Supplementary Table 1. Characteristics of eligible studies

Virus	Reference	Country	Population & Sample size	Method	Target	Type of sample	Score
HSV-2	Adam et al 1974	USA	CC = 50; CON = 186	Immunological (NT)	Antibodies	Serum	7
HSV-2	Adam et al 1985	USA	CIN = 23; CON = 23	Immunological (RIA)	Antibodies	Serum	6
HSV-2	Adelusi et al1976	Nigeria	CC = 94; CON = 99	Immunological (CF)	Antibodies	Serum	6
EBV	Ammatuna et al 2000	Italy	CIN1= 52; CIN2/3= 7; CON = 51	PCR-based (PCR)	BAMHI-L	Brush/swab	6
HHV-6	Arivananthan et al 1997	Malaysia	CC = 30; CON = 7	Hybridization-based (ISH)	HHV-6A/B	FFPE	6
HSV-2	Arnheim et al 2011	Finland et al	CC = 603; CON = 2968	Immunological (ELISA)	Antibodies	Serum	7
EBV	Aromseree et al 2015	Thailand	CC = 40; CIN1= 85;	PCR-based (PCR)	BALF5	Biopsy	5
			CIN2/3= 85; CON = 82;				
HSV-2	Aurelian et al 1973	USA	CC = 49; CON to CC = 49; PCL = 20; CON to PCL = 20	Immunological (NT)	Antibodies	Serum	6
HSV-2	Bahena-Román et al 2020	Mexico	CC = 171; CIN1 = 231; CIN2/3 = 37; CON = 205	Immunological (ELISA)	Antibodies	Serum	7
			CC = 171; CIN1 = 228; CIN2/3 = 40; CON = 205	PCR-based (RT-PCR)	HSV-2 DNA	Brush/swab	
HSV-1	Becker et al 1996	USA	CIN1 = 57; CIN2 = 74; CIN3 = 124; CON = 332	Immunological[a]	Antibodies	Serum	7
HSV-2			CIN1 = 57; CIN2 = 73; CIN3 = 124; CON = 333				
HSV-1/2	Bell et al 1978	USA	CC = 13; CON to CC = 13; PCL = 17; CON to PCL = 15	Immunological (NT)	Antibodies	Serum	6
HHV-6/7	Biganzoli et al 2020	Argentina	CIN1 = 61; CIN2/3 = 35; CON = 29	PCR-based (Nested PCR)	HHV-6/7 DNA	Brush/swab	7
HCMV	Broccolo et al 2008	Italy	CIN1 = 46; CIN2/3 = 57; CON = 66	PCR-based (RT-PCR)	HCMV DNA	Brush/swab	6
HHV-6/7					HHV-6/7 DNA		
HCMV	Brock et al 1989	Australia	CC = 115; CON = 193	Immunological	Antibodies	Serum	6
HSV-1/2							
EBV	Cameron et al 2018	Kenya	CIN1= 50; CIN2/3= 14; CON = 266	PCR-based (PCR)	BamH1-W	Brush/swab	7
HCMV	Chan et al 1999	China	CC = 30; CIN1 = 56; CIN2 = 34; CIN3 = 77; CON = 207	PCR-based (Nested PCR)	HCMV mtrII	Brush/swab	5
KSHV					ORF25; ORF26		
KSHV	Chavoshpour‐Mamaghani	Iran	Cervical cancer = 61; PCL = 124; CON = 179	PCR-based (PCR)	ORF26	FFPE	7
	et al 2021					Brush/swab	

