tau² = 0.80; Chi² = 1185.23, df = 21 (P < 0.00001); I² = 98%
Test for overall effect: Z = 1.68 (P = 0.09)
Test for subgroup differences: Not applicable



Patient outcomes (continuous)

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. mean difference IV, Random, 95% CI
Rantz-2001b	10.2	4.2	10	15.2	6.1	16	19.1%	-0.89 [-1.72 , -0.05]
Rantz-2001a	13.8	7	37	15.2	6.1	17	28.8%	-0.20 [-0.78 , 0.37]
Curtis-2011	69.67	20.74	632	68.8	23.14	632	52.2%	0.04 [-0.07 , 0.15]
Total (95% CI)			**679**			**665**	**100.0%**	**-0.21 [-0.66 , 0.25]**

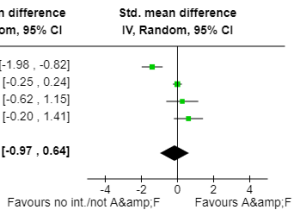
Heterogeneity: Tau² = 0.10; Chi² = 5.25, df = 2 (P = 0.07); I² = 62%
Test for overall effect: Z = 0.90 (P = 0.37)
Test for subgroup differences: Not applicable



Knowledge (continuous)

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. mean difference IV, Random, 95% CI
Park-2021	14	1.64	30	15.79	0.63	28	25.9%	-1.40 [-1.98 , -0.82]
Friese-2019	6.5	1.6	121	6.9	67	136	29.1%	-0.01 [-0.25 , 0.24]
Koh-2009	10.3	1.8	11	9.8	1.8	9	21.9%	0.27 [-0.62 , 1.15]
Yang-2019	5.2	1.58	13	4.13	1.82	12	23.0%	0.61 [-0.20 , 1.41]
Total (95% CI)			**175**			**185**	**100.0%**	**-0.17 [-0.97 , 0.64]**

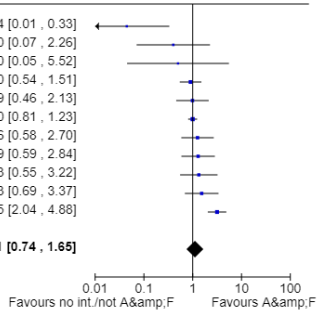
Heterogeneity: Tau² = 0.56; Chi² = 23.52, df = 3 (P < 0.0001); I² = 87%
Test for overall effect: Z = 0.41 (P = 0.68)
Test for subgroup differences: Not applicable



Patient outcomes (dichotomous)

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds ratio IV, Random, 95% CI
Mancheril-2021	242	268	209	210	3.2%	0.04 [0.01 , 0.33]
Park-2021	2	27	5	30	4.0%	0.40 [0.07 , 2.26]
Oneil-2016	1	1000	2	1000	2.4%	0.50 [0.05 , 5.52]
Bucknall-2022	29	1000	32	1000	12.7%	0.90 [0.54 , 1.51]
Cheater-2006e	17	95	15	83	10.1%	0.99 [0.46 , 2.13]
Blanco-Mavillard-2021	269	726	280	754	15.4%	1.00 [0.81 , 1.23]
Cheater-2006b	18	83	15	83	10.1%	1.26 [0.58 , 2.70]
Cheater-2006d	17	94	13	89	9.9%	1.29 [0.59 , 2.84]
Wagner-2005	32	44	34	51	9.0%	1.33 [0.55 , 3.22]
Cheater-2006a	17	83	13	90	9.8%	1.53 [0.69 , 3.37]
Collins-2021	118	363	31	234	13.5%	3.15 [2.04 , 4.88]
Total (95% CI)		**3783**		**3624**	**100.0%**	**1.11 [0.74 , 1.65]**
Total events:	762		649			

Heterogeneity: Tau² = 0.26; Chi² = 35.93, df = 10 (P < 0.0001); I² = 72%
Test for overall effect: Z = 0.51 (P = 0.61)
Test for subgroup differences: Not applicable



Perceived control (continuous)

N/A

Intention (continuous)

N/A

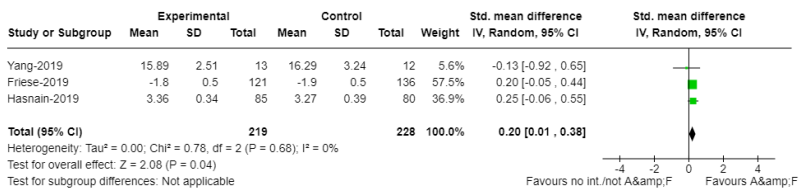
Social norms (continuous)

N/A

Additional file 6. Forest plots all comparisons and outcomes.

