Disease Control Priorities in Developing Countries, 3rd Edition
Working Paper

Title: Methods and Results for Systematic Search, Cost, and Cost-Effectiveness, Disease Control Priorities, Third Edition: Reproductive, Maternal, Newborn, and Child Health

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Introduction:

This working paper describes in more detail the methods employed for the systematic search undertaken for cost and cost-effectiveness data, summarized in Horton (2015). It also provides supplementary more detailed tables.

The economic analysis was based on literature searches undertaken for the project. A preliminary search on reproductive, maternal, neonatal and child health was conducted on Pubmed, NHS-EED (National Health Service Economic Evaluation Database), Embase, DARE (Database of Rreviews of Effects), EconLit, HEED (Health Economics Evaluation Database), and PEDE (Pediatric Economic Database) in June 2013 and limited to journal articles published in English between January 1st, 2000 and August 31st, 2013. This search was primarily intended to provide cost data for another publication (Levin and Brouwer, 2015). The focus was restricted to low- and middle-income countries. The search was subsequently updated to add selected additional topics in July 2014. Three specific new vaccines were added, to include those vaccines of recent particular policy interest (rotavirus, pneumococcus and HiB), to ensure that no articles where there were cost-effectiveness data but without detailed costs, had been missed in the hand-screening stage, and to bring the search up to date. The search terms are given in Table 1.

Following an initial screening of the records, a subset of articles deemed potentially relevant (and excluding duplicates) was then screened to identify articles for which full text was obtained. Only studies with original data on unit cost or cost modelled with data from a credible or known source such as WHO-CHOICE (World Health Organization's "Choosing Interventions which are Cost-Effective") or DHS (Demographic and Health Surveys) were included. We also included studies with data from the perspective of the health system, hospital, or program, or from the economic or societal perspective, if the health system costs were delineated. In addition, studies with no detailed description of the interventions, time and location of data collected and data analysis were excluded. For each study, whether or not sensitivity analysis was performed and whether the cost and consequences were discounted or not were recorded. These articles were analyzed to extract cost-effectiveness information summarized in the volume (or discarded, if they did not fulfil inclusion criteria). All articles chosen for extraction were read by two readers and any discrepancies in cost-effectiveness data extracted were resolved by discussion. Data on numbers of records/abstracts read/articles which qualified for data extraction for cost-effectiveness are given in the flowchart in Figure 1. Figure 2 provides a flow chart from a related (but different) search for unit cost data.

The articles from the systematic searches were then enhanced by additional searches. These included searching all items included in the bibliographies of several previous systematic searches (Gyles et al., 2012; Mangham-Jefferies et al., 2014; Ozawa et al., 2012; White et al., 2011), as well as some hand searches of Pub Med for selected topics (rubella vaccine, which was added to the Expanded Program on Immunization; Integrated Management of Neonatal Child Illness, etc.). These searches tended to yield one or two (and in some cases no) references. These were of importance for finalizing the cost-effectiveness figure.

Given the overlaps in material between this volume and others, additional references were drawn from similar searches undertaken for other volumes. In particular, sixteen articles were drawn from the systematic search undertaken for the surgery volume (covering safe abortion, intrapartum care, C-section and adult male circumcision) (Mock and others, 2015). The search strategy for that volume is described briefly in Chapter 18 of that volume (Prinja and others, 2015) and full search terms are available in an online Working Paper (Levin and others, 2015). One new article on malaria was drawn from a systematic search undertaken for a subsequent volume on AIDS, TB and malaria (in preparation).

All cost-effectiveness results (cost per DALY, QALY, death averted, life-year saved, case averted, CYP, CFR) were standardized to US dollars of 2012 as follows. First, costs were converted back into the currency of the original study country using exchange rates from the World Development Indicators (World Bank, 2013). The same source was used to obtain a consumer price index which was used to update prices to the year 2012, and costs and cost-effectiveness numbers were converted then back to US dollars using the market exchange rate. Where the original study used international dollars for a regional grouping (primarily some WHO-CHOICE studies), the conversion to US dollars of 2012 was not undertaken, since published data on consumer price indices and exchange rates are not available on a regional basis.