HSV-2	Choi et al 1977	Canada	CC = 57; CON = 166	Immunological[b]	Antibodies	Serum	6
HSV-2	Dale et al 1988	UK	CC = 70; CIN = 34; CON = 108	Immunological (ELISA)	Antibodies	Serum	6
HCMV	Daxnerova et al 2003	USA	CIN1 = 154; CIN2/3 = 250; CON = 266	PCR-based (PCR)	HCMV DNA	Brush/swab	6
HSV-1/2	de Abreu et al 2016	Brazil	CIN2/3 = 71; CON = 614	PCR-based (PCR)	HSV-1/2 DNA	Brush/swab	7
HSV-2	de Sanjosé et al 1994	Spain	CC = 223; CON to CC = 238; CIN3 = 249; CON to CIN3 = 242	Immunological (ELISA)	Antibodies	Serum	7
HCMV		Colombia	CC = 150; CON to CC = 149; CIN3 = 276; CON to CIN3 = 270				
HSV-2	D.Soumya et al 2023	India	CC = 109; CON = 26	Immunological (ELISA)	Antibodies	Serum	6
HSV-2	Farivar et al 2012	Iran	CC = 76; CON = 150	PCR-based (RT-PCR)	HSV-2 DNA	FFPE	5
EBV	Feng et al 2021	China	CIN1 = 1; CIN2/3 = 5; CON = 159	PCR-based (RT-PCR)	EBV DNA	Brush/swab	6
HSV-2	Ferrera et al 1997	Honduras	CIN1 = 9; CON to CIN1 = 18; CIN2/3 = 33; CON to CIN2/3 = 65;	Immunological (ELISA)	Antibodies	Serum	6
			CC = 48; CON to CC = 93;				
HCMV			CIN1 = 9; CON to CIN1 = 18; CIN2/3 = 32; CON to CIN2/3 = 63;				
			CC = 49; CON to CC = 95				
HSV-2	Graham et al 1982	USA	CC = 134; PCL = 47; CON = 130	Immunological (RIA)	Antibodies	Serum	8
HSV-2	Gupta et al 1992	India	CC = 51; CON to CC = 47; CIN = 76; CON to CIN = 72	Immunological[c]	Antibodies	Serum	8
HSV-1/2	Janda et al 1973	Czechoslovakia	CC = 61; CON to CC= 57; PCL = 18; CON to PCL =18	Immunological (NT)	Antibodies	Serum	6
EBV	Kahla et al 2012	Tunisia	CC = 44; CON = 81	PCR-based (PCR)	EBNA1	Biopsy	8
HSV-2	Kalimo et al 1981	Finland	CC = 7; CON = 26	Immunological (RIA)	Antibodies[d]	Brush/swab	6
HSV-1/2	Kawana et al 1976	Japan	CC = 14; CON = 14	Immunological (CF)	Antibodies	Serum	6
HSV-2	Kessler et al 1974	Yugoslavia	CC = 350; CON = 350	Immunological (NT)	Antibodies	Serum	6
EBV	Khenchouche et al 2013	Algeria	CC = 58; CIN1 = 16; CIN2/3 = 21; CON = 14	PCR-based (PCR)	BALF1	Biopsy	6
HCMV	Kienka et al 2019	USA	CIN1= 4; CIN2/3= 4; CON = 52	PCR-based (RT-PCR)	HCMV DNA	Brush/swab	7
EBV					EBV DNA		
HSV-1/2	Kumar et al 1980	USA	CC = 35; CON = 32	Immunological (CF)	Antibodies	Serum	7
HCMV							
EBV	Landers et al 1993	Ireland	CC = 18; CIN1 = 25; CIN2/3 = 50; CON = 25	Hybridization-based (ISH)	BamH1 W	FFPE	6