Attitude (dichotomous) N/A

Attitude (continuous)

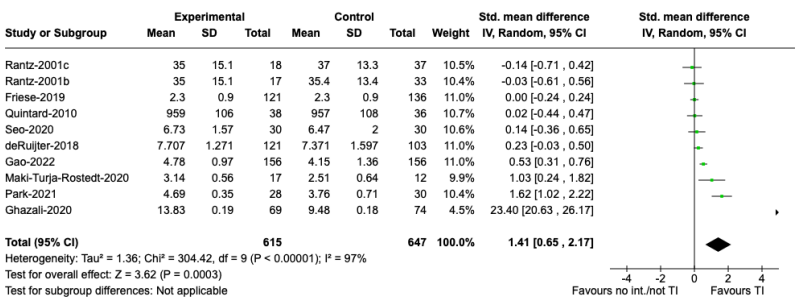


Skills (continuous) N/A

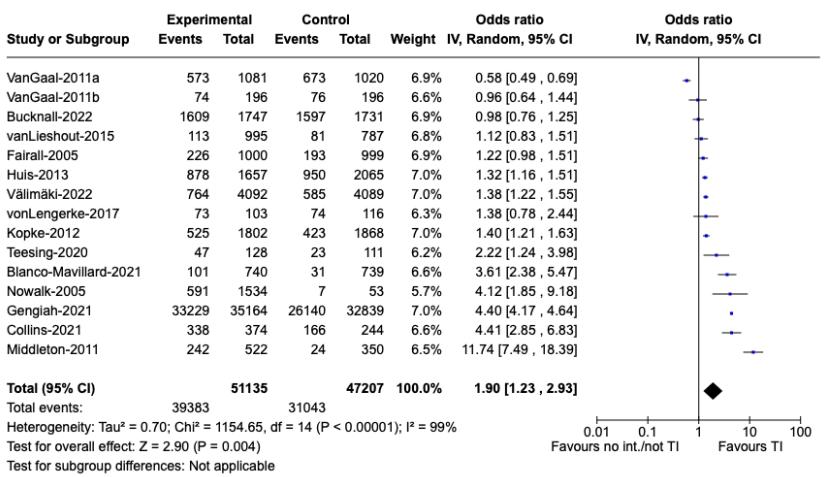
Additional file 6. Forest plots all comparisons and outcomes.

COMPARISON 8: STRATEGIES INCLUDING TAILORED INTERVENTION (TI) AS COMPARED TO NO INTERVENTION OR STRATEGIES THAT DID NOT INVOLVE TI

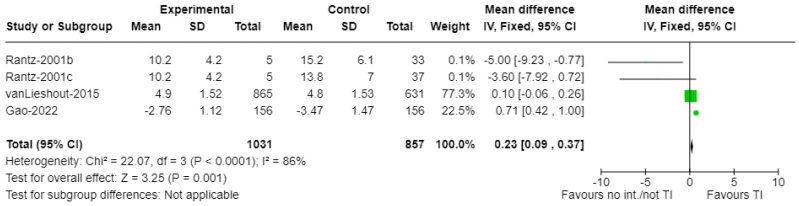
Clinical practice (continuous)



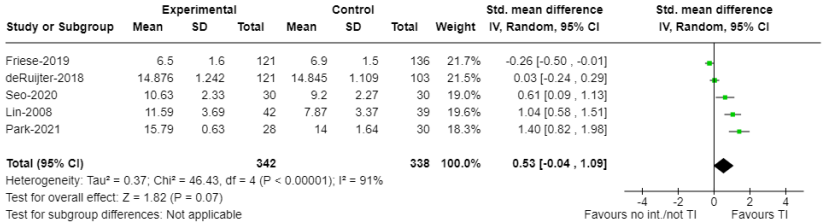
Clinical practice (dichotomous)



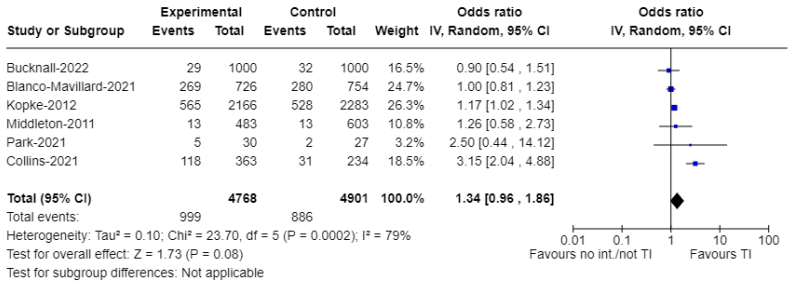
Patient outcomes (continuous)



Knowledge (continuous)



Patient outcomes (dichotomous)



Perceived control (continuous) N/A

Intention (continuous) N/A

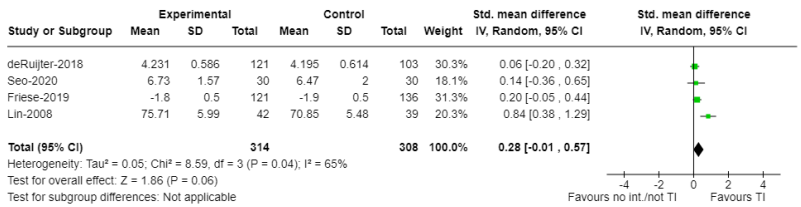
Social norms (continuous) N/A

Attitude (dichotomous) N/A

Skills (continuous) N/A

Additional file 6. Forest plots all comparisons and outcomes.