Figure 3 (reproduced from Figure 1 in Horton, 2015) summarizes the cost-effectiveness results for a number of different interventions, expressed in US $ of 2012 per DALY. Table 2 here cites the specific studies used to generate the summary cost-effectiveness figure. Table 3 contains the full results for all cost-effectiveness studies identified, along with results of grading and conversion of the cost-effectiveness data to US $ of 2012 by study.

For interventions involving vaccinations, the cost per vaccine dose (or the cost per "fully vaccinated girl") is given in Table 4. Vaccine price is a crucial determinant of cost-effectiveness, and vaccine studies are generally done using a range of prices (prior to the final price being known). In Table 4, not all the results available in the original articles are summarized. Instead, the GAVI (Global Alliance for Vaccines and Immunization) price is used for GAVI-eligible countries, and a relevant price used for countries no longer eligible for GAVI funding, whereas the original studies often use a wider range of prices.

All articles used for cost-effectiveness were graded for quality, using the Drummond and others (2005) checklist, as used by Chao and others (2014), to provide a quality score for each article out of 10. This grading was undertaken by one individual.

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Figure 1. Flowchart for RMNCH cost-effectiveness search strategy

Flow chart of identification, screening, and eligibility of included studies for cost-effectiveness of Reproductive, Maternal, Neonatal and Child Health (RMNCH)

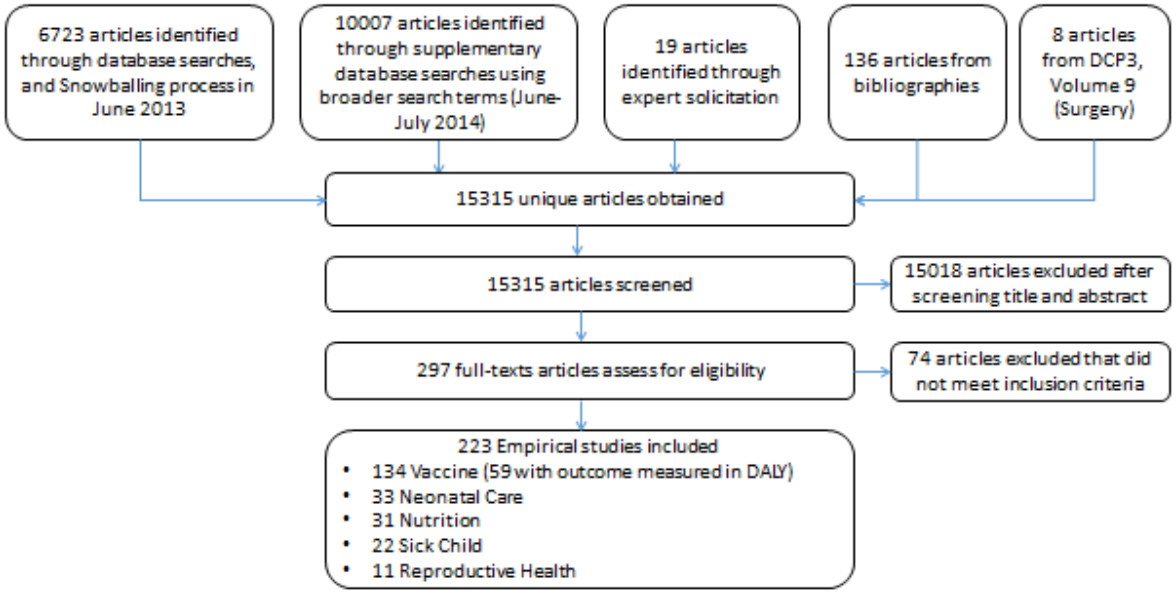

Figure 2. Flowchart for RMNCH unit cost search strategy.