HSV-2	Lehtinen et al 1989	Finland	CC = 14; CON to CC = 28; CIN3 = 15; CON to CIN3 = 30	Immunological (ELISA)	Antibodies	Serum	7
HSV-2	Lehtinen et al 1992	Finland	CC = 32; CON = 62	Immunological (ELISA)	Antibodies	Serum	6
HSV-2	Lehtinen et al 1996	Finland	CC = 72; CON = 143	Immunological (ELISA)	Antibodies	Serum	7
HSV-2	Lehtinen et al 2002	Norway et al	CC = 178; CON = 525	Immunological (ELISA)	Antibodies	Serum	7
EBV	Marinho-Dias et al 2013	Portugal	CC = 9; CIN1 = 21; CIN2/3 = 22; CON = 18	PCR-based (RT-PCR)	EBV POL	Brush/swab	6
HCMV							
EBV	McCormick et al 2015	Brazil	CC = 18; CIN1= 17; CIN2/3= 15; CON = 15	PCR-based (PCR)	EBV DNA	Brush/swab	5
HSV1/2	Mcdonald et al 1974	Canada	CC = 107; CON to CC = 107;	Immunological (NT)	Antibodies	Serum	4
			PCL = 39; CON to PCL = 39				
HSV-2	Mendis et al 1981	England	CC = 25; CON = 24	Immunological (ELISA)	Antibodies	Serum	7
		Sri Lanka	CC = 29; CON = 24				
		Malawi	CC = 26; CON = 13				
HSV-2	Mendis et al 1981	England	CC = 79; CON to CC = 59; PCL = 22; CON to PCL = 28	Immunological (ELISA)	Antibodies	Serum	5
HSV-2	Muñoz et al 1995	Spain	CC = 195; CON to CC = 189; CIN3 = 234; CON to CIN3 =213	Immunological (ELISA)	Antibodies	Serum	7
		Colombia	CC = 121; CON to CC = 141; CIN3 = 215; CON to CIN3 =212				
HSV-2	Nahmias et al 1974	USA	CC = 57; CON = 82	Immunological	Antibodies	Serum	7
HSV-1/2	Najem et al 1983	England	CC = 32; CON = 32	Immunological (ELISA)	Antibodies	Serum	4
HSV-2	Peng et al 1991	China	CC = 98; CON = 142	Immunological[e]	Antibodies	Serum	8
HSV-1/2	Pérez et al 2006	Argentina	CC = 34; CIN1 = 79; CIN2/3 = 74; CON = 79	PCR-based (PCR)	HSV-1/2 DNA	Brush/swab	7
EBV	Santos et al 2009	Brazil	CC = 14; CIN2/3 = 66; CON = 89	PCR-based (Nested PCR)	EBNA3B	Brush/swab	5
EBV	Sasagawa et al 2000	Japan	CC = 31; PCL = 23; CON = 35;	PCR-based[f]	EBV mRNA	Brush/swab	7
			CC = 14; PCL = 17; CON = 12	Hybridization-based (ISH)	EBER-1	FFPE	
EBV	Se Thoe et al 1993	Malaysia	CC = 8; CON = 15	Hybridization-based (ISH)	BamHIO/K	Biopsy	5
EBV	Seo et al 2005	Korea	CC = 56; CIN3 = 20; CON = 20	PCR-based (PCR)	BamHI-W	Brush/swab	5

EBV	Shimakage et al 2001	Japan	CC = 16; PCL = 5; CON = 4	Hybridization-based (ISH)	EBNA-2	FFPE	5
EBV	Shoji et al 1997	Japan	CC = 60; CIN1/2 = 44; CIN3 = 70; CON = 20	PCR-based (PCR)	EBV DNA	FFPE	6
EBV	Silver et al 2011	India	CC = 4; CIN1 = 2; CIN2/3 = 7; CON = 246	PCR-based (RT-PCR)	EBV DNA	Brush/swab	6
HSV-1/2	Skinner et al 1977	England	CC = 15; CON = 192	Immunological (CF)	Antibodies	Serum	6
EBV	Szkaradkiewicz et al 2004	Poland	CIN1/2 = 12; CIN3 = 10; CON = 26	PCR-based (PCR)	EBV DNA	Brush/swab	6
HSV-2	Thiry et al 1977	Belgium	CC = 47; PCL = 88; CON = 51	Immunological (NT)	Antibodies	Serum	5
HSV-2	Vass-Sorensen et al 1984	Norway	CC = 44; CON = 30	Immunological (Blotting)	Antibodies	Serum	6
HSV-1/2	Vestergaard et al 1972	Denmark	CC = 135; CON = 115	Immunological (CF)	Antibodies	Serum	6
HSV-2	Vonka et al 1984	Czechoslovakia	CC = 21; CIN2/3=221; CON = 472	Immunological (RIA)	Antibodies	Serum	5
HSV-2	Wilkie et al 1980	England	CC = 40; PCL = 29; CON = 23	Hybridization-based	HSV-2 RNA	Biopsy	5
EBV	Zhang et al 1992	China	CC = 80; CON = 43	Hybridization-based[g]	BamHI W	Biopsy	6
HSV-1/2	Zhao et al 2012	China	CC = 24; PCL = 210; CON = 233	PCR-based (RT-PCR)	HSV-1/2 DNA	Brush/swab	6
			CC = 24; PCL = 177; CON = 183	Immunological (ELISA)	Antibodies	Serum	

Note: CC = Cervical cancer; CON = Controls; PCL = Precancerous cervical lesion; NT = Neutralization test; RIA = Radioimmunoassay; CF = Complement fixation test; ISH = In situ hybridization; Biopsy = fresh-frozen tissue;

[a]purified glycoprotein assay; [b]indirect hemagglutination test; [c]indirect fluorescent antibody test; [d]cervical secretions; [e]western Blot; [f] reverse transcriptase-polymerase chain reaction; [g]southern blot.