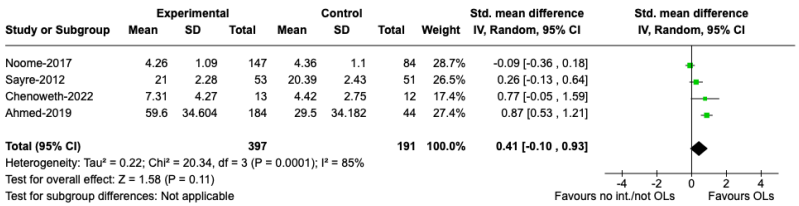
Attitude (continuous)



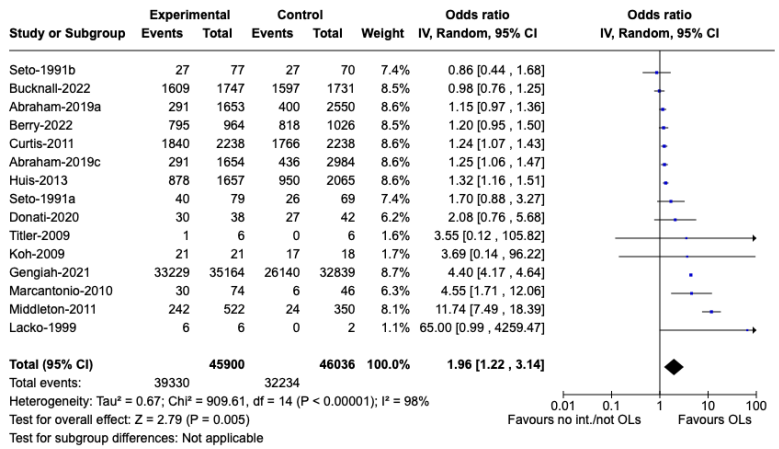
Additional file 6. Forest plots all comparisons and outcomes.

COMPARISON 9: STRATEGIES INCLUDING OPINION LEADERS (OLS) AS COMPARED TO NO INTERVENTION OR STRATEGIES THAT DID NOT INVOLVE OLS

Clinical practice (continuous)



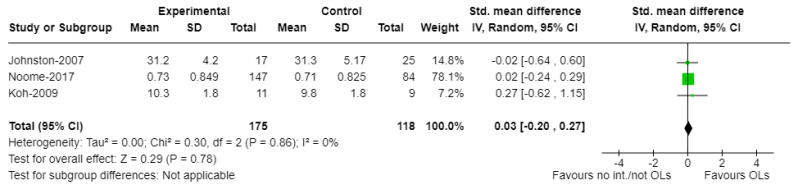
Clinical practice (dichotomous)



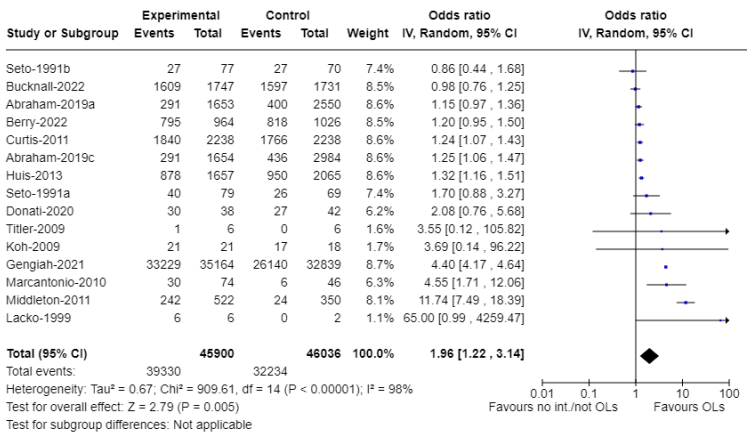
Patient outcomes (continuous)

N/A

Knowledge (continuous)



Patient outcomes (dichotomous)



Perceived control (continuous)

N/A

Intention (continuous)

N/A

Social norms (continuous)

N/A

Attitude (dichotomous)

N/A

Skills (continuous)

N/A

Attitude (continuous)

N/A