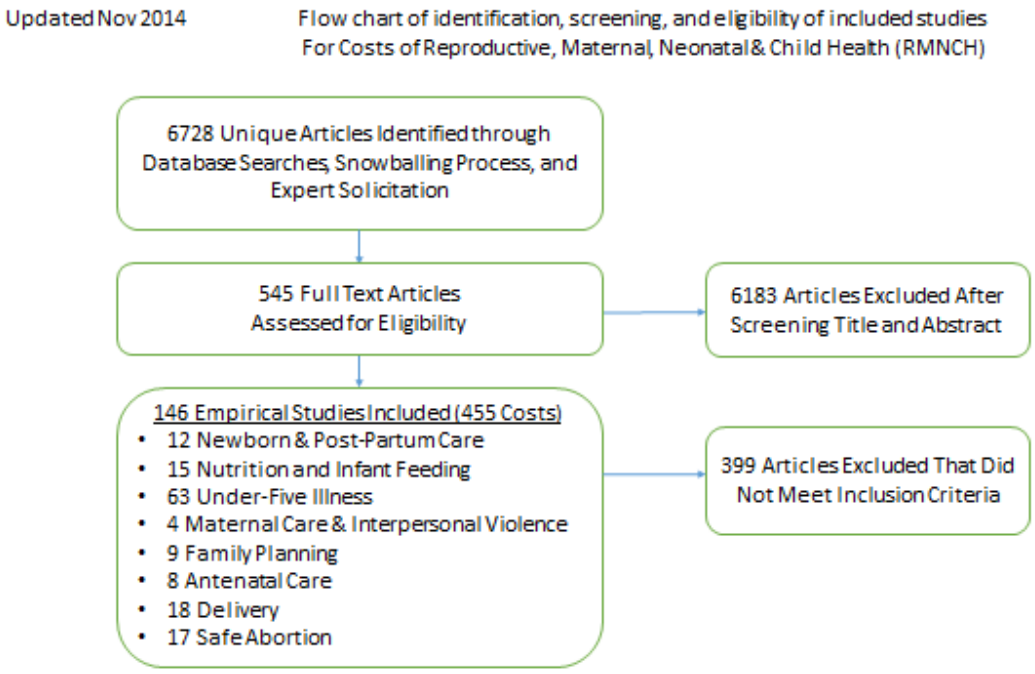

Figure 3. Ranking of cost-effectiveness results (in US $ of 2012) per DALY

(reproduce the figure here)

Source: Horton (2015)

Table 1. Search Terms and Strategy for Literature Reviews Used, RMNCH Volume

Category of terms	**Terms**
Geography terms	["developing countries" OR "developing country" OR "low and middle income countries" OR LMIC OR "south america" OR "latin America" OR Afghanistan OR Albania OR Algeria OR Angola OR Antigua OR Barbuda OR Argentina OR Armenia OR Armenian OR Aruba OR Azerbaijan OR Bahrain OR Bangladesh OR Barbados OR Benin OR Belize OR Bhutan OR Bolivia OR Botswana OR Brazil OR "Burkina Faso" OR "Burkina Fasso" OR Burundi OR Urundi OR Cambodia OR "Khmer Republic" OR Kampuchea OR Cameroon OR Cameroons OR Cameron OR Camerons OR "Cape Verde" OR "Central African Republic" OR Chad OR China OR Colombia OR Comoros OR "Comoro Islands" OR Comores OR Mayotte OR Congo OR Zaire OR "Costa Rica" OR "Cote d'Ivoire" OR "Ivory Coast" OR Djibouti OR "French Somaliland" OR Dominica OR "Dominican Republic" OR "East Timor" OR "East Timur" OR "Timor Leste" OR Ecuador OR Egypt OR "United Arab Republic" OR "El Salvador" OR Eritrea OR Ethiopia OR Fiji OR Gabon OR "Gabonese Republic" OR Gambia OR Gaza OR Georgia OR Ghana OR Grenada OR Guatemala OR Guinea OR Guiana OR Guyana OR Haiti OR Honduras OR India OR Maldives OR Indonesia OR Kenya OR Kiribati OR "Lao PDR" OR Laos OR Lesotho OR Basutoland OR Liberia OR Libya OR Madagascar OR "Malagasy Republic" OR Sabah OR Sarawak OR Malawi OR Nyasaland OR Mali OR Malta OR "Marshall Islands" OR Mauritania OR Mauritius OR "Agalega Islands" OR Mexico OR Micronesia OR Moldova OR Moldovia OR Moldovian OR Mongolia OR Montenegro OR Morocco OR Ifni OR Mozambique OR Myanmar OR Myanma OR Burma OR Namibia OR Nepal OR "Netherlands Antilles" OR "New Caledonia" OR Nicaragua OR Niger OR Nigeria OR "Northern Mariana Islands" OR Oman OR Muscat OR Pakistan OR Palau OR Palestine OR Panama OR Paraguay OR Peru OR Philippines OR Philipines OR Phillipines OR Phillippines OR Rwanda OR Ruanda OR "Saint Kitts" OR "St Kitts" OR Nevis OR "Saint Lucia" OR "St Lucia" OR "Saint Vincent" OR "St Vincent" OR Grenadines OR Samoa OR "Samoan Islands" OR "Navigator Island" OR "Navigator Islands" OR "Sao Tome" OR "Saudi Arabia" OR Senegal OR Serbia OR Montenegro OR Seychelles OR "Sierra Leone" OR Slovenia OR "Sri Lanka" OR Ceylon OR "Solomon Islands" OR Somalia OR Sudan OR Suriname OR Surinam OR Swaziland OR Tajikistan OR Tadzhikistan