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Supplementary Table 2. Summary of studies included in adjusted OR estimates

Study	Stage of disease	Adjusted odds ratio (95%CI)	Adjusted potential confounding factors
Arnheim et al 2011	CC	1.1 (0.9-1.5)	HPV16, HPV18, C. *trachomatis*, and cotinine
Ferrera et al 1997	CC	0.80 (0.04–15.1)	HPV
Lehtinen et al 1996	CC	0.6 (0.2-1.4)	Smoking and sexually transmitted disease
Muñoz et al 1995	PCL(CIN3)	1.17 (0.65-2.14)	age, center, parity, number of sexual partners
	CC	1.46 (0.82-2.59)	age at first sexual intercourse, education, smoking status, chlamydia antibodies and HPV status by PCR
Peng et al 1991	CC	1.3 (0.7-2.3)	age, income, residence, age at first marriage, and cigarette smoking
de Sanjosé et al 1994	PCL (CIN3)	1.2 (0.7-2.0)	age, center, number of sexual partners, age at first sex,
	CC	1.1 (0.6-1.7)	antibodies to C. *trachomatis*, HPV-PCR and males' partners
Gupta et al 1992	PCL (CIN1/2)	7.3 (2.3-22.2)	age
	PCL (CIN3)	8.9 (3.2-24.7)	
	CC	4.9 (2.0-12.2)	
Pérez et al 2006	PCL (CIN1)	1.7 (0.5–6.01)	age and HPV
	PCL (CIN2/3)	1.4 (0.4–4.7)	
	CC	1.6 (0.3–7.2)	
Zhao et al 2012	PCL (CIN)	4.9 (1.3-15.4)	age
	CC	4.7 (1.1-6.8)	

CC = cervical; PCL = precancerous cervical lesions; CIN = cervical intraepithelial neoplasia, grade 1 (CIN1), grade 1, grade 2 (CIN2), grade 3 (CIN3);

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Supplementary Table 3. Meta-regression analysis for association between HHVs and cervical lesions (PCL and CC)

	Univariate analysis			Multivariate analysis	
	p value	Estimate (95%CI)	R^2 (%)	p value	Estimate (95%CI)
Method			0.00		
Immunological	0.0357	-0.9204 (-1.7793 to -0.0616)		0.8127	0.1846 (-1.3423 to 1.7115)
PCR-based	0.0851	-0.7763 (-1.6599 to 0.1074)		0.9434	-0.0413 (-1.1823 to 1.0997)
Hybridization-based	Ref	Ref		Ref	Ref
Specimen			1.46		
Serum	0.0710	-0.6898 (-1.4386 to 0.0590)		0.1649	-1.0411 (-2.5106 to 0.4283)
FFPE	0.5257	0.3529 (-0.7370 to 1.4428)		0.6401	0.2676 (-0.8544 to 1.3897)
Brush/swab	0.0909	-0.6825 (-1.4737 to 0.1088)		0.1220	-0.7175 (-1.6268 to 0.1918)
Biopsy(fresh-frozen)	Ref	Ref		Ref	Ref
FFPE + Brush/swab	0.1449	-1.0789 (-2.5293 to 0.3716)		0.1604	-1.0534 (-2.5242 to 0.4175)
Biopsy + Brush/swab	0.1824	-1.1259 (-2.7809 to 0.5291)		0.1974	-1.1001 (-2.7730 to 0.5727)
HDI regions			8.57		
Low HDI	0.0057	1.9876 (0.5789 to 3.3962)		0.0027	2.2146 (0.7689 to 3.6604)
Medium HDI	0.4275	0.3013 (-0.4430 to 1.0456)		0.2401	0.4707 (-0.3146 to 1.2561)
High HDI	Ref	Ref		Ref	Ref
Very high HDI	0.9491	0.0121 (-0.3598 to 0.3840)		0.5931	0.1218 (-0.3250 to 0.5686)
Year of publication			0.11		
Before 2000	Ref	Ref		Ref	Ref
After 2001	0.4530	0.1350 (-0.2177 to 0.4877)		0.8333	0.0622 (-0.5167 to 0.6410)