	OR Tadjikistan OR Tadzhik OR Tanzania OR Thailand OR Togo OR "Togolese Republic" OR Tonga OR Trinidad OR Tobago OR Tunisia OR Turkey OR Turkmenistan OR Turkmen OR Uganda OR Ukraine OR Uruguay OR Vanuatu OR "New Hebrides" OR Venezuela OR Vietnam OR "Viet Nam" OR Zambia OR Zimbabwe OR "Africa, Northern" OR "Northern Africa" OR "North Africa" OR "Africa South of the Sahara" OR "sub-Saharan Africa" OR "subsaharan Africa" OR "Africa, Central" OR "central Africa" OR "Africa, Eastern" OR "Eastern Africa" OR "east Africa" OR "Africa, Southern" OR "southern Africa" OR "Africa, Western" OR "western Africa" OR "west africa" OR "Caribbean Region" OR Caribbean OR "Central America" OR "Panama Canal Zone" OR "French Guiana" OR Borneo OR Brunei OR "Mekong Valley" OR "mekong delta" "Republic of Congo" OR "Congo-Brazzaville" OR "Democratic Republic of the Congo" OR DRC OR "Congo-Kishasha" OR "Equatorial Guinea" OR "South Sudan" OR "South Africa" OR "Guinea-Bissau"]
AND	
Economic terms	[costs OR "cost analysis" OR economics OR "cost savings" OR "cost of illness" OR "health care costs" OR "direct service costs" OR "drug costs" OR "hospital costs" OR "health expenditures" OR "cost effectiveness" OR "cost-effectiveness" OR "cost of treatment" OR "cost of disease" OR "cost of care" OR "health care cost" OR "economic evaluation" OR "cost analysis" OR "economic analysis" OR "cost benefit analysis" OR "cost allocation" OR "cost of services" OR "medicine costs" OR "hospital cost" OR "health expenditure" OR "out-of-pocket" OR expenses OR expenditure OR "household expense" OR "household expenditure" OR QALY OR DALY]
AND	
RMNCH terms: a. Abortion care terms b. Antenatal care terms	 "post-abortive care" OR PAC or "post abortion care" OR "manual vacuum aspiration" OR MVA or "surgical abortion" OR "dilation and curettage" OR "D&C" OR "safe abortion" OR "unsafe abortion" OR abortion OR "ectopic case management" OR "ectopic pregnancy management"