Supplementary Table 4. Meta-regression analysis for association between HSV-1 and cervical lesions (PCL and CC)

	Univariate analysis			Multivariate analysis	
	p value	Estimate (95%CI)	R^2 (%)	p value	Estimate (95%CI)
Method			0.00		
Immunological	Ref	Ref		Ref	Ref
PCR-based	0.6247	-0.2814 (-1.4089 to 0.8461)		0.9235	0.1052 (-2.0427 to 2.2530)
Specimen			0.00		
Serum	0.3704	0.4496 (-0.5342 to 1.4333)		0.9102	-0.1848 (-3.3945 to 3.0249)
Brush/swab	Ref	Ref		Ref	Ref
HDI regions			0.00		
High HDI	Ref	Ref		Ref	Ref
Very high HDI	0.4056	0.4724 (-0.6410 to 1.5859)		0.8481	-0.2363 (-2.6551 to 2.1825)
Year of publication			0.00		
Before 2000	Ref	Ref		Ref	Ref
After 2001	0.3704	-0.4496 (-1.4333 to 0.5342)		0.4936	-1.0245 (-3.9578 to 1.9087)

Supplementary Table 5. Meta-regression analysis for association between HSV-2 and cervical lesions (PCL and CC)

	Univariate analysis			Multivariate analysis	
	p value	Estimate (95%CI)	R^2 (%)	p value	Estimate (95%CI)
Method			6.93		
Immunological	0.0095	-2.1160 (-3.7152 to -0.5169)		0.2865	0.6758 (-0.5671 to 1.9187)
PCR-based	0.0187	-2.0603 (-3.7783 to -0.3423)		0.0228	-2.0115 (-3.7425 to-0.2804)
Hybridization-based	Ref	Ref		Ref	Ref
Specimen			8.74		
Serum	0.0087	-2.1316 (-3.7235 to -0.5397)		0.0035	-2.9144 (-4.8732 to -0.9556)
FFPE	0.0138	-4.5944 (-8.2500 to -0.9387)		0.0206	-4.3065 (-7.9510 to -0.6620)
Brush/swab	0.0354	-1.8358 (-3.5459 to -0.1257)		0.0833	-1.5655 (-3.3370 to 0.2060)
Biopsy(fresh-frozen)	Ref	Ref		Ref	Ref
HDI regions			16.31		
Low HDI	0.0116	1.7478 (0.3910 to 3.1045)		0.0081	1.7998 (0.4670 to 3.1326)
Medium HDI	0.9988	0.0008 (-0.9876 to 0.9891)		0.7410	0.1650 (-0.8136 to 1.1437)
High HDI	Ref	Ref		Ref	Ref
Very high HDI	0.4365	-0.1978 (-0.6958 to 0.3003)		0.4292	-0.2169 (-0.7546 to 0.3208)
Year of publication			0.00		
Before 2000	Ref	Ref		Ref	Ref
After 2001	0.6624	-0.1208 (-0.6629 to 0.4214)		0.1649	-0.5021 (-1.2106 to 0.2065)

Supplementary Table 6. Meta-regression analysis for association between EBV and cervical lesions (PCL and CC)

	Univariate analysis			Multivariate analysis	
	p value	Estimate (95%CI)	R^2 (%)	p value	Estimate (95%CI)
Method			0.00		
PCR-based	0.7324	0.2032 (-0.9618 to 1.3683)		0.3582	0.6673 (-0.7562 to 2.0908)
Hybridization-based	Ref	Ref		Ref	Ref
Specimen			4.04		
FFPE	0.1491	0.9228 (-0.3309 to 2.1765)		0.0085	2.5882 (0.6617 to 4.5147)
Brush/swab	0.5600	0.3267 (-0.7718 to 1.4251)		0.2862	0.7933 (-0.6645 to 2.2511)
Biopsy(fresh-frozen)	Ref	Ref		Ref	Ref
Biopsy + Brush/swab	0.3951	-0.7844 (-2.5923 to 1.0235)		0.2160	-1.0417 (-2.6919 to 0.6084)
HDI regions			0.00		
Medium HDI	0.3977	0.6647 (-0.8758 to 2.2052)		0.7145	-0.3131 (-1.9905 to 1.3644)
High HDI	Ref	Ref		Ref	Ref
Very high HDI	0.6949	0.1959 (-0.7833 to 1.1751)		0.0608	-1.4516 (-2.9693 to 0.0661)
Year of publication			8.45		
Before 2000	Ref	Ref		Ref	Ref
After 2001	0.4247	0.5323 (-0.7745 to 1.8392)		0.4085	0.6383 (-0.8754 to 2.1520)