	"antenatal care" or "prenatal care" or "pre-natal care" OR "prenatal screening" OR "antenatal screening" OR ANC OR "basic ANC" OR pregnancy OR "tetanus toxoid" OR "safe motherhood" OR "maternal nutrition" OR "antenatal nutrition" OR "multiple micronutrient supplementation" OR "micronutrient supplementation" OR "balanced energy supplementation" OR "folic acid" OR "iron supplement" OR "calcium supplement"
c. Family Planning terms	"family planning" or "birth control" or "oral contraception" or "oral contraceptives" or contraception or contraceptives or condom or condoms or "hormonal injection" or "injectable contraceptives" or "surgical contraception" or "intrauterine device" or "IUD" or "implant" or sterilization or "female sterilization" or "male sterilization" or vasectomy or "LAM" or "lactational amenorrhea method" or "natural family planning" or "vaginal barrier" or "vaginal tablets" or "vaginal ring" or "vaginal film" or "other contraceptives" or "female condom" or "diaphragm" or "emergency contraceptives" or "reproductive health" or "birth spacing" or "barrier method" or "hormonal method"
d. Newborn/Post-partum Care terms	Newborn OR "kangaroo mother care" OR KMC OR "skin-to-skin contact" OR "breastfeeding" OR "lactation support" OR "feeding counselling" OR "feeding support" OR "low birth weight" OR "maternal sepsis" OR "newborn sepsis" OR "postpartum hemorrhage" OR "post-partum hemorrhage" OR "postpartum haemorrhage" OR "post-partum haemorrhage" OR eclampsia OR preeclampsia OR "pre-eclampsia" OR "hypertensive disease case management" OR delivery OR birth OR "cesarean section" OR "caesarean section" OR "cesarean birth" OR "caesarean birth" OR "vacuum assisted delivery" OR "forceps assisted delivery" OR "birth attendant"
e. Childhood Disease terms	Deworming OR "intestinal worms" OR diarrhea OR diarrhoea OR rotavirus* OR "E. coli" OR "gastrointestinal infection" OR "diarrhea management" OR "oral rehydration" OR zinc OR dysentery OR pneumonia OR "pulse oximetry" OR radiographs OR "community case management" OR fever OR malaria OR febrile OR "insecticide treated materials" OR "indoor residual spraying" OR "HiB Vaccine"* OR "anti-malarial" OR "antimalarial" OR "anti-biotics" OR "antibiotics" OR pneumococcal* OR "acute respiratory infection" OR "streptococcus pneumoniae" OR "HiB" OR "haemophilus influenza" OR "syncytial

f. Childhood Disease Platforms	virus" OR "skin condition" OR "skin conditions" OR "drug resistance" OR "severe disease" OR "growth monitoring" OR screening OR diagnosis OR "rapid diagnostic tests" OR diagnostics OR measles OR "community mobilization" OR "home visitation" OR "community-based intervention" OR "community-based programs" OR pharmacies OR "social franchise" OR syphilis OR IPTP OR ITN OR "clean birth kit" OR "emergency obstetric care" OR "skilled birth delivery" OR pPROM OR "fetal growth restriction" OR meningitis OR preterm OR CPAP OR surfactant
g. Platforms	(school* AND (feeding OR deworming OR malaria OR vaccination* OR vision OR hearing)) OR "school based approaches" OR "school-based approaches" OR "school aged kids" OR "school-aged kids" OR "school based control" OR "school-based control" OR "oral health" OR "early child delivery platforms" OR (child AND (campaigns OR platform OR outreach OR "school based" OR "cash transfers" OR conditional OR unconditional)) OR IMCI OR "Integrated Management of Childhood Illness" OR "skin condition" OR "skin conditions" OR "drug resistance" OR "severe disease" OR zinc OR "integrated packages" OR "growth monitoring" OR "vitamin A" OR screening OR diagnosis OR "rapid diagnostic tests" OR diagnostics OR "integrated care" OR measles OR "community mobilization" OR "home visitation" OR "community-based intervention" OR "community-based programs" OR pharmacies OR "social franchise"
h. Maternal Depression or Caring terms	("Social marketing" OR "Social franchising" OR "Community-based distribution" OR "Community health worker" OR "Performance-based disbursement" OR "Voucher program" OR (integration AND (PMTCT OR "antenatal care" OR "family planning" OR "post-partum care"))
i. Intimate Partner	(Maternal OR postpartum OR postnatal OR perinatal OR delivery) AND ("care for depression" OR depression OR "routine screening for detection" OR psychoeducation OR "psycho-education" OR "antidepressants" OR "home visit" OR "pre-school support" OR "mental health" OR "mental disorder" OR "care for women" OR "breastfeeding" OR lactation OR "complementary feeding" OR "psycho-social care" OR "food preparation" OR "hygiene practices" OR "home health" OR "caregiver supply" OR "family support" OR "care practice" OR "care for women")