Supplementary Table 7. Meta-regression analysis for association between HCMV and cervical lesions (PCL and CC)

	Univariate analysis			Multivariate analysis	
	p value	Estimate (95%CI)	R^2 (%)	p value	Estimate (95%CI)
Method			0.00		
Immunological	Ref	Ref		Ref	Ref
PCR-based	0.4248	0.2692 (-0.3919 to 0.9302)		0.3894	0.8108 (-1.0357 to 2.6574)
Specimen			0.00		
Serum	0.4248	-0.2692 (-0.9302 to 0.3919)		0.3959	-0.7719 (-2.5541 to 1.0103)
Brush/swab	Ref	Ref		Ref	Ref
HDI regions			0.00		
Medium HDI	0.7717	-0.2240 (-1.7373 to 1.2893)		0.7506	0.3167 (-1.6366 to2.2701)
High HDI	Ref	Ref		Ref	Ref
Very high HDI	0.2430	0.5495 (-0.3729 to 1.4719)		0.2071	1.0128 (-0.5606 to 2.5862)
Year of publication			0.00		
Before 2000	Ref	Ref		Ref	Ref
After 2001	0.3089	0.3885 (-0.3599 to 1.1369)		0.5722	-0.5763 (-2.5761 to 1.4235)

Supplementary Table 8. GRADE assessment for primary outcomes

Certainty assessment							Summary of findings		
Outcome		Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Study (participant)	OR (95% CI)	GRADE of evidence
HHVs	PCL	Not serious	Serious[a]	Not serious	Not serious	Not serious	43 (6865/8352)	1.91 (1.54–2.36)	Very low
	CC	Not serious	Serious[a]	Not serious	Not serious	Serious[b]	55 (5802/11721)	2.81 (2.19–3.61)	Very low[c]
HSV-1	PCL	Not serious	Not serious	Not serious	Not serious	Not serious	7 (940/1513)	1.06 (0.81-1.39)	Low
	CC	Not serious	Serious[a]	Not serious	Not serious	Not serious	11(609/1250)	1.59(0.73-3.45)	Very low
HSV-2	PCL	Not serious	Serious[a]	Not serious	Not serious	Not serious	22 (3175/3927)	2.04 (1.46-2.84)	Low[c]
	CC	Not serious	Serious[a]	Not serious	Not serious	Serious[b]	38 (3991/8427)	3.13 (2.35-4.18)	Very low[c]
HCMV	PCL	Not serious	Not serious	Not serious	Not serious	Not serious	7 (1291/1202)	1.30 (0.83-2.02)	Low
	CC	Not serious	Not serious	Not serious	Not serious	Not serious	6 (611/932)	1.46 (0.80-2.64)	Low
EBV	PCL	Not serious	Not serious	Not serious	Not serious	Not serious	16 (770/1134)	3.55 (2.52-5.00)	Moderate[c]
	CC	Not serious	Serious[a]	Not serious	Not serious	Not serious	14 (470/719)	4.89 (2.18-10.96)	Low[c]

PCL: precancerous cervical lesions; CC: Cervical cancer; CI: Confidence interval; OR: Odds ratio

Explanations: In the GRADE approach, observation studies start as low-quality evidence[1]

a, I^2>50%; b. Peters test P<0.05; c, Upgrading, for large effects report if relative effect is >2 or >5.

Reference

1. Guyatt G, Oxman AD, Akl EA, Kunz R, Vist G, Brozek J, Norris S, Falck-Ytter Y, Glasziou P, DeBeer H, et al: **GRADE guidelines: 1. Introduction-GRADE evidence profiles and summary of findings tables.** *J Clin Epidemiol* 2011, **64:**383-394.