	Violence Terms	"gender-based violence" OR GBV OR (women AND violence) OR "sexual violence" OR "violence against women" OR "intimate partner violence" OR "intimate male partners" OR "social cost of violence" OR "female genital mutilation" OR fgm OR incest OR rape OR "dowry-related violence" OR "emotional violence" OR trafficking OR "lifetime physical violence" OR "sexual victimization" OR "forced sex" OR "sexually assaulted" OR "sexual assault" OR "sexual trauma" OR trafficked OR "domestic violence" "domestic abuse" OR "sexual coercion" OR "sexually coercive" OR "genital cutting"
j.	Nutrition and Optimal Infant Feeding terms	"food fortification" OR periconceptional OR "folic acid supplementation" OR "iron supplementation" OR "daily supplementation" OR breastfeeding OR "complementary feeding" OR "counselling and support" OR "infant feeding" OR "home fortification" OR "micronutrient powders" OR "acute malnutrition" OR malnutrition OR "calcium supplementation" OR "nutritional care" OR "lactating women" OR "iodine supplementation" OR "vitamin A supplementation" OR "child nutrition" OR "infant nutrition" OR "maternal nutrition" OR undernutrition OR "under-nutrition" OR "severe acute malnutrition" OR SAM OR CMAM OR "community management acute malnutrition" OR "community-based therapeutic care" OR "ready to use therapeutic food" OR "ready to use food" OR "ready to use supplementary food" OR "plumpy nut" OR GAM OR MAM OR wasting OR wasted OR malnourish OR "acutely malnourished OR RUT OR RUTF OR RUSF OR "plumpynut" OR plumpysoy OR imunut OR plumpy OR nutributter OR "lipid-based" OR FBF OR "fortified blended flour" OR "super cereal" OR MESH terms: childhood nutrition disorders, infant nutrition disorders, growth disorders, protein-energy malnutrition, kwashiorkor, marasmus

Source: Authors
*used in July 2014 search only

Note:
ANC= Antenatal care
CMAM= Community-based management of acute malnutrition
CPAP= Continuous positive airway pressure
DALY= Disability-adjusted life-year
D&C= Dilation and curettage
Fgm= Female genital mutilation
GAM= Global acute malnutrition

GBV= Gender-based violence
HiB= *Haemophilus influenzae* type B
IMCI= Integrated management of childhood illness
IPTP= Intermittent preventive treatment in pregnancy
ITN= Insecticide-treated net
IUD= Intrauterine device
KMC= Kangaroo mother care
LAM= Lactational amenorrhea method
MAM= Moderate acute malnutrition
MVA= Manual vacuum aspiration
PAC= Post-abortive care
PMTCT= Prevention of mother-to-child transmission
pPROM= Preterm premature rupture of membrane
QALY= Quality-adjusted life-year
RUSF= Ready-to-use supplementary food
RUT= Ready-to-use therapy
RUTF= Ready-to-use therapeutic food
SAM= Severe Acute Malnutrition

Table 2. Studies used to create Figure 3, ranking of cost-effectiveness for RMNCH

Intervention	References for cost-effectiveness data used in Figure 16.3
Reproductive health	
Adult male circumcision	Auvert and others (2008); Fieno (2008); Uthman and others (2010)
Access to modern contraceptives	Babigumira and others (2012)
Microfinance/gender training for intimate partner violence	Jan and others (2010)
Safe abortion	Hu and others (2010)
Maternal and newborn care	
Intrapartum care (surgical)	Carvalho and others (2013); Erim and others (2012); Goldie and others (2010), all for LIC; Hu and others (2007) for Mexico
C-section	Alkire and others (2012)
Management of obstructed labour	Adam and others (2005)
Home based maternal/neonatal care	Bang and others (2005); LeFevre and others (2013)
Train midwives in neonatal care, hospitals	Manasyan and others (2011)
Clean delivery kit and train traditional birth attendants	Sabin and others (2012)
Quality improvement protocol newborns in hospitals	Broughton and others (2013)
Switch from home MCH visits to clinic, urban areas	Routh and others (2000)
Fever	
Treatment severe malaria with artesunate (vs quinine)	Lubell and others (2009, 2011)
Treatment severe malaria with rectal artesunate in community (vs refer)	Buchanan (2010); Tozan (2010);
Home management of fever with antimalarials vs refer	Nonvignon (2012)
Treatment of pneumonia	Simoes and others (2006)
Diarrhea	
Oral rehydration therapy	Robberstad and others (2004)
Zinc added to oral rehydration therapy	Robberstad and others (2004)

Handwashing (BCC)	Borghi and others (2002)
Water treatment at household level	Clasen and others (2007)
Rural water supply/ sanitation	Haller and others (2007)
Urban water supply/ sanitation	Haller and others (2007)
Vaccines	
Original EPI 6 vaccines plus Hepatitis B	Brenzel and others (2006); Hepatitis B: Griffiths and others (2005); Kim and others (2007); Prakash and others (2003)
Pneumococcus and rotavirus, Gavi price, LICs	**Pneumo:** Kim and others (2010); Niessen and others (2009); Tate and others (2011); Touray and others (2011). **Rota**: Abbott and others (2012); Atherley and others (2009); Berry and others (2010); Flem and others (2009); Kim and others (2009, 2010); Podewils and others (2005); Rheingans and others (2009); Smith and others (2011); Tate and others (2009; 2011)
Other 2 EPI-9 vaccines: GAVI price, high mortality countries (Haemophilus influenza B HiB, rubella)	**HiB:** Akumu and others (2007); Broughton (2007); Gessner and others (2008); Niessen and others (2009); **Rubella**: Babigumira and others (2013)
Other 2 EPI-9 vaccines: MICs (Haemophilus influenza B, rubella)	Clark and others (2013); Niessen and others (2007); Platonov and others (2006)
Pneumonia and rotavirus, market price, lower-middle income countries	**Pneumo**: Constenla (2008); Nakamura and others (2011); Niessen and others (2009); Sinha and others (2007, 2008); **Rota:** Chotivitayatarakorn and others (2010); Clark and others (2009); Constenla (2008); Constenla and others (2009); Jit and others (2011); Kim and others (2010); Podewils and others (2005); Rheingans and others (2007)
Pneumonia and rotavirus, market price, lower-middle income countries	**Pneumo:** Nakamura and others (2011); Sinha and others (2008); Sartori and others (2012); Urueña and others (2011); Vespa and others (2009). **Rota:** de la Hoz and others (2010); Podewils and others (2005); Rheingans and others (2007)
Region-specific vaccines (Japanese encephalitis, meningitis A, yellow fever)	**Japanese encephalitis**: Touch and others (2010); **Meningitis**: Miller and Shahab (2005): **Yellow fever**: Monath and Nasidi (1993)
Cholera and typhoid	**Cholera**: Jeuland and others (2009); **Typhoid**: Cook and others (2008)
Nutrition	
Micronutrient interventions (biofortification,	Chow and others (2010); Edejer and others (2005); Fiedler and MacDonald (2009); Ma and others (2008); Meenakshi and others (2010); Sharieff and others (2006); Stein and others (2006, 2008)

fortification, supplementation)	
Community management of Severe-acute malnutrition	Bachmann (2009); Puett and others (2013); Wilford (2012)
Comprehensive nutrition package (Lancet 2013)	Bhutta and others (2013)

Table 3: Full cost-effectiveness results for all studies included in analysis. (WILL FOLLOW LATER)